METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

1932 AUGUST Part 8

I.—PROPERTIES OF METALS

(Continued from pp. 417–424.)

Mechanical Properties of Copper.—IV–V. A. Krupkowski (*Rev. Mét.*, 1932, 29, 16–33, 74–92).—Cf. *J.*, this volume, p. 213. (IV.—) K. has investigated the relationship between ball-hardness and cone-hardness tests of copper. The results of experiments made with cones of different angles on annealed copper indicate that the hardness as expressed by the load in relation to the superficial area of the impression varies as a function of the angle of the cone and passes through a maximum. Expressed by the load in relation to a unit of circular section, the hardness values increase with decrease of angle at the summit of the cone. Cone-hardness numbers are influenced by the load with acute-angled cones, but with obtuse-angled cones the effect decreases. When a cone is forced into a metal the sides do most work in forming the impression. The degree of cold-working of the metal at the surface of the impression is a function of the angle of the cone and increases as the angle diminishes. The ratio of cone-hardness to ball-hardness is not constant, but depends both on the Meyer n value and on the hardness of the metal. The true hardness of annealed copper in Meyer units, as obtained by observation of the point at which re-application of the load after annealing of the sample under investigation produces no further increase in size of the impression, tends towards 13·5, and is independent of the form of the instrument and the load. In ball- and cone-hardness tests of copper, the form of the impression depends on the degree of cold-work in the copper. Three forms are recognized—with "sinking in," with level edges, and with "piling up." The extent of the deformed area is a function of the limit of the plasticity on the one hand, and the hardness corresponding with the mean pressure on the other. (V.—) Hardness tests on cold-worked copper showed that the hardness increases rapidly at first up to 30% reduction of section, but afterwards more slowly. In the neighbourhood of 55% reduction of section by cold-working, the hardness indicated by the mean pressure is expressed by a number which is independent of the form of the instrument and the value of the load employed. Hardness at elevated temperatures was studied in an apparatus permitting the use of different atmospheres, and precise measurement of temperature. Cone-hardness tests at 120° C. have shown that the hardness curves of copper change direction at the temperature of recrystallization. The hardness–temperature curve of soft copper consists of 2 portions, convex towards the axis of temperature, and meeting at the recrystallization point. There is complete similarity between the hardness and tensile-strength curves. In a study of the notched-bar figure as a function of temperature, K. used a method permitting precise measurement of temperature of specimen at the moment of rupture. Tests made on commercial electrolytic copper showed, in the case of cold-worked copper, a continuous fall in the notched-bar figure up to 500° C. with only a slight increase at the recrystallization temperature (340° C.). Above 500° C. it increases rapidly and attains at 700° C. a value corresponding with soft copper. Copper annealed in a neutral gas (nitrogen) showed a maximum value at the recrystallization temperature (340° C.), and afterwards a diminution. Copper annealed in hydrogen showed an almost constant notched-bar figure over the range 50°–500° C.—H. S.

Thermal Conductivity of Indium at Low Temperatures. W. J. de Haas and H. Bremmer (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 131–136).—[In English.] Measurements of the thermal conductivity of indium down to the temperatures obtainable with liquid helium show that as the temperature is lowered the conductivity increases, passes through a maximum, and decreases rapidly at the lowest temperatures. Below the transition point the thermal conductivity is increased by applying a magnetic field.—E. S. H.

Effect of Small Percentages of Certain Metals upon the Compressibility of Lead at an Elevated Temperature. Lyall Zickrick (*Amer. Inst. Min. Met. Eng. Preprint*, **1932**, Feb., 1–14).—In the manufacture of lead cable sheathing it is found that readjustment of the press-operating conditions is necessary when changing from one brand of lead to another. The extrusion process is briefly described. Compression tests were made on 5 different brands of lead, in the form of rectangular blocks 0·75 × 0·75 × 1·5 in., immersed in a temperature regulated oil-bath. At 200° C. the purest leads are softest, whilst alloying with copper causes a rapid increase in deformation pressure up to 0·08% copper. Larger amounts of copper have no appreciable effect. Bismuth, tin, and antimony slightly increase the deformation pressure; calcium has a relatively greater effect. The results are given in detail.—R. G.

Analysis of Several Specimens of Native Platinum from the Lena Basin. G. Chernik (*Gornii Zhurnal* (*Mining Journal*), 1927, (11), 688–689).—[In Russian.] Analysis of 2 specimens of Pt found in a field in the basin of the river Lena gave the following results: (1) Pt 65·9, Ir 4·4, Pd 0·1, Rh 4·7, Os trace, Ru 2·7, osmiridium 13·6, Fe 7·3, Cu 0·1, total 98·8%; sp. gr. 16·96. (2) Pt 65·7, Ir 4·3, Pd 0·2, Rh 3·2, Os trace, Ru 1·5, osmiridium 15·7, Fe 8·1, Cu 0·2, total 98·9%; sp. gr. 16·82.—N. A.

Measurements of the Specific Heats of Silver from 1·35 to 20·3° K. W. H. Keesom and J. A. Kok (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 301–306).—[In English.] The atomic heat of silver increases from 0·000254 to 0·3995 over the range 1·35°–20·3° K.—E. S. H.

The Mechanism of the Formation of Capillary Silver from Silver Sulphide. H. W. Kohlschütter (*Z. Elektrochem.*, 1932, **38**, 345–353).—The formation of capillary silver by the reduction of silver sulphide was investigated. The system silver–silver sulphide was examined and the following factors on which the process depends were determined: the rate of reduction of silver sulphide, the mobility of the silver, nuclear formation, and nuclear growth. Observations made of macroscopical and microscopical dimensions in relation to known fundamental processes were used to deduce conclusions of a sub-microscopical character.—J. H. W.

Reaction of Gases with Incandescent Tantalum. Mary R. Andrews (*J. Amer. Chem. Soc.*, 1932, **54**, 1845–1854).—Measurements were made of the absorption of gases by filaments of tantalum sealed in glass bulbs and heated to various temperatures. With nitrogen, absorption increases with increasing pressure up to an absorption of 100 volumes, and the equilibrium pressure then falls as absorption increases up to the formation of TaN. With hydrogen the absorption depends on the concentration of atomic hydrogen in the gas. There was no evidence of a compound. Oxygen was absorbed readily. Oxide was formed along the grain boundaries. The results with hydrogen and nitrogen suggested that diffusion of these gases was along the grain boundaries. With hydrocarbons, the carbides Ta_6C_5 and TaC may be formed; these both have very high melting points.—R. G.

The Cry of Tin. Hugh O'Neill (*Nature*, 1932, **129**, 833).—Cf. *J.*, this volume, p. 420. A crackling sound was observed during the cold-rolling of crystals of iron containing 1·8% of silicon, and subsequent examination showed the presence of twins. Cubic metals sometimes show mechanical twinning, the Neumann bands of α-iron being a case in point. The larger the grain size of α-iron the greater is the ease of production of Neumann bands and the smaller the resistance of the metal to failure by shock. The addition of phosphorus, tin, silicon, and aluminium enlarges the grain size and permits the production of twins by static deformation.—E. S. H.

A Method for the Detection of Transformations of Crystallized Substances [Tin] at High Pressures. G. Tammann and R. Kohlhaas (*Z. anorg. Chem.*, 1931, **199**, 209–224).—*Inter alia* the paper contains pressure–volume curves of the transformation of grey into white tin under pressures up to 2000 kg./cm.^{2} at constant temperatures. The pressure necessary to effect the transformation with a measurable velocity is lower the higher the temperature; thus at 40° 25°, 10°, and 2° C., it is 100, 500, 1050, and 1650 kg./cm.^{2} respectively.—M. H.

The Specific Heats of Solids at Temperatures Obtainable with Liquid Helium. IV.—Measurements of the Atomic Heats of Tin and Lead. W. H. Keesom and J. N. van den Endo (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 143–155).—[In English.] Over the range 1·3°–21·0° K. the atomic heat of tin increases from 0·00137 to 1·113 and that of zinc increases from 0·000386 to 0·489. At 3·7° K. the atomic heat of tin undergoes a rapid change; the close coincidence with the transition temperature suggests some connection with superconductivity.—E.H.

Measurements Employing Liquid Helium. XVIII.—The Behaviour of Super-Conducting Tin under the Incidence of Slow-Moving Electrons. W. Meissner and K. Steiner (*Z. Physik*, 1932, **76**, 201–212).—Slow-moving electrons, incident on a sheet of superconducting tin, are found not to traverse the metal sheet. The effective energy of electronic emission from tin is found to correspond with 2·6 v., and the difference between this value and that calculated from the photoelectric effect, viz., 4·5 v., may be attributable in part to surface contamination of the metal.—J. S. G. T.

Alternating Torsional Tests with Zinc Crystals. W. Fahrenhorst and E. Schmid (*Z. Metallkunde*, 1931, **23**, 323–328).—Alternating torsional tests were carried out with single crystals of zinc (1 mm. diam.) of different orientation; the torsional angle was ± 4°. With base angles less than 20°, transverse cracks occurred perpendicular to the basal plane in prism planes II, with base angles between 20° and 40°, generally no cracks could be observed, and with base angles greater than 40° inclined and longitudinal cracks occurred in prism planes I and II. After different numbers of load changes (n) the crystals were subjected to tensile tests. The shear strength and the normal strength (the latter being determined at the temperature of liquid air) of the basal plane which are determinative for the plastic deformation of zinc crystals considerably increase with n to a maximum, then decrease again as n further increases, *i.e.* at first a hardening takes place, which is followed by a softening of the crystals. The number of load changes required to produce maxima in these properties is far smaller than the number necessary to produce the first visible cracks, hence the process which produces crystal softening takes place in the lattice and is not associated with that causing macroscopic cracking. The endurance strength may be defined as that stress which does not cause the strength to exceed the maximum, even after an infinite number of changes of load.—M. H.

Cohesion. J. E. Lennard-Jones (*Proc. Phys. Soc. (Lond.)*, 1931, **43**, 461–482).—The mathematical theory of cohesion, based on modern quantum theory, is discussed. The modern theory considers a metal as an enormous molecule with a very large number of energy levels and electron patterns. It has less energy than the original isolated atoms of which it is composed. In the assembly of atoms, patterns of individual atoms overlap and an individual electron which originally belonged to one nucleus is brought under the influence of several. Electrostatic attraction is increased, and this, even in the absence of any other cohesive force, would cause the metal to hold together. In addition, metallic cohesion is probably due partly to exchange phenomena between electron spins and to van der Waals fields. The relative extents to which these factors contribute to the cohesion of a metal is a matter for investigation.—J. T.

Change in Mechanical Properties under Test for Repeated Bending during Rotation. W. D. Kuznetzov and A. A. Vorobiev (*Sobshenia Leningradskogo Instituta Metallov* (*Communications of the Leningrad Institute of Metals*, **1931**, (9), 50–61).—[In Russian.] The tests carried out on repeated bending during rotation have definitely established that with increase in fatigue an alteration takes place in the mechanical properties of the specimen. It is impossible to determine the hardness of the specimen under conditions of intermittent load, merely by statistical mechanical tests, since no relation exists between the number of cycles up to breaking point on the one hand, and the modulus and limit of elasticity and the magnitude of full and residual deformation at constant load on the other. A plastic specimen resists fatigue better than a more brittle one of the same material. With increase of loading cycles, plastic materials become more brittle and strong at first and then gradually weaker owing to the development of cracks which finally cause destruction. Brittle metals at first show little change of properties, and then rapidly weaken. The maximum alteration in mechanical properties of the specimen occurs at the point of greatest strain. With increase in the number of loading cycles, the modulus of elasticity increases and the working capacity of the specimen in stretching (the area of the diagram) falls, approximating to that of a brittle specimen. Under equal conditions, the relative elongations under tension of the specimen are directly proportional to the bending effect $P : \Delta l = \Delta l_0 - aP$. As fatigue sets in by repeated bending during rotation, the relative elongation of the specimen first increases, then decreases, then remains constant for a time, and finally, near the breaking point, rapidly rises again. Fatigue depends on the rate of change in loading: for a given stress interval there exists an optimum value for the cycle velocity at which the fatigue of the specimen is a minimum.—N. A.

Thermal Effects in Elastic and Plastic Deformation. M. F. Sayre (*Amer. Soc. Test. Mat. Preprint*, **1932**, 1–9).—It has long been known that in materials loaded below the elastic limit, application of compressive stress causes a rise, and of tensile stress, a decrease, in temperature, but it has not been generally realized that these temperature changes also involve an elastic after-effect which takes the form of a gradual creep in length as these temperature differentials become equalized. The so-called elastic after-effect, and also elastic hysteresis, is thus in part at least due to a purely thermal cause, entirely independent of any defects in elastic behaviour in the material itself. From the view-point of creep or hysteresis studies, it is therefore suggested that the thermal creep should be estimated and deducted from experimental results before attempting to reach any conclusions as to the laws which govern the non-thermal component of the creep or hysteresis. Numerical estimates of the magnitude of the thermal creep are given. From the view-point of accurate stress–strain measurements, as in the use of elastic devices for calibration of testing machines, it is suggested that definite time schedules of work be chosen and adhered to in order to minimize the effect on accuracy of these two types of creep. Above the elastic limit, stress variations continue to cause this first type of temperature change, but there is superimposed an increase in temperature resulting from the absorption of energy in plastic deformation within the material. For small percentages of elongation, this temperature rise due to plastic flow is not large; in fact, under most conditions it is less than the temperature rise or fall which would accompany an equal unit elastic elongation. It differs, however, markedly in character, in that the elastic changes occur uniformly throughout the entire mass of the body, whilst the energy released in plastic flow is, momentarily at least, concentrated in the immediate neighbourhood of the slip planes concerned. Along these slip planes, temperatures therefore rise for a brief fraction of a second to figures probably several thousand times higher than the average increase in temperatures which ultimately occurs in the entire mass of material. These temperatures in fact may and probably do rise high enough to have an important influence on the behaviour of the metal. The exact values will be determined in a large measure by the speed with which the deformation is carried on and by the surrounding temperature conditions. It is suggested that unsatisfactory results in the past in studies of plastic flow may in part at least have been caused by incomplete control of these speed and temperature factors in testing.—S. G.

Report of Research Committee [of A.S.T.M.] on Fatigue of Metals. H. F. Moore (*Amer. Soc. Test. Mat. Preprint*, 1932, 1).—A summary of the work done during the preceding year. It is noted that no reliable accelerated test has been developed as yet. See also the two abstracts below of appendices to this report.—W. A. C. N.

Summary of Present-Day Knowledge of Fatigue Phenomena in Metals. Corrosion-Fatigue of Metals. T. S. Fuller, P. F. Mumma, and H. F. Moore (*Amer. Soc. Test. Mat. Preprint*, 1932, 2–5).—Appendix to Report of Research Committee on Fatigue of Metals (see preceding abstract). This is the first part of a summary of present-day knowledge of fatigue phenomena in metals, which is also supplementary to articles given in the 1930 report of the Research Committee on the Fatigue of Metals. Haigh's observations on certain railway axles, and McAdam's investigations on rotating beam specimens under corrosive conditions opened up this important subject of diminished fatigue strength when chemical influences are present. McAdam stated that corrosion fatigue is due to the accelerating influence of stress on corrosion, and commences with pitting: it is better described as "fatigue corrosion" than as "corrosion-fatigue." Although under any given conditions there is a fairly definite "corrosion fatigue limit" for a metal, and this value can be used for comparative purposes, it cannot be used directly as a basis for design. Later experimenters found that certain inhibitors could be employed to stop corrosion under stress, but when local corrosion was present the efficiency of the inhibitor was reduced. Protective coatings which are continuous give effective safeguard, but if the continuity is broken, corrosion proceeds at an increased rate. Evans is of the opinion that the same body may either act as inhibitor or stimulator of corrosion, according to its concentration and distribution. Dissolved oxygen can act in both ways. The results have been applied to the caustic embrittlement of boiler steel. The mechanism of corrosion-fatigue appears to consist in the mechanical breaking down by repeated stress of the protective film of oxide which is found on nearly all metals.—W. A. C. N.

The Significance and Limitations of Fatigue-Test Results. R. E. Peterson and H. F. Moore (*Amer. Soc. Test. Mat. Preprint*, 1932, 5–10).—Appendix to Report of Research Committee on Fatigue of Metals (see abstract above). The term "fatigue" of metals should be used only in case of failure by a spreading crack, and the phenomenon of fatigue has not taken place unless spreading fracture has started. Failure by fatigue is of more importance in machinery than in structures. Metal pressure vessels lie, in this respect, intermediately between machinery and structures. No short-period tests have been found sufficiently reliable to replace the determination of the endurance limit. For most metals some idea of fatigue strength can be obtained from static tensile strength, although the ratio of the two values varies widely for different types of metals. Very few fatigue results at high temperatures are available. Apparently at some temperature the tendency of a metal to fail by creep becomes dominant and that to fail by fatigue fades out. A bibliography of 33 references is attached.—W. A. C. N.

What is Fatigue? Hans Müller (*Zentral-Europ. Giess.-Zeit.*, 1930, 3, 7–9).—An elementary discussion on the question of fatigue.—W. A. C. N.

A New Method for Increasing the Hardness of Metals. E. G. Herbert (*Elektrotech. u. Maschinenbau*, 1932, **50**, 210–211).—A full abstract from *Proc. Roy. Soc.*, 1931, [A], **130**, 514. See this *J.*, 1931, **37**, 196, and this volume, p. 216.—W. P. R.

The Diffusion of Two Metals into One Another with Formation of an Intermetallic Compound. G. Tammann and H. J. Rocha (*Z. anorg. Chem.*, 1931, **199**, 289–305).—(1) The problem whether an intermediate phase has a constant composition or a small range of homogeneity can be decided by measurements of the rate of thickening of the diffusion layer, consisting of the intermediate phase, when the two components are heated together. In the first case the increase in thickness is proportional to the time of diffusion; in the second case, however, the rate of thickening obeys the parabolic law. Experiments on the diffusion of tin into gold have shown that the phase $AuSn_4$ has not a constant composition. (2) Experiments have been made on the diffusion of cadmium into copper, zinc into iron, and zinc into β-brass.—M. H.

The Solubility of Gases in Metals. V. H. Gottschalk and R. S. Dean (*Amer. Inst. Min. Met. Eng. Preprint*, **1932**, Feb., 1–16).—A review of previous and present theories explaining metal–gas phenomena. The absorption of gases by hot metals is considered to be different from simple solubility, and therefore the mass law cannot be applied. A computation is made of the "ideal solubility" of gases in a hypothetical solvent having the characteristics of a molten metal, and the conclusion is reached that the simple solubility of gases in molten metals, if not absolutely zero, is certainly less than the experimental error of laboratory methods. The variable results on the subject may be due to factors which have not been appreciated, such as dissociation. Attention is directed to the desirability of considering thermionic effects. Methods for the removal of gases from metals are discussed and an explanation based on internal pressure is given to account for the apparent paradox that the reaction in such systems as cuprous oxide–cuprous sulphide is not explosive.—R. G.

The Degassing of Metals. F. J. Norton and A. L. Marshall (*Amer. Inst. Min. Met. Eng. Preprint*, **1932**, Feb., 1–28).—The degassing of molybdenum in the form of sheet by heating *in vacuo* in a specially designed apparatus was studied. Specimens from different sources gave similar results. A temperature of 1760° C. was necessary for degassing in an atmosphere of the order of 0·001 μ. The gases obtained were mainly carbon monoxide and nitrogen, the latter being the more difficult to remove. It was found that a degassed sample, if not handled, remained practically free from gas in air. The time for degassing was roughly proportional to the thickness of specimen. Similar experiments were made on nickel, tungsten, and graphite anodes. The absorption of nitrogen and carbon monoxide by molybdenum and tungsten was studied under varying conditions. The solubility of nitrogen in both metals was proportional to the square root of the pressure. A summary of the results is given.—R. G.

The Exact Measurement of Specific Heats of Solid Substances at High Temperatures. V.—On the Cooling Correction of the Metal Colorimeter in Exact High-Temperature Calorimetry. F. M. Jaeger, E. Rosenbohm, and J. A. Bottema (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 347–352).—[In English.] A study is made of the best conditions under which the cooling correction is reduced to the lowest possible value.—E. S. H.

The Strength of Persistent Currents in Superconductive Circuits. J. C. McLennan, J. F. Allen, and J. O. Wilhelm (*Phil. Mag.*, 1932, [vii], **14**, 168–180).—The strengths of the persistent currents in similar rings of lead, tin, and tantalum in the superconductive state have been determined. Neither temperature nor rate of change of flux has any effect on the strength of the persistent current, which is the same in each of the metals for the same change of flux, provided the rings are of the same size and form.—J. S. G. T.

Metals at High Temperatures.—I. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 75–76).—An account summarizing the papers published in a "Symposium on Effect of Temperature on the Properties of Metals" and discussion held jointly by the American Society for Testing Materials and the American Society of Mechanical Engineers. Abstracts of all the papers were published in this *J.*, 1931, **47**.—R. G.

Metals at High Temperatures.—II. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 83–84).—Cf. preceding abstract. A continuation of a review of published data, including the comparison of aluminium alloys with cast-iron from the point of view of their use for pistons.—R. G.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 421–432.)

On Inverse Segregation of Aluminium–Copper Alloys. H. Bohner (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1931, **3**, 3–19).—The inverse segregation in a number of quaternary and more complex aluminium-rich alloys containing copper (4·4–6·4%) and smaller percentages of silicon, manganese, iron, and titanium has been studied by microscopic investigation and chiefly by the analysis of samples taken from different parts of a cylindrical ingot 20 cm. in diam. and 70 cm. high.—M. H.

Investigations on the Influence of Iron on the Properties of Duralumin. W. O. Kroenig (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1931**, (11), 758–768).—[In Russian.] Cf. *J.*, this volume, p. 221. The higher the iron content (between the limits 0·22% and 1·50%) of Duralumin, the lower is the tensile strength and hardness, both after tempering and on ageing. With increase of the iron content, the Duralumin shows a growing number of inclusions of a eutectic structure, whilst from 0·9% iron, inclusions of a primary nature make their appearance. The lowering of the mechanical properties of Duralumin with increase in iron content is fundamentally due to the fact that the basic solid solution, obtained by tempering, becomes less rich in $CuAl_2$, owing to the formation of the complex eutectic Al–Fe–Cu. The hypothesis of Archer and Jeffreys ("Light Metals and Alloys," *U.S. Bur. Stand. Circ.*, No. **346**, 1927), that the iron prevents the disintegration during ageing of the solid solution of $CuAl_2$ in aluminium, is not confirmed.—N. A.

The Influence of Iron on the Properties of Duralumin. W. O. Kroenig (*Trans. Central Aero-Hydrodynamic Inst.* No. **96**, 1931, 1–15; *U.S.S.R. Sci. Res. Inst. Supreme Council Nat. Econ.*, No. **468**).—[In Russian, with a German summary.] See preceding abstract.—M. Z.

"Nicral" Aluminium Alloys. Anon. (*Amer. Machinist* (*Eur. Edn.*), 1932, **76**, 627).—Short note. Aluminium alloys having the following compositions are now marketed: nickel 0·5–1, chromium and related metals 0·25–0·5, copper 0·25–1·0, magnesium 0·25–0·5%, and iron and silicon as in commercially pure aluminium. The colour resembles that of chromium plate. The alloys can be polished without excessive tarnishing, are suitable for drawing, forming, and welding, have high resistance to fatigue and high coeff. of reflectivity, retain their strength at elevated temperatures, and cast well. They do not spontaneously age and have a Young's modulus of slightly above 10,000,000 lb./in.^{2}—J. H. W.

Solid Solubility of Silicon in Aluminium. L. Losana and R. Stratta (*Metallurgia italiana*, 1931, **23**, 193–197).—L. and S. have established the limits of solubility of silicon in aluminium at 578° C. (eutectic temperature of Al·Si) and at room temperature, by means of dilatometric, thermal, and hardness measurements, using alloys of very high purity. The measurements, the sensitivity of which was greatly increased by thermionic valves, have enabled L. and S. to determine the complete curve for the solubility of silicon in aluminium.—G. G.

The Ternary Equilibrium System Al–Mg–Si. L. Losana (*Metallurgia italiana*, 1931, 23, 375–382).—The diagram of the ternary system aluminium–magnesium–silicon is completely studied; the surfaces of liquidus and solidus are determined by differential thermal analysis and by dilatometric measurements. L. gives evidence for the dissociation of some solid solutions as a function of the temperature, whilst the results obtained are further confirmed by density, electrical resistance, hardness, &c., measurements. The existence of intermetallic compounds is completely excluded. The solid solutions have a limited area of existence near the pure metals. The difference in casting properties of some alloys by the addition of small quantities of silicon is also investigated.—L. L.

Influence of Vanadium on the Conductivity of Aluminium and Al–Va–Cu Foundry Alloys. Anon. (*Aluminium Broadcast*, 1931, 3, (5), 12–13).—An abstract of a research memorandum from the A.F.C. (French Aluminium Co.). Vanadium lowers the conductivity of aluminium, the effect being proportional to the amount of vanadium up to 0·65%, the limit of solid solubility. When added to aluminium–copper alloys, vanadium has a grain refining effect and renders them susceptible to heat-treatment.—J. C. C.

Investigations Relating to Improvement (Vergütung) of the Zinc–Aluminium Alloy of Composition Al_2Zn_3. Herbert Meyer (*Z. Physik*, 1932, 76, 268–280).—Characteristics of the changes of hardness and electrical resistance produced in alloys by heat-treatment of various kinds are briefly referred to, and a detailed investigation of the change of electrical resistance of the alloy Al_2Zn_3 is described. Three types of change of resistance with time, dependent on the temperature at which improvement is effected, are found, viz., a continually increasing resistance, the attainment of a maximum resistance, and a continually decreasing resistance. The effect of alternating heat-treatments on the resistance is investigated. Results suggest the transformation of the material from and into one or other of 2 crystal systems.—J. S. G. T.

Latest Achievements in the Sphere of Light Alloys Suitable for Rolling. J. G. Muzalevsky (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1930**, (9), 609–623).—[In Russian.] Experiments on the plating of aluminium alloys with pure aluminium demonstrated the marked anti-corrosion properties of such alloys. The pure aluminium coating was found to be most strongly adherent in the case of alloys containing no magnesium. A very important factor governing the success of the plating process is temperature control (for alloys without magnesium, 380°–400° C.) and rate of heating, a high rate giving good results. Aluminium alloys of medium, and magnesium alloys of high, tensile strength are described.—N. A.

Comparative Experiments on Light Piston Metals. M. v. Schwarz (*Aluminium Broadcast*, 1931, 3, (2), 8–10).—Translated from *Z. Metallkunde*, 1930, 22, 417. See this *J.*, 1931, 47, 74.—J. C. C.

The Manufacture and Properties of Copper-Cadmium Wire. S. A. Pogodin and G. A. Kagan (*Sobshenia Leningradskogo Instituta Metallov* (*Communications of the Leningrad Institute of Metals*), 1931, (11–12), 136–163).—[In Russian.] Cadmium has a very beneficial influence on the mechanical strength of hard-drawn copper: thus wire of 3 mm. diam. of the alloy containing 0·98% cadmium has a tensile strength of 60 kg./mm.^{2}, *i.e.* 30% above that of similar wire of pure copper, whilst the electrical conductivity falls only to 85·5% of standard annealed copper. In the case of the annealed copper–cadmium wires, a small increase in strength is accompanied by a similar percentage fall in conductivity. Hard-drawn copper–cadmium wires preserve almost completely the value of their temporary resistance to breaking stress after heating for 30 minutes to 250° C. Even the addition of such small quantities of cadmium as 0·15% exerts this stabilizing influence on the mechanical properties of hard-drawn copper, and it should therefore be used in the manufacture of wire and parts for electrical apparatus which may be exposed to heating—*e.g.* by short-circuiting and friction. The investigation which has been carried out on the effect of work-hardening and the annealing temperature on the properties of copper–cadmium wire, has afforded information for selecting the most suitable combination of composition, mechanical strength, and electrical conductivity for every individual case.—N. A.

On the Causes of Change in Certain Properties of Manganin. N. A. Schalberov (*Zhurnal Tehnicheskoy Fiziki* (*Journal of Technical Physics*), 1931, [B], 1, (6), 509–545).—[In Russian.] During bright-annealing of 2 samples of Manganin wire: (1) copper 83·83, manganese 12, nickel 2·84, iron 0·46, silicon 0·55, lead 0·05%; (2) copper 84·93, manganese 11·25, nickel 2·75, iron 0·35, silicon 0·31, lead 0·04%, the resistance increased 15%, and the resistance maximum was displaced towards lower temperatures. Both phenomena, as well as the increase in resistance of commercial Manganin wire on ageing, are probably due to the more or less gradual attainment of a state of homogeneous equilibrium: prolonged bright-annealing at 560°–600° C. destroys the original heterogeneous condition of the commercial wire and thus removes the cause of change in resistance. Certain investigators have observed a fall in the sp. resistance and a sharp rise (with change in sign) of the temperature coeff. after annealing at high temperatures. These changes are attributed to the formation of an oxidized layer, poor in manganese, on the surface of the wire. Work-hardening does not affect the shape of the temperature-resistance curve. All thermal treatment of Manganin wire carried out with the object, not of removing the effect of work-hardening, but of reducing the temperature coeff., is based on the cautious oxidation of the surface of the wire. Whilst lowering the temperature coeff., however, this procedure introduces irregularities into the electrical properties causing them to alter with time, and hence its use is inadvisable.—N. A.

The Production and Properties of Constantan [at the " Sevkabel " Works]. S. A. Pogodin and E. M. Lekarenko (*Sobshenia Leningradskogo Instituta Metallov* (*Communications of the Leningrad Institute of Metals*), **1931**, (10), 25–46).—[In Russian.] The mechanical and electrical properties of Constantan made from electrolytic copper and nickel of various brands, and deoxidized with aluminothermic manganese or 33·63% manganese–copper alloy have been studied. Electrolytic nickel gives poor results (high percentage of rejects) and is therefore unsuitable for making Constantan. Melting must be carried out as rapidly as possible to prevent contamination with oxygen, carbon, and sulphur; although graphite crucibles and oil-fired furnaces were used in the tests it is considered that H.-F. induction furnaces are best. Melting in the oil-fired furnaces took 2–3 hrs. The copper and nickel content of the charge remains practically unaltered during melting and the content of harmful impurities does not increase or exceed the permissible limits. In the early tests the metal was cast in rods using cast-iron moulds 180 cm. high, with an internal diam. of 7·5–8 cm. and a wall thickness of 5·5–6 cm., weighing 320 kg. Many castings were rejected owing to splitting of the ingot in the mould caused not by impurities in the metal, but by an exceptionally bad condition of the walls of the moulds and a strongly developed columnar structure of the ingot. The formation of surface cracks is due to the same causes. These moulds favour the formation of a columnar structure, since their tall and narrow shape necessitates a somewhat high superheating of the metal. The massive walls of the mould rapidly abstract the heat and the rate of solidification is very high. By reducing the height to 80 cm. and wall thickness to 4 cm. (weight of ingot 35 kg.), the temperature of pouring was lowered and the columnar structure of the ingots obviated. The adoption of a short heating, prior to rolling, gave a negative result. A long, gradual warming is necessary, in order to equalize the concentration of the solid solution, the optimum conditions being: 1000°–1500° C., heating period 1½–2 hrs. if possible, in a neutral atmosphere. The type of rejects which occurs most frequently in rolling shows deep, transverse cracks, the splitting occurring along the boundaries of the strongly-developed columnar crystals: the rejects are due both to the nature of the ingot and to the conditions of rolling. The ultimate strength and impact strength at high temperatures indicate a rapid fall in plasticity with rise in temperature. Rolling to 9 mm. diam. is effected in 16 passes, and to 6·5 mm. in 20. The rolled ingot is then annealed at 850° C. and descaled in a bath of 10% sulphuric acid and 2% potassium dichromate at 50°–60° C., after which the surface is cleaned and polished. Drawing into wire may be carried out as for iron wire with annealing, at diameters of 2, 0·7, and 0·3 mm. for thick grades at 700°–800° C. and for thin at 600°–650° C. —N. A.

Gold–Silver Alloys as a Type of Continuous Solid Solutions. W. Broniewski and K. Wesolowski (*Compt. rend.*, 1932, **194**, 2047–2049).—A method of studying alloys which form solid solutions is by indirect comparison with such a series as the copper–nickel alloys, which have the disadvantage of altering their magnetic state and so affecting the continuity of their properties. Since the gold–silver alloys form a continuous series of solid solutions at all temperatures and exhibit no discontinuity, they are well adapted to replace the copper–nickel alloys for this purpose. In this work, 15 properties of the gold–silver alloys have been determined as functions of the composition, namely: fusibility, electrical conductivity, temperature coeff. of electrical resistance from 0° to 100° C., e.m.f. compared with lead, thermo-electric effect between − 78° and 100° C., maximum e.m.f. of solution in $N/10$ solution of potassium cyanide, coeff. of thermal expansion between 17° and 444° C., percentage elongation, total percentage elongation to rupture (A), uniform percentage to rupture (A), Brinell hardness, tensile strength, elongation due to stretching (A–a), and the elastic limit. These are shown as curves.—J. H. W.

The Conduction of Heat of Lead–Thallium at Low Temperatures. W. J. de Haas and H. Bremmer (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 323–328).—[In English.] Below the superconducting transition point (4·09° K.) of the alloy represented by the composition $PbTl_2$, the thermal resistance increases linearly with magnetic fields under the threshold value of lead–thallium and remains practically constant thereafter. This change is not observed with either of the pure constituent metals.—E. S. H.

Dynamic Properties of Ultra-Light Alloys. I. Musatti (*Metallurgia italiana*, 1930, **22**, 1052–1068).—The endurance limits of various types of ultra-light alloys were compared. By using the rotating machine it was found that, for magnesium alloys containing zinc and aluminium, the limit is 11–12 kg./mm.^{2}, which is of the same order of magnitude as for Duralumin. On the other hand, notched-bar impact tests show that the resistance is rather below that of Duralumin. The cast magnesium alloys compared favourably with Silumin and cupriferous alloys. Many rods, when submitted to fatigue below the endurance limit, showed improved resistance characteristics. The paper contains numerous tables and diagrams of the numerical data obtained in the tests.—L. L.

The Plasticity of Ultra-Light (Magnesium) Alloys under Prolonged Static Loading. N. Parravano and G. Guzzoni (*Metallurgia italiana*, 1931, **23**, 475–484).—In a previous article on "Mechanical Properties of Ultra-Light Alloys" (*Metallurgia italiana*, 1930, 22, 367; see this *J.*, 1930, **44**, 522), in which the value of the common determination of the tensile strength, as applied to the magnesium alloys, was criticized, and the importance of elastic limit and creep limit determinations stressed, P. and G. reached the conclusion that all values obtained for the mechanical properties, such as elastic limits &c., are a function of time of application of the load, and therefore represent some momentary value of little use. In this second article, they discuss the plasticity of magnesium from a crystallographic point of view, and seek an explanation for the type of curves obtained by the creep tests. They find that from a certain load upwards, the creep curves have a parabolic form, and do not appear to become horizontal again. This means that the creep continues until the metal fractures. An analogous conclusion has already been reached with steels. From the practical point of view, the short-time tests for the determination of creep strength, such as that of Pomp, are of great importance, but P. and G. demonstrate that these methods cannot be applied to ultra-light alloys. They have suggested and studied a new method (based on the assumption of the parabolic form of the creep curves) in which the curves are plotted on a logarithmic chart, so that they become straight lines, and these lines are prolonged until 1 year is reached on the abscissæ : the load corresponding with a total set of 0·2% in 1 year may be taken as the creep limit (or endurance strength), and its value may be derived in this graphical way by interpolation. To define with precision the curve corresponding with a given load, a test period of at least 200 hrs., with frequent determinations of the strain, appears to be necessary for magnesium alloys, whilst for steels a period of 50 hrs. is sufficient.—G. G.

Volume Change during Solidification of Manganese and Some Alloys. Kotarô Honda, Yoshiharu Matsuyama, and Yatsugo Isobe (*Rikwagaku-Kenkyū-jo Ihō* (*Bull. Inst. Phys. Chem. Res., Tokyo*), 1930, **9**, 906–910).—[In Japanese.] Cf. this *J.*, 1931, **47**, 141. Volume changes during solidification of manganese and some alloys containing manganese, nickel, or cobalt are measured by using the thermobalance. Values of V/V'% (V = volume of liquid sample at the melting point; V' = contraction by solidification) obtained are : manganese (Mn 99·9, C 0·01, Al 0·03, Fe 0·05%, Si trace), − 4·50; manganese–carbon (C 1·10%), − 1·60; nickel–carbon (C 2·23%), + 2·06; cobalt–carbon (C 2·20%), + 2·03.—S. G.

The Supraconductivity of Mercury–Cadmium Alloys. W. J. de Haas and J. de Boer (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 128–131).—[In English.] The change of resistance of alloys of mercury and cadmium containing 30, 40, and 50 atomic-% of cadmium has been measured at the temperatures obtainable with liquid helium. The transition points for these alloys are 2·16°, 1·91°, and 1·71° K., respectively. Reference is made to the great influence of the crystal lattice on superconductivity.—E. S. H.

Heat-Resistant Nickel–Chromium Alloys. Wilhelm Herrmann (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 76–79).—A description, with bibliography, of the properties of the plain binary nickel–chromium alloys and the ternary nickel–chromium–iron alloys with and without small quantities of other elements such as manganese, tungsten, and cobalt.—R. G.

Report of Committee A-10 [of A.S.T.M.] on Iron–Chromium, Iron–Chromium–Nickel, and Related Alloys. (*Amer. Soc. Test. Mat. Preprint*, **1932**, 1).—Brief summaries of the terms of work undertaken by the various subcommittees are given. No results are included in the report.—W. A. C. N.

Magnetic Properties of Permalloy ; Influence of Internal Strains, Longitudinal Stretching, and [Hydraulic] Pressure. Otto von Auwers (*Wiss. Veröff. Siemens-Konzern*, 1930, **9**, 262–293; and (abstract) *Z. Instrument.*, 1932, **52**, 97–98; *C.Abs.*, 1931, **25**, 62).—The magnetic properties of compound wires, consisting of a Permalloy sheath surrounding a central core, were studied after drawing both before and after heat-treatment. By proper choice of core material, the Permalloy sheath was subjected to various internal strains, whilst the corresponding external stresses were applied by stretching or the use of hydraulic pressure. The effects of these stresses on the magnetic properties are shown by a number of tables and curves exhibiting the influence of stretching and compression on the initial magnetization curve, the μ-curve, maximum permeability, remanance, coercive force, and position of the hysteresis loops. Under the influence of stretching, the hysteresis loops seem to be tipped to a definite axis passing through the origin as if there were two fixed points on the increasing and decreasing branches, the co-ordinates of which are independent of the load. Pressure in general affects only coercive force, and produces an effect opposite to that produced by stretching. The effects on hysteresis of regulated stresses seem to be the same as those produced by unregulated stresses (*e.g.* those due to impurities or working), but this is not the case with remanance and coercive force.—S. G.

The Rôle of the Platinum Metals in Dental Alloys. E. M. Wise, Walter S. Crowell, and J. T. Eash (*Amer. Inst. Min. Met. Eng. Preprint*, **1932**, 1–44).—The tensile properties of two series of quaternary alloys containing gold, silver, copper, and either platinum or palladium have been determined together with the effect of heat-treatment thereon. The alloys tested contained silver 20, copper 29, zinc 1, and gold + platinum (or palladium) 50 atomic-%. Alloys free from platinum metal and those containing less than 30 atomic-% of palladium are all amenable to precipitation-hardening, whilst those with more than 20 atomic-% of platinum are not sufficiently workable for dental purposes. The most satisfactory heat-treatment comprises quenching from 700° to 900° C., according to the platinum metal content, followed by tempering for 15 minutes at 300°–350° C. for alloys free from platinum metals or up to 450° C. for those containing these metals. Curves showing the tensile properties of wires of these alloys after different heat-treatments are included and briefly discussed. Ultimate strengths of up to 160,000 lb./in.^{2} can be obtained with the palladium alloys and up to 180,000 lb./in.^{2} with the platinum alloys. The ratio between the strengths of aged and quenched palladium alloys lies between 1·6 and 1·7 for alloys with 0–25 atomic-% of this metal and an ageing period of 15 minutes; with longer periods it may rise as high as 1·9. For the alloys with 5 atomic-% platinum the ratio is 1·9, but with more platinum it falls to 1·3–1·35. Equilibrium diagrams of the following binary and ternary systems are given and briefly discussed: silver–copper, gold–silver, gold–copper, palladium–gold, palladium–silver, palladium–copper, platinum–gold, platinum–silver, platinum–copper, gold–silver–copper, and palladium–silver–copper.—A. R. P.

A Study of Alloys of Silver. Léon Guillet, Alfred Petit, and Jean Cournot (*Rev. Mét.*, 1932, 29, 113–132).—An historical review of the use of silver alloys is given. The essential requirements in alloys for monetary or silversmith's purposes are discussed. Reference is made to the known diagrams of binary alloys of silver. Consideration is given to the homogeneity, rolling properties, colour, sonority, corrosion properties, and response to heat-treatment of silver–zinc, silver–cadmium, silver–tin, silver–zinc–cadmium, silver–copper–nickel, silver–copper–zinc–cadmium, silver–copper–nickel–zinc–cadmium, and silver–copper–nickel–zinc alloys investigated by the authors.—H. S.

Tin-Rich Antifriction Alloys of Tin, Lead, Copper, and Antimony. M. Fournier (*Rev. Mét.*, 1932, 29, 101–107).—The alloys examined contained up to 6% of lead, 6% of copper, and 12% of antimony. In alloys containing upwards of 8% of antimony, the content of cubic crystals Sb–Sn gives a good indication of the antimony content of the alloy, but antimony below 8% is not visible microscopically in the alloys. A good indication of the quantity of copper present is afforded by the amount of the white copper constituent present, which has an acicular habit. The content of lead is not indicated microscopically except in alloys containing antimony also, when lead increases the amount of the lead–antimony eutectic present. F. gives the results of hardness tests on cast and slowly-cooled, and on chill-cast alloys.—H. S.

Influence of Small Quantities of Aluminium on Tin-Rich Antifriction Alloys Containing Tin, Lead, Copper, and Antimony. M. Fournier (*Rev Mét.*, 1932, **29**, 108–111).—Small quantities of aluminium (*e.g.* 1%) modify considerably the structure of tin-rich anti-friction alloys of tin, antimony, copper, and lead, causing disappearance of the cubic crystals due to the limited solubility of Sb–Sn in the alloys. The aluminium-containing alloys have a fine globular structure when frozen rapidly, but in the case of slow freezing liquation occurs, the upper liquated portion containing the aluminium, some copper, and a little antimony. This latter property could be utilized if desired, to eliminate aluminium from an alloy. F. suggests that the alloys containing aluminium have inferior mechanical properties, and show a tendency to develop heterogeneity, which features are both undesirable.—H. S.

Zinc Alloys for High- and Low-Temperature Service. H. A. Anderson (*Symposium on Effect of Temperature on the Properties of Metals. Held at Joint Meeting of Amer. Soc. Mech. Eng. and Amer. Soc. Test. Mat.*, **1931**, 271–289).—See this *J.*, 1931, **47**, 431.—S. G.

Effect of Temperature upon the Charpy Impact Strength of Die-Casting Alloys. Bert E. Sandell (*Amer. Inst. Min. Met. Eng. Preprint*, **1932**, Feb., 1–4).—Results are given showing the effect of variation in temperature on the impact values of three alloys. The zinc-base alloys (copper 2 and 3%, aluminium 4%) were brittle at low temperatures and became more tough with increasing temperature, the 3% alloy reaching a maximum at 350° F. (192° C.). Two aluminium–silicon alloys (5 and 12% silicon) showed little variation in behaviour between 0° and 500° F. (− 17·8° and 260° C.).—R. G.

Properties of Materials at High Temperatures. VI.—The Strength at High Temperatures of Six Steels and Three Non-Ferrous Metals. H. J. Tapsell, A. E. Johnson, and W. J. Clenshaw (*Dept. Sci. Indust. Res., Eng. Res. Special Report*, No. **18**, 1932, 1–44).—The non-ferrous metals tested were: (*a*) phosphor-bronze with 5·49% tin, 94·26% copper, and 0·24% phosphorus; (*b*) Duralumin with 4·25% copper, 0·42% iron, 0·25% silicon, 0·63% manganese, and 0·44% magnesium; and (*c*) brass with 59·8% copper, 38·67% zinc, 0·34% tin, and 0·99% lead. In short-time tensile tests at elevated temperatures the rate of decrease of strength is least with the bronze and greatest with Duralumin, thus at 150° C. the ultimate strength of all 3 alloys is 21–23 tons/in.^{2}, but at 350° C. the values are 13·4 tons for the bronze, 9 tons for the brass, and 3·3 tons for Duralumin. The limit of proportionality of the bronze is much higher than that of Duralumin at room temperature, but at 350° C. it becomes relatively inferior. The elongation of phosphor-bronze falls continuously from 84% at 150° C. to 6% at 500° C., that of Duralumin rises from 22% at 150° C. to 80% at 350° C., and that of brass falls from 55% at 150° C. to a minimum of 12% at 250° C., then rises again to a maximum of 42% at 350° C. The limiting creep stress curve of Duralumin lies below the limit of proportionality curve, but represents stresses which are a much larger fraction of the ultimate stress than the respective fractions for phosphor-bronze or brass. The 60 : 40 brass has no definable elastic range and its limiting creep stress decreases rapidly with rise in temperature above 150° C., and at 250° C. is only a very small fraction of the ultimate strength. Phosphor-bronze at 150° C. behaves similarly to Staybrite at 300°–400° C., *i.e.* it has a very low limit of proportionality, but shows an ability to stiffen considerably and rapidly after overstrain. The application at 150° C. of a high stress sufficient to cause considerable initial overstrain produces relatively little additional strain with time. Curves of creep stress of these alloys and of 6 steels are given for temperatures up to 500° C.—A. R. P.

Structure Analogies of Intermetallic Phases. A. Westgren and W. Ekman (*Arkiv Kemi Mineral. Geol.*, 1930, **10 B**, (11), 1–6; *C. Abs.*, 1931, **25**, 1476).—In the intermediate phases of the β-brass type containing either copper, silver, or gold, it has been found that there is a ratio of valency electrons to atoms of 3 : 2, whilst in the lattices of the γ-brass type the ratio is 21 : 13. Recently metallic compounds have been found not containing copper, silver, or gold with atomic groupings resembling β- or γ-brass, viz., NiAu, MnAl, and FeAl, where the atoms of the transition elements behave as if they had a valency of zero. To test the validity of this remarkable rule, W. and E. made a series of alloys corresponding with the general formula A_5B_{21}, where A is a transition element (cobalt, nickel, rhodium, palladium, platinum), and B is either zinc or cadmium. The alloys were made in sealed evacuated quartz tubes by heating for about a week at 900°–1000° C. In all cases where alloying succeeded, a homogeneous material of γ-brass structure resulted, as was evidenced by the powder photograms. The homogeneity range extends for cobalt–zinc alloys from 15 to 22 atomic-% cobalt and for nickel–zinc alloys from 15 to 19 atomic-% nickel. It was noticed that alloying of transition elements with aluminium, zinc, or cadmium gives a much more pronounced decrease in volume than is the case with alloys formed with atoms having complete inner electron shells. The contraction for Ni_5Cd_{21} amounted to almost 8·7%, although nickel occupies only 19 atomic-% in the alloy.—S. G.

On the Theory of Formation of Segregate Structures in Alloys. C. H. Mathewson and D. W. Smith (*Amer. Inst. Min. Met. Eng. Preprint*, **1932**, Feb. 1–8).—A discussion of available published data on the crystallographic aspect of the separation of solute phases ("segregate structures"). The collected data are given in tabular form, mainly from the work of Mehl. It is evident that the crystal structure of the matrix does not determine the location of plate structures or other forms assumed by the segregate. The theory of Hanemann and Schröder of directed diffusion ("perfusion") is discussed. It is considered that segregate phases do not form in the cleavage planes nor along the planes of densest atomic packing in all cases. Generally, however, the direction of a close-packed string of atoms is found in the segregate plane and may be the position where transformation commences.—R. G.

The Exact Measurement of the Specific Heats of Solid Substances between 0° and 1625° C. VI.—On the Law of Neumann–Joule–Kopp–Regnault Concerning the Molecular Heat of Chemical Compounds in Function of the Atomic Heats. F. M. Jaeger and J. A. Bottema (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 352–362).—[In English.] The sp. heat of pure, tetragonal (white) tin has been determined as $c_p = 0{\cdot}05393 + 0{\cdot}22285 \times 10^{-4}t + 0{\cdot}45111 \times 10^{-7}t^2$, and that of the platinum–tin alloy represented by PtSn as $c_p = 0{\cdot}03836 + 0{\cdot}50724 \times 10^{-5}t + 0{\cdot}107879 \times 10^{-8}t^2$. Combining these results with the known value for the sp. heat of pure platinum, it is shown that the molecular heat of the compound at any given temperature is less than the sum of the atomic heats of the constituent metals at the same temperature. The additive law of Neumann, Joule, Kopp, and Regnault is, therefore, not valid. The deviations, which range from 4·5 to 8·7%, are themselves a function of the temperature, increasing linearly with rise of temperature, as a first approximation. In general, it is suggested that the so-called "law of additive atomic heat" is not valid for intermetallic compounds.—E. S. H.

Supersaturation. J. R. Partington (*J. Physical Chem.*, 1932, **36**, 1853–1854).—P. directs attention to, and claims priority for, previous work of his, in which the relation between particle size and supersaturation phenomena is discussed.—J. S. G. T.

Remarks Concerning the Phase Rule. Pierre van Rysselberghe (*J. Physical Chem.*, 1932, **36**, 1733–1737).—De Donder's formulation of the phase rule, involving a precise definition of the number of "independent constituents" of a heterogeneous system, is discussed. Its application to systems of any degree of complication is simple and direct. It gives an unambiguous solution of the problem of determining the masses of all the constituents in all phases.—J. S. G. T.

III.—CORROSION AND PROTECTION

(Continued from pp. 432–439.)

CORROSION

[Corrosion of] Armatures on Aluminium Fermenting and Storage Tanks. G. Eckert (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1931, 3, 354–356).—Describes severe contact corrosion caused by a brass bunghole in an aluminium beer tank.—M. H.

The Corrosion of Aluminium and Some of its Alloys. E. W. Zechnovitzer (*Sobshenia Leningradskogo Instituta Metallov* (*Communications of the Leningrad Institute of Metals*), 1931, (10), 52–65).—[In Russian.] The resistance to corrosion of aluminium has been determined in distilled water, river-water, sea-water, brine (0·1 and 1N-sodium chloride), 1% sodium chloride, 1% hydrogen peroxide, and 1N-sodium carbonate. With an increase in iron content from 0·4 to 0·65%, the corrosion-resistance of aluminium shows a marked decrease. In dilute solutions of sodium carbonate, a green film of basic copper carbonate is formed on the aluminium alloy with 2·5% copper, whilst if the solutions are more concentrated (10–15%) the alloy becomes completely covered with an unbroken black layer of copper oxide. Black spots (pores and inclusions) which may be observed in the alloy have no marked influence on its resistance. The resistance of Silumin (10·44% silicon) is much less than that of the alloy K.S. Seewasser (silicon 0·23, iron 0·48, magnesium 2·76, manganese 0·92, antimony 0·3, copper 0·56%) owing to the presence of centres of corrosion, whereas K.S. Seewasser corrodes much more evenly. —N. A.

Testing the Resistance to Corrosion of Copper–Cadmium Wire. E. W. Zechnovitzer and M. N. Rozov (*Sobshenia Leningradskogo Instituta Metallov* (*Communications of the Leningrad Institute of Metals*), 1931, (10), 46–52).—[In Russian.] The potential of copper containing up to 1·2% cadmium has been determined with Duffek's apparatus, against a mercury electrode with oxygen bubbling through the electrolyte, and then against an $N/10$ calomel electrode, on a compensated circuit with a mirror galvanometer. 0·1N solutions of sodium chloride, potassium chloride, sulphuric acid, copper sulphate, and cadmium sulphate were used as electrolytes, and readings were taken at definite intervals. The results showed that the electrode potential of pure copper differed only slightly from that of an alloy containing 0·98% cadmium. More accurate determinations were carried out on the Poggendorf–Buty system. As long as the cadmium content is small, there are no sharp differences of potential. The corrosion experiments were carried out in distilled water and 0·1N solutions of sulphuric, hydrochloric, and nitric acids and sodium chloride, sodium hydroxide and ammonia, loss in weight over a period of 120 hrs. being determined. Hydrochloric acid and ammonia were found to exert the most powerful effect. The alloys are more resistant than pure copper towards alkalis, but the reverse is true for acids. Gas corrosion was studied in sulphur dioxide and carbon dioxide, results being determined by changes in weight, electrical resistance, and mechanical properties. The humidity of the gas was found to exercise a marked influence. The corrosion-resistance of copper–cadmium wire after a 21-day test in sulphur dioxide (5·5–6·8%) was found to be little different from that of pure copper wire. In carbon dioxide the corrosion process is much slower; the only results of a 5-day test being a darkening of the surface.—N. A.

The Effect of Sea-Water on the Alloys of Copper. ——. (*Cuivre et Laiton*, 1929, 2, (17), 9–11).—A communication from the German Copper Institute.

This is a study of the effect of saline solutions in stimulating and furthering the corrosion of the best-known copper alloys. Comparisons are made between the behaviours of the different alloys when heated.—W. A. C. N.

Corrosion Structures. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 79–80).—A discussion and summary of work by L. Graf (*Metallwirtschaft*, 1932, **11**, 77, 91; see *J.*, this volume, p. 355) on the X-ray examination of corroded gold–copper alloys.—R. G.

The Rate of Solution of Zinc in Acids. Cecil V. King and M. M. Braverman (*J. Amer. Chem. Soc.*, 1932, **54**, 1744–1757).—Measurements were made of the rate of solution of commercially pure zinc in hydrochloric, acetic, and several organic acid solutions, and compared with those of magnesium and cadmium. The effect of speed of rotation of the specimen, and of the presence of oxidizing agents were studied. It is concluded that the old diffusion theory of Noyes and Whitney requires modification, whilst the more recent theory of Brönsted is definitely contradicted by the results.—R. G.

Remarks on the Character of the Solution of Metals by Chemical Reagents, as Determined by Experiment. A. Portevin and P. Bastien (*Génie civil*, 1932, **100**, 559–562).—Although the loss in weight of a corroded metal is easily determined, it does not serve in general to characterize the type of corrosion. Five types of deterioration by corrosion may be distinguished: (1) uniform solution. Such corrosion occurs when the ultra-light alloys of magnesium are attacked by citric acid or hydrochloric acid; (2) local corrosion accompanied by pitting. In this case the loss of weight may be much less than in case (1), but the effect on the physical properties may be far more pronounced; (3) corrosion producing a chemical change in one of the constituents of the alloy, such as occurs in the graphitization of cast iron in the presence of chloride solutions. In this case also the loss in weight is no criterion of the extent to which corrosion has progressed; (4) fissuring by corrosion, the classic example of which is the season-cracking of brass when in a state of internal stress; (5) corrosion causing definite brittleness, as instanced by the embrittling action of hydrogen on mild steel. Bearing in mind the above possibilities P. and B. have studied the effects on magnesium–aluminium copper alloys of three corroding media: (*a*) organic acid—type (1) corrosion; (*b*) mineral acids—types (1) and (2) corrosion; (*c*) a salt solution—type (2) corrosion.—W. P. R.

The Estimation of the Loss in Weight in Corrosion Tests. Jean Cournot and Marcel Chaussain (*Compt. rend.*, 1932, **194**, 1823–1824).—The usual method of estimating the loss in weight as a means of determining the effect of corrosion by weighing the specimen before the test and after brushing, washing, and drying after the test is very unreliable. Tests on corroded pure iron showed that the loss due to brushing was much too high, and that more comparable results were obtained by removing the products of corrosion by boiling the specimen in a solution of soda in the presence of zinc or by analyzing the oxide formed. If this conclusion is established for pure iron, which is uniformly attacked without the formation of pin-holes, it is likely to be still more valid with less pure metallurgical products which are corroded irregularly.—J. H. W.

Controlled Data from an Immersion Test. R. F. Passano (*Amer. Soc. Test. Mat. Preprint*, **1932**, 1–7).—It has previously been reported that there are many factors which influence the amount of corrosion taking place under water. In this study, it was found that there are 7 essential external factors: temperature, oxygen concentration, velocity, type of water, area of specimen, surface condition of specimen, and time of test. With these held at definite values using well water from the Miami Valley, it was demonstrated that the resulting data did not vary significantly in a series of tests. It was necessary to use modern statistical theory to show these things. When the essential conditions had been established, the time of test was purposely varied, whilst the other factors were maintained, and it was found that the average loss of weight was apparently proportional to the logarithm of time over the interval investigated.—S. G.

PROTECTION

Modification of Metallic Surfaces. E. T. Richards (*Zentral-Europ. Giess.-Zeit.*, 1930, 3, (11), 11).—The opinion is expressed that the good or bad qualities of any surface modifications for the purposes of corrosion resistance, *e.g.* plating, oxidation, are to a great extent dependent on the nature and properties of the basic material.—W. A. C. N.

The MBV-Method [Modified Bauer–Vogel Method] an Effective Method for the Surface Protection of Aluminium and its Alloys. G. Eckert (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1931, 3, 349–351).—The process consists in immersing the article in a 5% sodium carbonate solution containing 1·5% sodium chromate at 90°–100° C. for 3–5 minutes or at 70° C. for 60 minutes. The properties of the protective layer are described and the possibilities of application of the method discussed.—M. H.

Advantages of Oxide Films as Bases for Aluminium-Pigmented Surface Coatings for Aluminium Alloys. R. W. Buzzard and W. H. Mutchler (*Aircraft Eng.*, 1932, **38**, 106).—Abstract of *Nat. Advisory Cttee. Aeronautics, Tech. Notes*, No. **400**, 1931, 1–16. See *J.*, this volume, p. 236.—H. S.

Electrolytic Oxidation of Aluminium and its Applications. Shoji Sedo (*J. Soc. Mech. Eng.* (*Japan*), 1931, **34**, 973–985; *C. Abs.*, 1931, **25**, 5101).—[In Japanese.] S. describes the anode characteristics, general properties of anode film, requirements for obtaining a thick film of oxide, and applications of oxide-film coated aluminium. He proposes to use an aqueous solution of oxalic acid as an electrolytic solution to obtain a thicker film of aluminium oxide than in other cases (Bengough and Sutton). In the experiments a 2% aqueous solution of oxalic acid was used, the temperature being varied from 20° to 34° C. A.c. was superposed on d.c. to counteract polarization of the anode. The specimen was 80 cm.^{2} in area and the thickness of the film obtained was 0·0342 mm. By keeping the treated specimen in a closed vessel containing steam at a pressure of 4–5 atmospheres for 10 minutes, S. succeeded in rendering the film non-corrosive to acid and alkali. The properties of aluminium oxide films obtained by S.'s method—such as density, hardness, flexibility, resistance to abrasion, and corrosion and insulating power—are explained in detail.—S. G.

Galvanic Coatings of Pure Lead, their Application as Protection against Corrosion in Mining. E. Bertl (*Z. Metallkunde*, 1932, **24**, 62).—A brief account.—M. H.

Some Factors Affecting the Preece Test for Zinc Coatings. H. H. Walkup and E. C. Groesbeck (*Amer. Soc. Test. Mat. Preprint*, **1932**, 1–11).—The results of a study of some factors involved in the Preece test for testing zinc coatings on ferrous products are presented. The Preece test has been severely criticized by various authorities because of the erratic results which are sometimes obtained, although it finds a wide use, for inspection purposes, in determining the uniformity of the coating. This study was undertaken with the object of ascertaining the underlying causes for the reported erratic results. A prominent characteristic of these erratic results is the formation of false end-points—that is, the appearance of adherent copper on the zinc coating before the underlying base metal has been reached. The causes producing these false end-points may be grouped under three general classes: (1) variation in nature of zinc coating, (2) variation in copper sulphate solution employed, and (3) manipulation. False end-points were obtained by various experimental methods. The results of two series of experiments carried out with hot-dip galvanized, "galvannealed," zinc, iron, and steel wire specimens are shown diagrammatically. By investigating the effects produced by variations in the potential and p_H value of different types of zinc coatings and copper sulphate solutions, it was determined that false end-points can be formed by the lodgment of copper particles on the specimen surface. The effects of certain variables on the adherence of copper deposits on the iron or steel base at the true end-points were also investigated.—S. G.

Report of Sectional Committee [of A.S.T.M.] on Zinc Coating of Iron and Steel. J. A. Capp and A. B. Campbell (*Amer. Soc. Test. Mat. Preprint*, **1932**, 1–3).—Work on embrittlement of steel has resulted in the preparation of a guide for safeguarding against the injurious effects of hot-galvanizing of structural steel products. A recommended practice for detecting embrittlement of hot-galvanized steel angles has been developed. Little progress has been made in developing satisfactory accelerated testing methods which will predict service in the atmosphere.—W. A. C. N.

Effect of Zinc Coatings on the Endurance Properties of Steel. W. H. Swanger and R. D. France (*Amer. Soc. Test. Mat. Preprint*, **1932**, 1–19).—The effect of the surface alterations, resulting from the application and presence of hot-dipped galvanized and electroplated zinc coatings, on the endurance properties of open-hearth iron and 0·45% and 0·72% carbon steel was determined by fatigue tests made with R. R. Moore rotating beam and Haigh axial loading machines. Rotating-beam tests were made on: (1) polished but uncoated specimens; (2) specimens coated by the hot-dip galvanizing process; (3) zinc-plated specimens; and (4) specimens acid pickled as for galvanizing. Axial loading tests were made on uncoated and galvanized specimens only. The open-hearth iron was tested in the "as-rolled" condition. The two carbon steels were tested in the normalized and annealed condition, in the quenched condition, and in the tempered condition, except that axial loading tests were not made on quenched specimens. The results of the fatigue tests are given in conventional *S–N* diagrams and are summarized in a table together with the results of tensile strength and hardness determinations. Photomicrographs are given showing the structures of the heat-treated steels and of the two types of coatings. The endurance ratios (endurance limit to tensile strength) by the rotating-beam method of test of the uncoated specimens varied from 0·38 to 0·70; by the axial loading method, from 0·31 to 0·59. The decrease in endurance limit from that of the polished, uncoated materials caused by the acid pickling was more marked in the quenched steels than in the annealed and the tempered steels. The decrease varied from 0 to 40%. A still greater decrease, as much as 42·5%, was caused by the presence of the hot-dipped galvanized coatings. The quenched and the tempered steels were affected more adversely than the annealed steels. The endurance limits of the zinc electroplated specimens were equal to or greater than those of the uncoated specimens. The difference in the effects of the two types of coating is believed to be caused by the differences in the nature of the bond between the zinc and the steel and the structure and hardness of the two coatings.—S. G.

Brittleness of Zinc-Coated Steel. J. S. Adelson (*Blast Fur. and Steel Plant*, 1932, **20**, 430–435).—This paper was also published in *Heat-Treating and Forging*, 1932, **18**, 180. See *J.*, this volume, p. 301.—R. Gr.

Mechanical Aids to Hot-Galvanizing. Wallace G. Imhoff (*Amer. Machinist* (*Eur. Edn.*), 1932, **76**, 616–618).—A discussion of the preparation of work, the composition of baths for hot-galvanizing, temperatures suitable for various kinds of work, of difficulties that may be encountered, and how they may be overcome.—J. H. W.

The Muriatic Acid Dip for Metal-Ware Galvanizing. Wallace G. Imhoff (*Amer. Metal Market*, 1931, **38**, (Sept. 12), 5, 7; *C. Abs.*, 1932, **26**, 3470).—The purpose of the dip is to overcome the corrosion occurring between pickling and galvanizing by counteracting the oxidizing effect of the sulphuric acid pickle. The chemical reactions involved are given in detail. In order to reduce contamination of the muriatic acid dip with iron, a water wash after pickling is strongly advocated. Comparison of practice at various plants shows that the strength of the muriatic acid dip follows to a great extent that of the pickle. In one plant, however, treatment after pickling consists of nothing more than draining and washing in a cold-water dip to which less than 1% muriatic acid has been added in order to remove the slightly oxidizing effect of the water. The consequence of this is that the wash tank can be emptied whenever necessary, and the iron content is always low. The routine procedure at 15 different plants is discussed in detail.—S. G.

Corrosion between Pickling and Galvanizing. Wallace G. Imhoff (*Amer. Metal Market*, 1932, 39, (May 6), 5; (May 7), 5–6; *C. Abs.*, 1932, 26, 3471).—Cf. preceding abstract. General practice in numerous plants is discussed. There is little agreement between the acid strength, temperatures, and time of pickling employed at each. To prevent corrosion it is necessary to "balance" the strengths of the sulphuric acid pickling solution and the muriatic acid dip. After removal from the latter the first product is iron chloride, which in air tends to form ferric hydroxide and finally the carbonate or red ferric oxide with some water in combination. Dross formation is accounted for by conversion to these compounds. From then on the corrosion product changes slowly to red ferric oxide as it slowly loses its molecules of water and the colour changes from yellow to a deep red rust colour. Zinc at the temperature of the molten galvanzing bath is a very strong reducing agent, and the zinc–iron alloy known as galvanizer's dross is formed through the reduction by it of the oxide. The oxygen is left free to combine with the various gases liberated in the fluxing reactions. The relations between the iron in pickling solutions and the iron derived from corrosion after pickling as a source of dross are further discussed.—S. G.

The Sulphuric Acid Pickle for Metal-Ware Galvanizing. Wallace G. Imhoff (*Amer. Metal Market*, 1931, 38, (Aug. 20), 7; (Aug. 21), 5, 10; *C. Abs.*, 1932, 26, 3471).—Facts concerning the sulphuric acid used in metal-ware galvanizing at 15 different plants are studied. The practice is compared at each regarding acid strength and consumption per ton, length of period between cleaning of tanks, temperatures, use of inhibitors, agitation, &c. —S. G.

The Size and Capacities of Metal-Ware Pickling Tanks. Wallace G. Imhoff (*Amer. Metal Market*, 1931, 38, (July 15), 5, 10; (July 16), 5, 10; (July 17), 5, 9; *C. Abs.*, 1932, 26, 3471).—The importance of thorough cleaning and pickling is emphasized, and an attempt is made to decide what is the average practice in the industry by examination of the data from 15 different plants, stated to comprise "practically all of the metal-ware industry." Reckoned on the basis of a single bath, the following are average figures: production, 4200 lb. or 14,000 ft.^{2}; pickle solution, 700 gall. of a 4% strength; hydrochloric acid, 100 gall. of equal parts acid and water. —S. G.

Buildings for Metal-Ware Pickling and Hot-Galvanizing. Wallace G. Imhoff (*Amer. Metal Market*, 1931, 38, (Apr. 16), 5, 10; (May 13), 5, 10; (May 14), 5, 10; *C. Abs.*, 1932, 26, 3471).—There is an important connection between housing facilities and methods and technique. Matters are discussed relating to fresh-water supply, disposal of waste acids and other sewage, the effect of fumes on stock and constructional material, &c. Full details are given of a large number of actual plants.—S. G.

Protective Metal Coatings. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 90–92).—A brief account of the papers discussed at a joint meeting of the Electroplater's and Depositor's Technical Society and the London Section of the Institute of Metals. These dealt with cadmium and zinc deposits on iron and steel, and with the protection of light metals and alloys by electro-deposits. —R. G.

Metallization by the Schoop Process. Anon. (*Cuivre et Laiton*, 1929, 2, (21), 16).—A general outline of the Schoop process as applied to the spraying of copper.—W. A. C. N.

Investigation of Mineral Paints and Lacquers for Metal Aircraft Structures. E. S. Tichonov (*Trans. Central Aero-Hydrodynamic Inst.* No. 88, 1931, 1–55; *U.S.S.R. Sci. Tech. Res. Inst. Supreme Council Nat. Econ.*, No. 457).—[In Russian, with English summary.] A detailed investigation of the properties of protective coatings obtained on the alloy Koltchugalumin by means of various paints and lacquers. The Koltchugalumin sheet had the composition: aluminium 94·2, copper 4·07, magnesium 0·65, iron 0·46, silicon 0·42, and manganese 0·40%. Its thickness was 2·5 mm.; its tensile strength 38·8–39·1 kg./mm.^{2} and its elongation 21·7–22·2%. The paints used were: white lead (2 brands), lampblack (2 brands), red paint (2 brands), khaki (3 brands), and blue-grey (2 brands), on which the following tests were carried out: (1) determination of the amount of pigment in the paint; (2) determination of the size of the particles of pigment; (3) sedimentation tests; (4) covering power; (5) drying power; (6) influence of the atmosphere on the coating; (7) fastness to light; (8) behaviour of the coating at high temperatures; (9) action of sea- and fresh-water; (10) action of inflammable mixture; (11) action of lubricating oils; (12) elasticity. The lacquers used were: protective lacquer for metals (3 brands), oil lacquer No. 20 (2 brands), oil lacquer No. 41, bituminous coal lacquer (2 brands), bituminous coal lacquer "Inertol" made by Paul Lechner of Stuttgart, on which the following tests were carried out: (1) determination of mechanical admixtures; (2) determination of sp. gr.; (3) determination of acidity; (4) determination of viscosity; (5) drying power; (6) consumption of lacquer and increase in weight of 1 mm.^{2} of metal surface; (7) resistance to atmosphere; (8) fastness to light; (9) behaviour at high temperatures; (10) action of sea-water; (11) action of fresh-water; (12) action of inflammable mixtures; (13) action of lubricating oils; (14) elasticity. In addition to the above paints and lacquers, 2 brands of aluminium powder were tested. It is concluded that white, black, and khaki paints are suitable for painting both external and internal Koltchugalumin parts. All the above paints are sufficiently fast to light and resist the effects of atmospheric corrosion and elevated temperatures; they are, however, unsuitable for protection against fresh- or sea-water. The red and grey-blue paints are entirely unsuitable for covering external parts, owing to their feeble resistance to light, air, and water. The protecting lacquers are primarily intended to preserve Koltchugalumin parts from corrosion during storage: if prolonged storage periods are contemplated, special precautions against bright light and moisture are necessary. Great care must be taken to ensure complete covering of the metal: for this purpose, a bright pigment, fast to light, should be incorporated in the lacquer. Of the 3 lacquers examined, only one fulfils the requirements. The oil lacquers are unsuitable as protective coatings for external parts of aircraft, but may be useful for storage. The bituminous lacquers are the best for protecting under-water parts: they are resistant to fresh- and sea-water, but are easily destroyed by the action of atmosphere, light, and changes of temperature. If these lacquers are used on the under-water parts of any apparatus, the latter must, immediately on withdrawal from the water, be protected from air and light. It is considered that the lacquer "Inertol" possesses the best properties.—M. Z.

A New Rust-Preventive Paint. Anon. (*Machinery* (*Lond.*), 1932, 38, 674).—"Nust" is a battleship grey paint said to consist of a suspension of colloidal lead in linseed oil. Iron which has been painted with this may be stretched by amounts up to 1% without causing the coating to peel off or crack.—J. C. C.

IV.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 439-440.)

Report of Committee E-4 [of A.S.T.M.] on Metallography. C. H. Davis and O. E. Harder (*Amer. Soc. Test Mat. Preprint,* **1932,** 1–3).—Progress is reported on investigations into the selection and preparation of samples, thermal analysis, photographic methods, X-ray methods, and the grain characteristics of steel.—W. A. C. N.

Micrographic Characteristics of Light Alloys. G. Guzzoni (*Metallurgia italiana*, 1930, **22**, 747–756; and (abstract) *Light Metals Research*, 1931, **1**, (12), 8).—The various methods for cutting, preparing, and polishing metallographic specimens of light alloys are discussed. The intermetallic compounds "B" and "X" present in commercial aluminium are described, and their nature and properties illustrated by photographs. The most important compounds which are ascertained as probably present in the alloys aluminium–silicon, aluminium–magnesium, aluminium–copper, aluminium–zinc, aluminium–manganese, aluminium–nickel, aluminium–magnesium–silicon, and other ternary and complex alloys are enumerated, and their structure is described and illustrated by means of clear photographs, as well as their etching properties and the best methods of identifying them. Structure, form, and dimensions of intermetallic constituents are related to the physical and mechanical properties of alloys. The study is a valuable one, very accurate and well illustrated; ample tables are included.—L. L.

Studies upon the Widmanstätten Structure. III.—The Aluminium-Rich Alloys of Aluminium with Copper, and of Aluminium with Magnesium and Silicon. Robert F. Mehl, Charles S. Barrett, and Frederick N. Rhines (*Amer. Inst. Min. Met. Eng. Preprint,* **1932,** Feb., 1–26).—The precipitate of $CuAl_2$ from aluminium-rich solid solution occurs as plates parallel to the (100) plane in the solid solution lattice, and at concentrations above 1·5% copper also in a form, probably plate-like, of more complicated relationship to the solid solution lattice. It is suggested that the (001) plane in $CuAl_2$ should be parallel to the (100) plane of the solid solution, and the [100] direction in $CuAl_2$ parallel to the [120] direction in the solid solution. The precipitate from the system Al–Mg–Si occurs as plates parallel to the (100) plane in the solid solution lattice and (at higher concentrations) on the (110) plane. Etching and X-ray tests gave indications of Al_3Mg_2, but did not confirm the presence of Mg_2Si. The connection of the work with age-hardening is discussed.—R. G.

Method of Preparation of Lead and Lead Alloy Cable Sheath for Microscopic Examination. W. H. Bassett, Jr. and C. J. Snyder (*Amer. Soc. Test. Mat. Preprint,* **1932,** 1–11).—Lead and lead alloy cable sheaths contain irregularities in grain structure that are best examined microscopically. Careful preparation of sheath samples is necessary because the grain structure of lead is very sensitive to "working." The microtome has been recommended for cutting a smooth surface, but the authors obtain satisfactory results by filing and polishing. All polishing is done by hand with a circular motion on emery paper and broadcloth backed by plate glass. Gasoline is used as a lubricant and cleaning medium. Lead and lead alloys require different etching reagents. A table of reagents used by various authorities is given. The authors recommend etching solutions for lead, lead-tin, and lead–antimony alloys. In all cases specimens must have sufficient etching to remove the surface layer of fine grains developed by cutting or polishing.

Examination of structures with vertical light is recommended. Suitable magnifications for lead are 5–75 diameters, for lead–tin alloys 20–200 diameters, and for lead–antimony alloys 50–500 diameters. Photographs demonstrating the results obtained are included.—S. G.

The Recrystallization of Silver and Platinum. O. Feussner. K. Gebhard and H. J. Wiester (*Z. Metallkunde*, 1932, **24**, 142).—Polemical. Cf. this *J.*, 1927, **38**, 466; 1930, **43**, 522.—M. H.

Optical Hints for the Metallographer.—II. L. V. Foster (*Heat-Treating and Forging*, 1932, **18**, 265–266).—The use of the numerical aperture (N.A.) and its effect on the resolving power and the use of filters in photomicrography are discussed.—J. H. W.

Lattice-Spacings in Iron–Aluminium Alloys. A. J. Bradley and A. H. Jay (*Found. Trade J.*, 1932, **46**, 308).—Abstract of a paper read before the Iron and Steel Institute. See *J.*, this volume, p. 308.—J. H. W.

Lattice Dimensions in Copper–Silver Alloys. Helen Dick Megaw (*Phil. Mag.*, 1932, [vii], **14**, 130–142).—The X-ray spectra of silver-rich and copper-rich alloys of copper and silver containing respectively 0·0–3·69% (atomic) of copper, and 0·0–1·72% (atomic) of silver have been investigated. Sets of these alloys were subjected to different heat-treatments, viz., (1) annealed at 728° C. for 3 days and quenched; (2) annealed at 728° C. for 2 days, cooled to 480° C. in 4 days, cooled to 452° in 2 days, annealed at 452° C. for 1 day, and quenched; (3) annealed at 728° C. for 3 days, cooled to 452° C. in 4 days, cooled to 150° C. in 9 days, then to 100° C. in 2 days, and finally cooled slowly to room temperature. In the silver-rich alloys, slowly cooled to room temperature, the results indicate that equilibrium had not been reached. Alloys annealed at 452° C. gave no such effect, nor does the effect occur to an appreciable extent with the copper-rich alloys. The spacing of pure silver is 4·0774 A., that of pure copper 3·6090 A. The correspondiug atomic radii are 1·4496 A. for silver and 1·2760 A. for copper. For a silver-rich alloy containing 3% (atomic) of copper, the apparent atomic radius of the copper atom is 1·319 A. For a copper-rich alloy containing 3% (atomic) of silver, the apparent radius of the silver atom is 1·489 A. The spacings in the case of silver-rich alloys containing 1·33% (atomic) of copper, and copper-rich alloys containing 0·57% and 1·13% (atomic) of silver appear to be anomalous. The alloy containing 1·13% (atomic) of silver annealed at 452° C. appears to be slightly supersaturated. The respective solubilities of copper in silver and of silver in copper are, at 452° C., 2·26 atoms-% and 0·83 atoms-%, respectively. The solubility of silver in copper at room temperature is probably not appreciably different from that at 452° C.—J. S. G. T.

Precision X-Ray Method in Alloy Research. J. Weerts (*Z. Metallkunde*, 1932, **24**, 138–141).—The method and apparatus for the precision measurement of the interference lines in Debye photograms as developed with G. Sachs are described. The lattice constants of continuous series of solid solutions have been determined in the systems silver–palladium, gold–palladium, gold–platinum, platinum–rhodium, and platinum–iridium, which, except the first, obey Vegard's law. The kinetics of the decomposition of a supersaturated aluminium–copper solid solution with 4·3% copper during ageing at 150° C. have been fully investigated by measurements of the change in the lattice constant. X-ray analysis at high temperatures, and the determination of the thermal expansion of non-cubic metals, are also discussed.—M. H.

The Electrostatic Potential of Some Cubic Crystal Lattices. T. S. Wheeler (*Phil. Mag.*, 1932, [vii], **14**, 56–65).—A simple method for the calculation of the electrostatic potential of a cubic lattice is discussed and applied to the calculation of the potential of various cubic lattices, *e.g.* face-centred and cube-centred. The results enable the potentials of crystals comprising these lattices to be deduced.—J. S. G. T.

The Development of the Theory of the Crystalline State. A. K. Boldyrev (*Zapiski Rossiiskogo Mineralogicheskogo Obschestva* (*Notes of the Russian Mineralogical Society*), 1929, [2], 58, (2), 249–264).—[In Russian.] The following aspects of the subject are examined: the stages in the development of the theory of crystal structure, the modern conception of crystal structure, types of crystalline space-lattice, atomic diameters, and the deductions from the theory which are important in chemistry, *i.e.* the problems of valency and the existence of molecules in the crystalline state.—N. A.

Method of Ensuring the Maximum Accuracy in Debye-Scherrer Analysis. A. I. Krasnikov (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki* (*Journal of Experimental and Theoretical Physics*), 1932, 2, (1), 74–77).—[In Russian.] For ensuring the maximum dispersive power of a Debye chamber, a special diaphragm has been constructed. By this means a width of line of 0·05 mm. was obtained for sodium chloride and of 0·11 mm. for aluminium; with an exposure of 200 mA-hours, in beams of iron, K_{α_1}, K_{α_2}, and K_{β_1}, and width of slit of 0·25 mm. for sodium chloride and 0·3 mm. for aluminium, and breadth of specimen of 0·15 mm. for sodium chloride and 0·2 mm. for aluminium. For the preparation of pure specimens of accurate dimensions the method of extrusion from glass tubes was employed. All measurements were carried out by means of the comparator, and the following constants for aluminium were determined: $d_{(111)}$ — 2·33013 A.; $d_{(100)}$ — 2·0202 A.; $d_{(110)}$ — 1·4298 A.; $d_{(311)}$ — 1·2932 A. Sodium chloride was used to determine the diameter of the chamber with an accuracy of 0·0004%.—N. A.

Investigation of Structures by Means of X-Rays in the Iron and Metal Industries. Karl Nüvemann (*Zentral-Europ. Giess.-Zeit.*, 1930, 3, (6), 2–7).—The usual arrangement of the apparatus for this method of investigation is illustrated and discussed. A number of examples is given in which X-ray application has revealed serious flaws.—W. A. C. N.

V.—ANALYSIS

(Continued from pp. 441–444.)

Spectrographic Analysis of Alloys. G. Guzzoni (*Metallurgia italiana*, 1930, 22, 274–286).—The various methods of obtaining emission spectra of alloys in solid form are described, and examples of qualitative analysis are given. The value of direct intensity measurements in quantitative work is discussed and an attempt is made to establish an experimental relation between the intensity of the lines and the concentration of the element in an alloy. The "raies ultimes" method is not sufficiently sensitive, as the photographic blackening and variations in the electrical conditions have a great influence. The method using an homologous pair of lines is independent, within wide limits, of the electrical conditions and of the photographic plate, and has recently been greatly developed and refined; the comparison of the intensity of the lines of the pair may be made visually, photometrically, or with a logarithmic sector. Examples of this method are given and discussed and its use is extended to the analysis of ternary and complex alloys; the third element has a great influence on the intensity of the lines of the other two elements, but the relative intensities are the same if the relative concentration of the element under determination with respect to the primary substance alone is considered and not its absolute concentration.—G. G.

The Analysis of Red Brass and Brass. Otto Niezoldi (*Z. ges. Giesserei-Praxis: Das Metall*, 1932, 53, 186–187).—Sn and Sb are separated from the alloy by dissolution of the latter in HNO_3, purified by fusion with S and Na_2CO_3, and subsequently separated by the H_2S–$H_2C_2O_4$ method. Details are given for the determination of the different constituents by using a separate portion of the alloy for every individual determination.—J. H. W.

Influence of the Platinum Group Metals on Gold Assays. F. M. Gavrilov (*Gornii Zhurnal* (*Mining Journal*), **1928**, (1), 30–32).—[In Russian.] Pt, together with Ag, is soluble in HNO_3. A necessary condition for this solution of Pt is the presence of considerable quantities of Ag, *i.e.* Ag : (Au + Pt) = 2·5 : 1. After the first digestion with boiling HNO_3, some Pt always remains in the Au core even in the presence of Ag, but after a scant cupellation and digestion, with a Pt content up to 2%, and with a sufficiently high concentration of Ag, the Pt is completely dissolved in HNO_3. With a higher Pt content, part of it remains in the Au even after the second cupellation and can be completely separated only by numerous repetitions of the process.—N. A.

Pneumatic Apparatus for Volumetric Analysis. E. A. Schilov (*Izvestia Ivano-Voznesenskogo Politehnicheskogo Instituta im. M.V. Frunze* (*Bulletin of the Ivano-Voznesensck Polytechnic Institute*), 1928, **11**, 61–73).—[In Russian.] A pneumatic method of delivering a given volume of liquid by means of an elastic membrane, is described; the design of the regulating device and its method of use are given. Experiments with pipettes and burettes of small capacity have shown the advantages of this method in the titration of small volumes.—N. A.

The Estimation of Barium as Chromate. —— Lemarchands and —— Sirot (*Compt. rend.*, 1932, **194**, 1577–1579).—Ba and Sr can be separated quantitatively by precipitation of the Ba with alkali chromate, but the solubility of $BaCrO_4$ in distilled water at 100° C. and in dilute and boiling solutions of KCl must be known. Determination of the mean solubility of $BaCrO_4$ in distilled water at 100° C. gave 11·81 mg./l., equivalent to a concentration of 0·0465 millimols. per 1000 grm. of water. For the solubility of $BaCrO_4$ in KCl solutions the value of K in the formula of Guldberg and Waage, $K = \frac{C.K_2CrO_4.C.BaCl_2}{C.BaCrO_4.C^2.KCl}$, was found to be 1·56–0·955 according to the KCl concentration.—J. H. W.

Determination of Small Quantities of Cadmium in Copper. B. M. Ideltchik (*Sobshenia Leningradskogo Instituta Metallov* (*Communications of the Leningrad Institute of Metals*), **1931**, (10), 65–66).—[In Russian.] The metal (5 grm.) is dissolved in 1 : 1 HNO_3 and the solution evaporated to a syrup, cooled, diluted slightly, treated cautiously with dilute NH_4OH, avoiding an excess, then with 25% KCN solution until decolorized, and saturated with H_2S. The precipitate is collected on a fine double filter, washed with H_2S solution containing a little NH_4OH and KCN until it acquires the colour of CdS, then with H_2S solution containing a little NH_4OH and $CH_3.COOH$ and dissolved in hot HCl (1 : 3). The solution is evaporated to dryness, the residue dissolved in water, and the solution, filtered if necessary, evaporated with 2–3 c.c. of conc. H_2SO_4, until white fumes are copiously evolved; Cd is then estimated electrolytically.—N. A.

The Volumetric Determination of the Lead Ion by the Oxalate Method by Analysis of the Precipitate or of the Solution. N. A. Tananaev and W. S. Kobzarenko (*Ukrainskii Khemichnii Zhurnal* (*J. Chim. Ukraine, Scientific Part*), 1931, **6**, (4), 199–206).—[In Russian.] The technique of the volumetric determination of Pb as PbC_2O_4 has been examined. Although direct titration of the C_2O_4'' in the precipitate gives good results, the quickest and most accurate procedure consists in adding a measured amount of standard $(NH_4)_2C_2O_4$ to the Pb solution, boiling, cooling, diluting to a known volume, and titrating the excess of $(NH_4)_2C_2O_4$ in an aliquot part of the clear solution with 0·1N-$KMnO_4$; the average error is 0·21% and only 1 hr. is required for the analysis. —M. Z.

VI.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

(Continued from p. 445.)

Dilatometric Diagrams. M. Seigle (*Rev. ind. minérale*, **1931**, 117–122; *C. Abs.*, 1931, **25**, 5062).—Chevenard's dilatometer was modified to permit the study of the influence of heating in hydrogen or *in vacuo* of wires and plates 8–10 mm. thick. The shapes of the dilatometric diagrams are discussed. No specific data are given.—S. G.

Rhodium Wire for Laboratory [Electric] Furnaces. Ilja Westermann (*Metallwirtschaft*, 1932, **11**, 152–153).—Constructional data are given for a rhodium wire-wound furnace working up to 1700° C. in an oxidizing atmosphere. At each end of the brittle rhodium wire a platinum terminal is welded, and the wire is then wound on a wax cylinder, which is then coated with a paste consisting of 8 parts of magnesia and 2 parts of alumina. By gentle heating the wax is melted away and the refractory mass containing the wire heating element is dried, and may then be built into a suitable casing. The effective heating chamber in the furnace described is 2·5 cm. in diam. and 10 cm. long.—v. G.

Electrical Method of Thermal Regulation for Tubular Furnaces. P. G. Strelkov (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki* (*Journal of Experimental and Theoretical Physics*), 1931, [A], **1**, (5), 231–242).—[In Russian.] A thermal regulator is described, which incorporates the bridge system of W. P. White, L. H. Adams, and H. H. Roberts, giving an intermittent regulation by means of point contacts. The contact galvanometer is replaced either by a photoelectric device, or by the "objective readings" and "slit" methods. This type of intermittent system is combined with a continuous regulator in the shape of a rheostat. The rider of the rheostat is operated by a mechanism which changes the direction of movement when the contacts of the intermittent regulator are made or broken. When the desired conditions have been attained, a "neutral" gear in the mechanism enables the rider to retain its position, but with an alteration of these conditions its movement is proportional to the alteration. The corrections are effected asymptotically, repeated regulation is avoided, and the amplitude of oscillations which are rectified is very greatly increased. The alteration of temperature during the operation of the furnace is likewise simplified. The regulator has been tested between 400° C. and 800° C., an average constancy of temperature to 0·1° C., and for some periods, of 0·05° C., being attained.—N. A.

A Potentiometric Thermoregulator. Andrei K. Walter and Petr Strelkov (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki* (*Journal of Experimental and Theoretical Physics*), 1931, [A], **1**, (5), 243–244).—[In Russian.] The furnace is run on d.c. A resistance is connected in parallel, the fall in potential across which is regulated by a battery of accumulators. A galvanometer relay is connected with the potentiometer circuit which controls a polar switch connected to a motor actuating the contact of a ballast resistance.—N. A.

On the Rationalization of an X-Ray Installation for Structural Analysis. W. I. Archarov (*Zhurnal Tehnicheskoy Fiziki* (*Journal of Technical Physics*), 1931, [B], **1**, (5), 498–502).—[In Russian.] The installation of a Hadding tube is described, together with a number of auxiliary appliances which are used in the Department of X-ray Metallography of the State Physico-Technical Institute: *e.g.* (1) for setting up the tube on the bench; (2) vacuum pump system; (3) for cooling; (4) electrical layout; (5) control, regeneration, and protection against the radiation.—N. A.

VII.—PHYSICAL AND MECHANICAL TESTING AND RADIOLOGY

(Continued from pp. 446–448.)

Practical Tests on Bearing Metals made of Various Alloys. H. J. Schuth (*Zentral-Europ. Giess.-Zeit.*, 1930, 3, (9), 8–11).—The tests were made with the object of determining whether the cost of bearings could be diminished without endangering the factor of safety. It is stated that considerable economies may be effected if due regard is paid to the proper load applied and to the lubrication. An apparatus is described in which the various alloys may be tested in the form of a bearing whilst keeping other factors reasonably constant. The rise in temperature is taken as a measure of the friction generated, and the definite rules observed in order to obtain concordant results are tabulated. The usefulness of the article is impaired by the fact that the compositions of the various alloys tested are not included.—W. A. C. N.

Destructive and Non-Destructive Tests of Welds. J. R. Dawson and A. B. Kinzel (*Proc. Internat. Acetylene Assoc.*, **1929**, 113–132).—See this *J.*, 1930, **43**, 571.—H. W. G. H.

Testing Machines and their Applications. P. Field Foster (*Machinery* (*Lond.*), 1931, **37**, 729–732; **38**, 174–177, 467–470, 642–644).—A general account is given of the behaviour of metals when subjected to the tensile test, and the construction of the following testing machines and equipment is described and illustrated: (*a*) Denison 30-ton single-lever machine (with Hele-Shaw oil-pump) and autographic recorder; (*b*) Buckton 100-ton horizontal machine with Wicksteed and spring-balanced recorders; (*c*) Amsler pendulum dynamometer type universal machine and mercury-filled calibrating boxes. The inertia effect due to the swing of the beam in lever machines is discussed, and it is pointed out that the effect is generally diminished through lost motion in the lever system.—J. C. C.

20,000-Lb. Vertical Single-Lever Testing Machine. Anon. (*Machinery* (*Lond.*), 1931, **38**, 514–515).—A short description of a testing machine constructed by Greenwood and Batley, Ltd., Leeds.—J. C. C.

An Automatic Autographic Extensometer for Use in Tension Tests of Materials. R. L. Templin (*Amer. Soc. Test. Mat. Preprint*, **1932**, 1–10).—This paper describes an automatic autographic extensometer which has been developed in response to a demand for an inexpensive, accurate method for determining yield-strengths of materials in routine tension tests. The instrument provides a means of obtaining load-strain curves at strain magnifications varying from about 400 to about 16,000. For commercial routine tests magnifications of 400 or 800 are used, and yield-strengths can be obtained with an accuracy comparable to the usual values for ultimate tension strength. A complete description of the extensometer is presented and typical load-strain curves are reproduced. Whilst the instrument has been designed primarily for tension tests, it can also be used for compression tests without modification. —S. G.

"Elasticometer" Spring Testing Machine. Anon. (*Machinery* (*N.Y.*), 1929, **36**, 77).—Brief illustrated description of a machine for testing springs in tension and compression, made by the Coats Machine Tool Co., Inc., New York, U.S.A.—H. F. G.

On the Question of Testing Metals for Hardness. I. P. Prokofiev (*Vestnick Ingenerov* (*Messenger of the Engineers*), **1927**, (4), 145–148).—[In Russian.] Comparative tests with the Rockwell and the Herbert apparatus are described, and curves are given showing the relation between Rockwell, Herbert, Brinell, and Shore hardness numbers.—N. A.

The Determination of the Hardness of Metals by the Method of Rebound. K. M. Yuriev and A. M. Zhukov (*Sobshenia Leningradskogo Instituta Metallov* (*Communications of the Leningrad Institute of Metals*), **1931**, (9), 34–49).—[In Russian.] Y. and Z. show by means of a specially constructed apparatus, provided with a freely falling ball, that for a given metal (iron, brass, zinc, aluminium, lead) the ratio between the height of rebound and the height of drop of the ball is practically a constant. The height of rebound may be taken as a measure of hardness only when the modulus of elasticity of the specimens under investigation is constant or varies only within narrow limits. The relation between the results obtained with a universal and a steel ball is plotted graphically. The purity and mechanical treatment of the specimen under investigation exert an important influence especially in the case of hard metals. If the apparatus is not truly vertical, the height of rebound decreases with the increase in the inclination, this effect being particularly marked in the case of hard metals. In practice, this inclination should not exceed 1°. The effect of repeated impact of the ball on the same spot, and of the material used as base for resting specimens of varied thickness is shown graphically. The effect of the volume of the specimen and of the individual characteristics of the scleroscopes was also studied, and the relation between Shore and Brinell numbers established.—N. A.

The Determination of Hardness by Scratching Standard Plates. J. I. Kanevsky (*Vestnick Ingenerov* (*Messenger of the Engineers*), **1928**, (12), 536–538).—[In Russian.] The scratch method, using a set of specially filed plates graded in Brinell, Rockwell, Vickers, Shore, or any other units, is suggested for rapid hardness measurements.—N. A.

Nomogram for Determining the Hardness of Metals by Means of Poldi-Hütte's Apparatus. B. S. Sosnovsky (*Vestnick Ingenerov i Tehnikov* (*Messenger of the Engineers and Technologists*), **1931**, (7), 331–334).—[In Russian.] The construction of a nomogram for reading Brinell numbers between 50 and 313·3 is described. The differences between the logarithms of the diameters of the impressions made on the specimens and on a standard test-piece are plotted as abscissæ, whilst the Brinell hardness numbers are plotted as ordinates. Different standards of hardness met with in practice are represented by inclined straight lines. The nomogram is constructed on the basis of the equation $\log H_2 = \log H_1 + 2(\log D_1 - \log D_2)$, where H_2 is the hardness of the specimen, H_1 the hardness of the standard, D_1 the diameter of the impression on the standard, and D_2 that of the impression on the specimen.—N. A.

Nomogram for Determining the Hardness of Metals with Poldi's Apparatus (for Cases where the Hardness of the Product is Greater than that of the Standard). B. S. Sosnovsky (*Vestnick Ingenerov i Tehnikov* (*Messenger of the Engineers and Technologists*), **1932**, (2), 83).—[In Russian.] The nomogram for determining hardness in cases where the hardness of the metal under test is greater than that of the standard (cf. preceding abstract).—N. A.

RADIOLOGY

The Examination of Welded Seams by Means of X-Rays. S. T. Nazarov and K. K. Hrenov (*Vestnick Elektropromishlenosti* (*Messenger of the Electrical Industry*), **1931**, (11–12), 519–526).—[In Russian.] General information on the X-ray method of examining welded seams is given, together with the influence on the results of various factors, such as the experience of the welder, quality of the electrodes, and influence of the current. Different specimens welded with the same electrode give similar results which are but little affected by the skill of the welder. Porosity of the weld, given the same electrode metal, largely depends on the composition of the electrode coating. For a sound weld, the use of a d.c. arc is necessary.—N. A.

On X-Rays and their Useful Employment in the Foundry. M. Widemann (*Zentral-Europ. Giess.-Zeit.*, 1930, **3**, (7), 1–4).—A general exposition of the principles involved in the generation and use of X-rays.—W. A. C. N.

VIII.—PYROMETRY

(Continued from p. 370.)

Recording Pyrometer Errors Caused by Humidity. T. R. Harrison (*J. Soc. Automotive Eng.*, 1930, **30**, 100).—Strip charts used in nearly all recording instruments have round perforations along one edge and elongated perforations at the opposite edge to allow for expansion and contraction of the paper as the relative humidity of the atmosphere changes. This expansion and contraction, however, causes errors in reading. Thus if a recorder is correct when the relative humidity is 50%, there will be an error of + 7·6° F. (— 13·5° C.) at 2000° F. (1080° C.) if the relative humidity falls to 15% and an error of — 12·4° F. (— 24·3° C.) if the humidity rises to 85%.—W. P. R.

Principles of Different Pyrometer Systems. Anon. (*Zentral-Europ. Giess.-Zeit.*, 1930, **3**, (5), 11).—In the " Pyro " pyrometer the thermal radiations are focussed on a metal junction, the thermoelectric power of which is measured by a galvanometer. In the " Ardometer " the rays are thrown on to a thermo-element attached to a blackened platinum disc. In the " Pyrradio " total radiation pyrometer for very high temperatures the rays are also concentrated on a similar disc carrying a thermal element. Various types of glowing filament pyrometers—including the " Optix " and the " Pyrophot "—and the newer pocket instrument, the Pyroversum, are also briefly described.
—W. A. C. N.

IX.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Continued from pp. 448–453.)

ELECTRODEPOSITION

Chromium-Plating (Chemical Part). —— Zhigulev and —— Kuznetzov (*Vestnick Elektropromishlenosti* (*Messenger of the Electrical Industry*), **1930**, (12), 525–531).—[In Russian.] The following baths are recommended: (1) 250 grm. chromium trioxide, 2·5 grm. sulphuric acid, and 2·5 grm. boric acid per litre; (2) the sulphuric acid is replaced by 3·2 grm. chromic sulphate. The baths are operated at 45°–50° C. with a current density of 16–20 amp./dm.^{2} for nickel and steel and 25 amp./dm.^{2} for copper and brass. Prior to use the chromium trioxide should be heated gently to remove any nitric acid, and the boric acid must be dissolved separately. Methods for the determination of CrO_3, $Cr^{\cdot\cdot\cdot}$, and SO''_4 are given.—N. A.

Chromium-Plated Gauges. Anon. (*Machinery* (*Lond.*), 1931, **38**, 533–534).—Chromium-plated gauges have been standardized by the Ford Motor Co., and give about 10 times as long service as unplated gauges. The method of manufacture is outlined. About 0·005 in. of chromium is deposited, using lead anodes, and depositing at the rate of about 0·001 in./hr. The anodes must be symmetrically arranged and for ring gauges must extend through the centre hole. During the final grinding, the wheel must not be too hard, otherwise the plate may peel and blister.—J. C. C.

Chromium-Plating Aluminium. Anon. (*Machinery* (*N.Y.*), 1929, **36**, 199).—Brief note of a process said to be used commercially by the Perma-Chrome

Process Corporation, of Cleveland, U.S.A. Aluminium sheet, of scleroscope hardness 7, exhibited, after being chromium plated, a hardness of 16.—H. F. G.

Chromium-Plating and its Occupational Risks. M. Roels (*Rev. trav. Bruxelles,* 1931, **32,** 116–128; *C. Abs.*, 1931, **25,** 5100).—Oxygen and hydrogen are liberated which atomize chromic acid from the bath. The acid damages the mucous membranes and may eat through the cartilaginous septum. Chromic acid sets up on the hand indolent and painful sores called chrome holes.—S. G.

Ultra-Rapid Nickel-Plating in France. Marcel Ballay (*Electrochem. Soc. Preprint,* **1932,** Sept., 59–73).—The recent introduction of chromium plating into France stimulated research in nickel-plating, with a view to the improvements of methods that were slow and confined to non-ferrous articles. At the laboratories of Léon Guillet, in Paris, where the investigations were carried out, results favoured the hot single sulphate bath, operated at high current densities (up to 10 amp./dm.^{2}). From a commercial point of view this bath is far superior to the old cold bath used in France and operated at low current densities. The laboratories also recommended to the French platers the conveyor system for further reduction in operating costs. Details are given of a typical installation near Paris, and emphasis is laid on the nickel-plating of steel articles. In conclusion, the plating of nickel on aluminium and aluminium alloys is reported on, and particular attention is directed to the use of the clear, hot, ferric chloride pickle preliminary to plating. This has been found to be applicable to a wide variety of aluminium alloys and superior to any pickles used heretofore.—S. G.

Nickel Dermatitis. C. Du Bois (*Schweiz. Med. Woch.*, 1931, **21,** 278–280; *C. Abs.*, 1931, **25,** 5100).—Nickel itch resulting from exposure to nickel-plating vapours occurred in 95% of the 370 persons employed. The itch passes into acute dermatitis. The vat solution contained 35% nickel sulphate, 18% magnesium sulphate, and 1–2% sulphuric acid. The plating was carried out at 85° C. Vapours obscured objects more than 3 ft. away. This rarely occurred where nickel-plating is done in the cold. Cases are more frequent in warm weather than in cold. Persons who sweat easily are first attacked. The first attack does not produce immunity, but susceptibility. Lanoline on the skin is a good preventive.—S. G.

The Electro-Deposition of Alloys.—II. L. B. Hunt (*Metallurgist* (Suppt. to *Engineer*), 1932, **8,** 66–68).—Cf. *J.*, this volume, p. 451. A continuation of a review of the work of different investigators. The only generalization on the subject which might tentatively be made is that any increase in cathodic polarization will lead to an increase in the amount of the more electro-negative metal in the deposit. As regards other features of the deposition of alloys, it is not possible to generalize; the contradictory results published suggest that other factors besides the ionic concentrations of the two metals are involved.
—R. G.

Plating Aluminium. Anon. (*Machinery* (*Lond.*), 1931, **38,** 151).—A letter. It is recommended that aluminium articles should, before electro-plating with nickel, be cleaned electrolytically in a 10% solution of sodium carbonate and then dipped for about 30 seconds in a solution maintained at 200°–212° F. (93°–100° C.) containing 1% of hydrochloric acid (sp. gr. 1·18), and 3% of ferrous chloride.—J. C. C.

Thickness of Plating Films. E. C. Larke (*Machinery* (*Lond.*), 1931, **38,** 664–666).—Formulæ are developed for calculating the thickness of plate on a symmetrically shaped section given (*a*) the weight of the sample with and without its plating, or (*b*) the sp. gr. of the plated sample and certain of its dimensions before plating.—J. C. C.

The Application of Electro-Deposited Metals to Engineering. C. H. Faris (*Machinery* (*Lond.*), 1931, **37,** 701–703).—An abstract of a paper read before the Manchester Association of Engineers. See this *J.*, 1931, **47,** 666.—J. C. C.

ELECTRO-REFINING, &c.

The Electrolytic Refining of Copper. Maurice Altmayer (*Cuivre et Laiton*, 1929, **2**, (20), 8–10).—A description of a normal type of electrolytic refining plant. There is nothing specially new, although the account is very full. The multiple system is used. Compositions of anodes, cathodes, and of electrolyte are given.—W. A. C. N.

The Electrolytic Extraction of Copper from Low Grade Materials. Maurice Altmayer (*Cuivre et Laiton*, 1929, **2**, (2), 9–12).—The hydrometallurgical extraction of copper is the most suitable method for the reclaiming of that metal from low-grade materials. The electrolytic deposition of the copper from the liquors yields a copper which is high grade and also a large proportion of the precious metals in the mud. The process is described in detail, and examples are quoted from the practice at various important plants in various parts of the world. This article gives an interesting comparison of the technique in these works.—W. A. C. N.

ELECTROCHEMISTRY—GENERAL

Variations in the Electromotive Force during the Formation of Alloys by the Wet Method. E. Pace (*Gazz. chim. ital.*, 1930, **60**, 811–818; *C. Abs.*, 1931, **25**, 1443).—In connection with studies of Mazzucchelli on the formation of binary metal alloys by the wet method, the phenomenon was examined from the electrochemical point of view. Similar experiments have been carried out by Tammann, but under different conditions and with a different object. The present paper deals with variations in the e.m.f. of the voltaic couple: $\mathrm{A}|\mathrm{A}^+$ solution$|\mathrm{B}$, during the entire transformation in the following systems: copper–tin, copper–antimony, antimony–tin, gold–cadmium, silver–cadmium, gold–tin, and silver–tin. A high initial e.m.f. would be expected because of the difference between the two potentials $\mathrm{A}|\mathrm{A}^+$ solution, and $\mathrm{B}|\mathrm{A}^+$ solution, where the first remains constant throughout and the second is electrochemically indefinite as a result of the nominal absence of B^+ ions and theoretically is infinite. Practically, however, the second has a definite value either because of solution of traces of B (by the action of atmospheric oxygen or by double decomposition with A^+ cations), or, in the case of B electrode, is completely passive, because of the oxidizing potential which it acquires in contact with the solution. The apparatus is described in detail. In the *copper–tin system*, during the formation of $\mathrm{Cu_3Sn}$ (cf. *Ber.*, 1897, **27**, 630) the e.m.f. at 100° C. was initially 0·134, and this rose slowly to a maximum of 0·214. In the *antimony–tin system*, the e.m.f. at ordinary temperature with open circuit varied from 0·31 to 0·33, whilst with a closed circuit it diminished gradually to a minimum value of 0·80 after several hrs., and this again increased to 0·300 when the circuit was opened. In the *gold–cadmium system*, the e.m.f. at ordinary temperature was 0·73 and at 100° C. was 0·77, and this diminished rapidly with the circuit closed until it reached 0·12 after 1 hr. at ordinary temperature and 0·013 after 20 hrs., whilst at 100° C. it diminished to 0·96 after only 15 minutes. In the *silver–cadmium system*, the initial e.m.f. at ordinary temperature was 0·67, and this increased slowly to a maximum of 0·73. With the couple in a closed circuit at ordinary temperature, the e.m.f. diminished slowly from 0·72 to 0·42 after about 30 minutes and reached 0·01 after 2 hrs. In the *gold–tin system* at ordinary temperature, the initial e.m.f. was 0·39 and diminished only to 0·37 after 6 hrs., whilst with the circuit closed it diminished from 0·37 to 0·05 after 20 minutes. When the temperature was increased to 100° C., a closed circuit for only 3 minutes was sufficient to reduce the e.m.f. from 0·36 to 0·06. In the *silver–tin system* at ordinary temperature, the e.m.f. was approximately 0·35, and with the couple in a closed circuit this diminished to 0·01 after only 2 minutes. At 100° C. the behaviour was substantially the same, except that the changes were accelerated.—S. G.

On the Passivity of Chromium.—III. Erich Müller (*Z. physikal. Chem.*, 1932, [A], **159**, 68–80).—In the cathodic activation of chromium in an acid the activation potential is more negative the greater the radius of the anion. The rate of dissolution of activated chromium in *N*-acid solutions is greater the smaller the anion radius. The passivation potential must be more positive the smaller this radius. These observations are explained by a new theory of passivity.—B. Bl.

The Overvoltage of Hydrogen on Alloys. Haakon Flood (*Z. physikal. Chem.*, 1932, [A], **159**, 131–134).—Stranski's theory of crystal growth affords an explanation of the phenomena associated with the overvoltage of hydrogen on alloys.—B. Bl.

X.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 453–455.)

Report of Committee B-2 [of A.S.T.M.] on Non-Ferrous Metals and Alloys. William Campbell and E. E. Thum (*Amer. Soc. Test. Mat. Preprint*, 1932, 1–3).—It is suggested that fire-refined copper should not be used for electrical purposes or in wrought alloys. The specification for fire-refined copper is now:

		%			%
Copper and silver	(min.)	99·7000	Nickel	(max.)	0·1000
Arsenic . .	(max.)	0·1000	Oxygen	(max.)	0·0750
Antimony. .	(max.)	0·0120	Selenium	(max.)	0·0400
Bismuth . .	(max.)	0·0020	Sulphur	(max.)	0·0075
Iron . . .	(max.)	0·0100	Tellurium	(max.)	0·0140
Lead . .	(max.)	0·0100	Tin	(max.)	0·0500

Special high-grade slab zinc for die-castings should contain not more than the following amounts of impurities: lead, 0·010; iron 0·005; cadmium 0·005%; aluminium, nil. The sum of the lead, iron, and cadmium should not exceed 0·010%. Several other investigations in hand are mentioned.
—W. A. C. N.

Report of Committee B-7 [of A.S.T.M.] on Light Metals, Cast and Wrought. J. B. Johnson and J. A. Gann (*Amer. Soc. Test. Mat. Preprint*, 1932, 1–10).—Proposed tentative specifications for aluminium alloy wire, rods, and bars, for magnesium alloy sheet, and for magnesium-base alloy wrought shapes (other than sheet) are given *in extenso*. In the first, rolling and heat-treatment are described. The alloy is to conform to the following limits in composition: copper 3·50–4·50; magnesium 0·2–0·75; manganese 0·4–1·00%; aluminium, a minimum of 92%. Full physical properties required in the various classes are stated, and a table is given showing the tolerances for the different shapes. The second specification covers alloys having a sp. gr. of 1·9 or less and which are in the form of annealed sheet. Alloy 1 should contain aluminium 3·5–6·5, manganese 0·2 (minimum), copper 0·1 (max.), other impurities, 0·3% (max.), magnesium, remainder. Alloy 2 must satisfy the following requirements: manganese 1·2 (minimum), copper 0·05 (max.), other impurities 0·2% (max.), magnesium, remainder. The 2 materials are to have minimum tensile strengths of 33,000 and 28,000 lb./in.^{2}, and minimum elongations (on 2 in.) of 10% and 5%, respectively. The third specification also refers to 2 alloys, similar to those mentioned in the last one, except that the aluminium limits in the first one are 3·5–8·5%. In this instance the minimum tensile strengths are 35,000 and 30,000 lb./in.^{2} and the minimum elongations (on 2 in.) 8% and 4%, respectively. The specification refers to fully-worked metal, *i.e.* material which has been reduced 90% or more in area during mechanical deformation.—W. A. C. N.

The Uses of Aluminium and Magnesium Alloys in Modern Construction. G. Guzzoni (*Metallurgia italiana*, 1931, 23, 177–192; 1146–1161).—(I.) G. gives a general survey of the present status of light and ultra-light alloys. Their mechanical properties are examined and discussed, and a comparison is made with other metallic materials. The importance of elastic limit determination is stressed, and the shapes and patterns most suitable for many important constructions are described, with reference to minimum weight, tenacity, rigidity, &c. (II.) The methods and characteristics of the fusion of the light and ultra-light alloys are described, and the difficulties encountered with the methods to surmount them are discussed. The various other methods of working, rolling, drawing, extrusion, die-pressing, &c., are then described, and useful information is given on cutting and machining. A detailed discussion is also given on joining and welding of aluminium and magnesium alloys.—L. L.

Structural Aluminium. Anon. (*Manchester Guardian*, **1931**, Jan. 8; *Aluminium Broadcast*, 1931, 3, (2), 12–13).—An account of the properties of the aluminium alloys most suited for structural purposes.—J. C. C.

Aluminium Busbars Resist Power Arcs. J. D. Porter (*Elect. World*, 1931, **98**, 104–105; *C. Abs.*, 1931, 25, 5101).—Experiments indicate that the aluminium arc is comparatively unstable and does less damage to the aluminium surface because of the arc's lack of concentration. Illustrations are given of aluminium and copper busbars tested under power arcs.—S. G.

On the Defects of Pistons in Aero Engines. E. A. Chudakov (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1928**, (3), 174–184; (4), 251–256).—[In Russian.] The fundamental defects in aero-engine pistons may be classified as: (1) cavities, fissures, and porosity; (2) cracks; (3) seizing up; (4) burning-out; (5) destruction of the strips separating the ring-grooves; (6) fusing of the rings. (1) is due to faulty casting, (2) to internal strains set up during casting, (3) to the properties of the material (thermal conductivity, mechanical strength, condition of the surface) and irregularities in the functioning of the engine. The other defects are mainly due to inefficient construction.—N. A.

Aluminium and its Alloys in the Construction of Railway and Tramway Rolling Stock and Omnibuses. A. M. Hug (*Aluminium Broadcast*, 1931, 3, (3), 13–17).—Abstract of a paper read at the International Congress of Mines, Metallurgy, and Applied Geology, Liège, 1930.—J. C. C.

Aluminium Containers for the Storage and Transport of Liquid Foodstuffs. H. Buschlinger (*Aluminium Broadcast*, 1931, 3, (4), 12–14).—Abstract of a supplement to *Werksleiter*, 1930, 4, 517. See this *J.*, 1931, 47, 166.—J. C. C.

Aluminium as a Packing Material. Anon. (*Aluminium Broadcast*, 1931, 3, (1), Supplement 1–3).—A review of the advantages of aluminium foil and aluminium sheet metal containers for packing purposes.—J. C. C.

Light Alloys in the Near Future. A. J. Field (*Aluminium Broadcast*, 1930, 2, (49), 3–4).—A review of probable progress in the development and application of aluminium alloys in America.—J. C. C.

The Effect of [Aluminium] Paint on the Efficiency of Radiators. Max Werner (*Aluminium Applications*, 1930, 2, (5)).—Abstracted from *Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1930, 1, 301. See *J.*, this volume, p. 319.—J. C. C.

The Uses of Aluminium. H. Schmitt (*Elektrotech. u. Maschinenbau*, 1932, **50**, 49).—Abstract from *Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1931, 3, 253. See *J.*, this volume, p. 102.—W. P. R.

Metallurgical Uses of Calcium. C. L. Mantell and C. H. Hardy (*Metallurgist* (Suppt. to *Engineer*). 1932, 8, 68–69).—A summary of a paper by M. and H. in *Metal Progress*, 1932, 21, (4), 60–65. See *J.*, this volume, p. 349.—R. G.

Report of Committee B–1 [of A.S.T.M.] on Copper Wire. J. A. Capp (*Amer. Soc. Test. Mat. Preprint*, 1932, 1–9).—Various alterations are suggested in the tentative specifications for round and grooved hard-drawn trolley wire, and for bronze trolley wire. A proposed tentative specification for hard-drawn copper transmission cable is put forward in detail. Details are included to cover purity of raw materials, manufacture, physical properties and tests, electrical properties and tests, permissible variations in dimensions, finishing, and inspection.—W. A. C. N.

Report of Committee B–5 [of A.S.T.M.] on Copper and Copper Alloys, Cast and Wrought. C. H. Mathewson and D. K. Crampton (*Amer. Soc. Test. Mat. Preprint*, 1932, 1–14).—Tentative specifications for copper water tubes are suggested. The tubes are divided into the following 3 classes—for underground services, for general plumbing, and for use with soldered fittings only. The copper should be free from cuprous oxide. When coiled the tubes should be annealed; when sold in straight lengths they should be hard-drawn. The minimum copper content should be 99·9% and the tubes should have the following mechanical properties: annealed—a tensile strength of 30,000 lb./in.^{2}, elongation, 25% on 4 in., and a mean grain size of 0·025–0·075 mm.; hard-drawn—a minimum tensile strength of 98,000 lb./in.^{2}. Hammering, opening, bending, expansion, and hydrostatic tests are defined. Permissible variations in dimensions are specified. The copper allowed by the specification for locomotive fireboxes, stay bolts, and boiler tubes is raised to 99·90% (including silver). Variations in the specifications for different classes of brass and bronze are put forward tentatively.—W. A. C. N.

The Use of Copper in Construction Work in Germany. E. Thom (*Cuivre et Laiton*, 1929, 2, (17), 5–6).—A communication from the German Copper Institute. It is stated that the copper in some of the monuments has lasted remarkably well through several hundred years. Stress is laid on the excellent patina, the general resistance to corrosion, and to the ease of working. —W. A. C. N.

Copper and its Alloys in Antiquity. A. Chaplet (*Cuivre et Laiton*, 1929, 2, (21), 5–7).—An historical survey of the evolution of copper, brass, and bronze instruments and tools, and of the early stages in the metallurgical development of copper. The article is illustrated by drawings from Egyptian records. —W. A. C. N.

Bronze in Antiquity—Mirrors. Vincent Briard (*Cuivre et Laiton*, 1929, 2, (20), 15).—An account of ancient copper and bronze mirrors, from Egyptian times, and also some good specimens produced in the 15th and 16th centuries. —W. A. C. N.

Mirrors. V. Briard (*Cuivre et Laiton*, 1930, 3, (26), 9–11).—Descriptions of mirrors dating back to Phœnician, Roman, and Greek times. Those mentioned particularly are illustrated, and are shown mostly mounted in metallic ornamentation. Silver completely eliminated copper and its alloys as the reflecting medium.—W. A. C. N.

Copper in Musical Instruments. Anon. (*Cuivre et Laiton*, 1929, 2, (21), 8).—With the exception of gold and silver, copper is said to be the only metal employed in the manufacture of musical instruments, because of the high amplitude of its vibrations.—W. A. C. N.

Bank Notes in Copper. V. Briard (*Cuivre et Laiton*, 1929, 2, (22), 17).—A new invention by Schoop, using metallized paper, which, it is said, is non-inflammable, indestructible, and particularly difficult to counterfeit. Many other applications are enumerated.—W. A. C. N.

Report of Committee A–9 [of A.S.T.M.] on Ferro Alloys. N. B. Hoffman and

Charles McKnight (*Amer. Soc. Test. Mat. Preprint*, 1932, 1–16).—Tentative specifications for ferro-tungsten, for low-carbon ferro-molybdenum, for molybdenum salts and compounds, and tentative methods of chemical analysis of ferro-tungsten and ferro-molybdenum are discussed. For ferro-tungsten the analysis should conform to the following :—

		%			%
Tungsten . .		75·00–85·00	Copper . .	(max.)	0·15
Carbon . .	(max.)	0·75	Arsenic . .	(max.)	0·10
Phosphorus .	(max.)	0·06	Antimony .	(max.)	0·08
Sulphur . .	(max.)	0·06	Tin . .	(max.)	0·10
Silicon . .	(max.)	1·00	Arsenic + antimony + tin	(max.)	0·20
Manganese .	(max.)	1·00			

In the case of ferro-molybdenum the analysis should be :—

		%			%
Carbon . .	(max.)	0·25	Sulphur .	(max.)	0·25
Molybdenum . .		55·00–65·00	Phosphorus .	(max.)	0·10
Silicon . .	(max.)	1·50	Copper .	(max.)	0·25

Molybdenum salts should contain molybdenum 30·00–45·00; phosphorus (max.) 0·10; sulphur (max.) 0·25; copper (max.) 0·20%. Detailed methods of analysis are given.—W. A. C. N.

Lithium : Its Production and Use in Germany. R. Mordaunt (*Met. Ind.* (*Lond.*), 1932, **40**, 537–538).—Lithium has applications as a hardener of lead to form a bearing metal, as a hardener of aluminium alloys (*e.g.* Skleron), as a deoxidizing agent for copper the electrical conductivity of which it does not appreciably reduce, for improving the surface properties of copper wire bars, and for refining various metals. The method of extracting lithium from its ores is briefly outlined.—J. H. W.

Mercury Vapour for Heat Transfer. New Mercury-Vapour [Turbine] Units. Anon. (*Fuel Economist*, 1932, **7**, 210).—The use of mercury vapour for purposes of heat transfer and the construction of 2 new mercury-vapour turbines each of 20,000 kw. capacity and employing 250,000 lb. of mercury, are briefly referred to.—J. S. G. T.

Nickel and its Uses in Engineering. W. T. Griffiths (*Mech. World*, 1929, **86**, 562).—Abstract of a lecture to the Junior Institution of Engineers. See this *J.*, 1931, **47**, 671.—F. J.

A 1932 British 35-m.p.h. Boat. Anon. (*Motor Boat*, 1932, **56**, 230–231).—In the new 24-ft. 6-in. 100-H.P. power-engined "Sea King" a feature of the propelling machinery is the driving-shaft of Monel metal. Copper petrol tanks have also replaced steel tanks.—J. W. D.

Tantalum and Columbium. Anon. (*Mineral Ind.*, 1931, **39**, 660).—The manufacture of vacuum tubes, spinnerettes for the rayon industry, and electrolytic devices still consumes considerable quantities of tantalum. Interest is being directed to its use in the chemical industries in view of its remarkable resistance to mineral acids and corrosive gases. Progress has been made in fabricating equipment by welding and in building up composite parts in which a thin coating of tantalum provides resistance to corrosion, whilst a backing of less expensive metal adds mechanical strength. Columbium is now produced in a ductile, pliable form, and wire, sheet, rod, &c., are commercially available. In general, it appears that it can be substituted for tantalum, but as the price is considerably higher and special advantages are lacking, there have been no commercial developments.—E. S. H.

XI.—HEAT-TREATMENT

(Continued from p. 156.)

Aluminium Alloy Airplane Parts Heat-Treated by Immersion Process. J. B. Nealey (*Iron Age*, 1932, 129, 606–607, 628).—See *J.*, this volume, p. 382. —J. H. W.

The Heat-Treatment of Brass. L. Guillet (*Cuivre et Laiton*, 1929, **2**, (16), 7–8).—A general account of the usual heat-treatments for brass and some of the physical properties which result therefrom.—W. A. C. N.

Heat-Treatment of Non-Ferrous Metals. P. Mabb (*Amer. Machinist* (*Eur. Edn.*), 1932, **76**, 163E–164E).—The temperature range and time of annealing for the heat-treatment of copper and copper alloys, nickel–brass, and aluminium and its alloys for various purposes and the resulting hardness in Vicker Pyramid numbers are given.—J. H. W.

XII.—JOINING

(Continued from pp. 383–385.)

Copper Brazing Applications Under Atmospheric Control. H. M. Webber (*Iron Age*, 1932, **129**, 602–604, 670–671; and (summary) *Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 86–87).—See *J.*, this volume, p. 186. Atmospheric control in copper brazing operations prevents oxidation and acts like a flux as a cleaner to the steel surface. The applications and advantages of this process are described.—J. H. W.

Some Practical Notes on Brazing and Soldering with Silver Solders. A. E. (*Machinery*, (*Lond.*), 1930, **37**, 5–7; also (abridged) *Science et Industrie*, 1931, **15**, 34).—The chief advantages of silver solders are the neatness, strength, and permanence of the joints obtained together with resistance to shock, corrosion, and relatively high working temperatures. Where vibration and high temperatures are encountered, as in aircraft, they are used for joining push-rod bushings, thermocouple elements, various brass connections and fittings to oil and fuel pipes, and control wires and cable fittings. The high electrical conductivity of the solder renders it of value in radio and other electrical apparatus. The silver content, melting point (1250°–1600° F.; 677°–871° C.), and approximate strength when used to solder butt joints in 62 : 38 brass are given for 6 grades containing from 5% to 61% of silver. The addition of even 5% of silver to ordinary brazing solders improves the working qualities. The colour and melting point of the solder should be adjusted to suit the metal with which it is used. Cleaning methods are outlined. The usual flux is borax, but for use on stainless steel a mixture of borax and boric acid with zinc chloride solution is recommended, whilst for Monel metal a mixture of equal parts of borax and boric acid moistened with alcohol is satisfactory. The flux should be loosened by dipping the work while still hot in cold water containing a little sulphuric acid. Practical notes are given on the use of the blowpipe flame for silver soldering.—H. F. G.

Granular Aluminium Hard Solder. L. Rostosky (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1932, **4**, 73–74).—Describes the advantages of an aluminium hard solder having a melting range of 500°–540° C.—M. H.

Granulated Hard Brass Solder. Anon. (*Z. ges. Giesserei-Praxis*: *Das Metall*, 1932, **53**, 168).—A note on the composition and properties of granulated hard brass solder.—J. H. W.

The Soldering of Copper Tubes. M. Henriquet (*Cuivre et Laiton*, 1929, **2**, (16), 9–10).—A general discussion of the precautions to be taken in joining tubes of copper and of the methods which are employed in making sound joints.

Special welding rods such as the Canzler, containing phosphorus and silver, and others containing aluminium, manganese, and vanadium as deoxidizers are coming into general use.—W. A. C. N.

Distillation Phenomena in Hard-Soldering with Zinc–Copper Alloys. W. Claus (*Z. ges. Giesserei-Praxis: Das Metall*, 1930, 51, 200).—Abstract of paper read before the Deutsche Gesellschaft für Metallkunde. See *J.*, this volume, p. 53.—J. H. W.

The Welding of Aluminium and its Alloys. M. Magnani and C. Panseri (*Metallurgia italiana*, 1931, **23**, 85–101, and (summary) *Metallurgist* (Suppt. to *Engineer*), 1931, **7**, 60–61).—Various methods used in the welding of light metals, especially for the construction of large tanks and reservoirs for the chemical industry (where the weld is of great importance on account of corrosion) are described. Oxy-acetylene welding and electric arc welding are first examined, and the influence and composition of various fluxes are noted. The composition and nature of numerous soft solders are then examined and discussed, and the strength, corrosion resistance, &c., are outlined. These soft solders may be used only for repairing light metal tanks, &c.; where the corrosion and the mechanical resistance have a certain importance, oxy-acetylene or arc welding or hammer welding must be used.—L. L.

The Electrical Welding of Aluminium Sheet by the Carbon Arc. A. P. Goriatchev and R. R. Syromiatnikov (*Sobshenia Vsesouznogo Instituta Metallov* (*Communications of the Pan Union Institute of Metals*), **1931**, (5–6), 76–79).—[In Russian.] In the welding of aluminium by Benardos' method the current may fluctuate within wide limits (100–180 amp.), with a sheet thickness of 5 mm. The best results are obtained with a flux containing 7·6% of sodium chloride, 65·1% of potassium chloride, and 27·3% of lithium chloride. In welding work-hardened aluminium, fracture occurs at the weld, whilst with annealed aluminium it occurs away from the seam. In both cases, the temporary resistance equals that of annealed aluminium (11·65–10·4 kg./mm.^{2}). The seam is sufficiently flexible to allow complete doubling of the sheet. Seam-hardness is 32·5, whereas that of annealed aluminium is 27·0.—N. A.

The Electric Arc Welding of Aluminium. Michael Zack (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1932, **4**, 75–76).—Z.'s patented method is characterized by the use of 3-phase alternating current, with a carbon electrode for preheating and a second electrode for melting the aluminium welding rod. A special flux is used.—M. H.

Welded Aluminium in Tank Trucks. W. M. Dunlap (*Proc. Internat. Acetylene Assoc.*, **1930**, 175–185).—Transport tanks in all sizes and for many purposes are successfully fabricated by welding in pure aluminium or 1¼% manganese alloy. Cast fittings in 5% silicon alloy are welded on to the wrought material.—H. W. G. H.

Repair of an Aluminium-Lined Pressure Vessel. W. Johag (*Autogene Metallbearbeitung*, 1931, **24**, 355–356).—A description of the repair of a corroded part of the lining by welding in a new piece of aluminium.—H. W. G. H.

Aluminium Jugs. Anon. (*Soudeur Coupeur*, 1932, **11**, (3), 10).—Four jugs for hospital use are illustrated and particulars are given of their fabrication, from 3 mm. aluminium sheet, by oxy-acetylene welding.—H. W. G. H.

Permanence for Roofs. Anon. (*Oxy-Acetylene Tips*, 1931, **10**, 179–182; and *Indust. Gases*, 1931, **12**, 196–199).—A description is given of the application of aluminium to roofing. Skylights, gutters, canopies, flashings, and even complete roofs are fabricated from aluminium and its alloys by acetylene welding. Cast aluminium ornaments can be welded in place.—H. W. G. H.

Autogenous Welding of Copper Applied to the Copper Fire-Box Plates of Locomotives. M. Dreyer (*Cuivre et Laiton*, 1932, **5**, (75), 129–136).—It is stated that whereas in welded work the whole piece, including the joint, expands and contracts as a whole, in riveting this is not the case, and the rivets may be subject to greatly divergent stresses. Illustrations of the older methods of repairing and assembling fire-box plates are shown. They are accompanied by descriptions of the procedures adopted. In order to avoid excessive oxidation during welding owing to the high temperatures employed, the use of Canzler rods, consisting of electrolytic copper containing silver and phosphorus, and occasionally vanadium, is suggested. Precise instructions are given for the regulation of the flame and the preparation of the piece for welding.—W. A. C. N.

The Use of Oxy-Acetylene Welding in the Repair of Copper Fire-Boxes of Locomotive Boilers. L. Saccomani and R. Jerzillo (*J. Amer. Weld. Soc.*, 1932, **11**, 28–30).—Long abstract of original article (published in *Welding J.*, 1931, **26**, 371; 1932, **29**, 11). See *J.*, this volume, p. 383.—H. W. G. H.

Butt-Welding Machine for Thin Copper Wire. Anon. (*Machinery* (*Lond.*), 1931, **37**, 658).—An illustrated description of a butt-welding machine manufactured by British Insulated Cables, Ltd., Prescot, for welding wires down to 0·0124 in. in diam.—J. C. C.

The Welding of Copper with the Oxy-Acetylene Flame. L. C. Percival (*Welding J.*, 1932, **29**, 102–104; and *Indust. Gases*, 1932, **13**, 5–9; also (summary) *Metallurgia*, 1932, **6**, 48).—The advantages of deoxidized copper are explained and instructions for welding are given. Emphasis is laid on the inherently reducing nature of the oxy-acetylene flame and its effect on copper containing oxide. Some applications of copper welding are described.—H. H.

Copper Welding. W. R. Hibbard (*Proc. Internat. Acetylene Assoc.*, **1929**, 147–154).—See this *J.*, 1930, **43**, 653.—H. W. G. H.

Welding German Silvers. Anon. (*Soudure et Oxy-Coupage*, 1932, **9**, 131).—A slightly oxidizing flame must be used to avoid excessive volatilization of zinc. Strips cut from the sheet, and therefore of exactly the same composition, are recommended as filler rods and boric acid as flux.—H. W. G. H.

Welding of Bronze and Brass Alloys. A. R. Lytle (*Proc. Internat. Acetylene Assoc.*, **1928**, 188–197).—See this *J.*, 1929, **41**, 613; **42**, 638; 1930, **43**, 635.
—H. W. G. H.

[Welding of] Non-Ferrous Metals—Aluminium. Anon. (*Welding Eng.*, 1932, **17**, (4), 25–26).—A description of the use of the electric torch, or indirect carbon arc, for welding aluminium.—H. W. G. H.

Contribution to the Knowledge of the Temperature of the Oxy-Acetylene Flame, the Effect of Water Vapour in the Acetylene, and the Consequent Effect on Welding. Helmut Jooss (*Autogene Metallbearbeitung*, 1931, **24**, 241–252, 259–267).—Varying amounts of water vapour are introduced into the acetylene by passing it over water-soaked pumice at different temperatures. The temperatures of the flames produced by these mixtures, together with oxygen, are measured by an optical method and 2 thermo-chemical methods. In the first, the flame is coloured by lithium and its spectrum matched by that of the positive crater of a carbon arc, the brightness of which can be controlled by diaphragms. The black body temperature of the carbon is measured by a radiation pyrometer and the true temperature of the flame calculated from this. In the second method, the temperature is calculated from the equilibrium constants for the reactions $CO + \frac{1}{2}O_2 = CO_2$; $H_2 + \frac{1}{2}O_2 = H_2O$, and $CO_2 + H_2 = CO + H_2O$. Each reaction gives a different result for the temperature. In the third method, the calculation is based on the heat of combustion and the sp. heat of the gas mixtures. Mild steel test-pieces are welded with each of the gas mixtures and are examined mechanically and microscopically. The ignition velocity of the gases is measured and found to decrease slightly with increase in water vapour content. It is concluded that the water vapour has no appreciable effect on the flame temperature, but reduces the strength of the welds when present in large amounts, although no reason for this is evident from the microscopic evidence.—H. W. G. H.

XIII.—WORKING

Continued from pp. 386–388.)

The Rates of Change of Shape During Plastic Deformation and their Relative Magnitudes. L. Weiss (*Z. Metallkunde*, 1932, **24**, 131).—Formulæ are derived for calculating the decrease in height, the displaced volume, and the percentage decrease in height or cross-section per second in the rolling and drawing process.—M. H.

Bimetal Production at the Koltchugin Works. P. A. Nikolsky (*Opyt Predpriatye* (*Experience of Concerns of the Non-Ferrous and Gold Industries*), **1931**, (2), 10–16).—[In Russian.] The experimental development of the production of bimetal (copper and brass with an iron core) at the Koltchugin works on an industrial scale is described. It is shown that by careful cleaning of the iron cores, and regulation of the heating during pouring of the non-ferrous metal and subsequent rolling and drawing of the bimetal bar, a product highly suitable for telephone and telegraph wire is produced.—M. Z.

Possible Lines of Application of Bimetal. N. I. Koravsky (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (11), 1491–1513).—[In Russian.] Owing to the lack of adequate supplies of non-ferrous metals in the U.S.S.R. and the necessity for restricting imports, the introduction of substitutes for non-ferrous metals is essential, and the use of bimetal which has a non-ferrous content of 10–40% should consequently be widely extended. The " Serp and Molot " works in Moscow manufacture bimetal telegraph and telephone wires, the Koltchugin works wire, rods, and sheet-iron covered with copper or brass, the Krasnye Vyborjetz works sheet and strip (good strip has been made with iron coated with aluminium and nickel–brass); and the Voroshilov works tubes (with different coatings inside and out) and rods. The processes of manufacture, composition, properties, and grades of the bimetal wire, rods, sheet, and strip are described in detail. Bimetal wire and rods are used in telegraph, telephone, and electrical transmission lines, light cable transport lines, electric lamps, radio valves, wire belting, and other products which do not require the use of cutting tools for their manufacture. During stamping, cutting, and other working of bimetal sheet the metal must be annealed at about 400°–700° C., owing to the peculiar nature of the hard iron core and soft metal covering. Welding is difficult, as the non-ferrous metal covering tends to burn away, but may be carried out if the weld is subsequently coated (*i.e.* by Schoop's process). Bimetal sheet, in general, may easily be plated (both by hot-dipping and electrolytically) and is capable of taking a high polish, although care must be taken to avoid stripping of the surface metal. Cutting tools cannot be employed for bimetal sheet, unless it is subsequently nickel-plated. Bimetal sheet is somewhat liable to corrosion, especially if the non-ferrous covering has been damaged locally. It is also rougher and of less uniform thickness than non-ferrous sheet, and shows more surface defects. Its chief uses are in the electrical, radio, and optical industries, in the manufacture of medical, surgical, and general laboratory appliances, musical instruments (for this use, uniformity of the covering is essential, as any irregularity damages the purity of tone), domestic utensils and appliances, for replacing fittings of copper and brass sheet in wagon and carriage construction, automobiles, heavy machinery, and shipbuilding. It cannot be used in parts exposed to wear or to the action of corrosive agents. Bimetal tubes are produced by preparing sheet iron cores of the required diameter which are covered with loosely fitting non-ferrous sleeves, the whole being then drawn through dies of the requisite size, so that the non-ferrous sleeves are stretched to fit firmly on to the cores. The grades and mechanical properties of bimetal tubes

are given. Such tubes can be used in electrical apparatus, shipbuilding, furniture, and domestic appliances, and, if double-coated (*i.e.* inside and out), in chemical plant. Bimetal scrap can be recovered by electrolysis, or, in the case of an aluminium covering, can be used as a deoxidizer in metallurgy.
—M. Z.

The Mechanical and Heat-Treatment of Aluminium for Cable Manufacture. M. O. Kornfeld (*Vestnick Elektropromishlenosti* (*Messenger of the Electrical Industry*), **1931**, (5–6), 209–214).—[In Russian.] To obtain aluminium of maximum conductivity the amount of silicon in solid solution must be reduced to a minimum by suitable heat-treatment. The initial electrical conductivity of aluminium does not change within the limits of experimental error, even when the metal is severely work-hardened. During the drawing of aluminium wire, if the cooling is faulty, the temperature may rise to 150° C. in the die, so that to obtain aluminium cables of high strength, efficient cooling both of the wire and of the die is essential. In order to manufacture aluminium cables of high mechanical strength for electrical transmission lines, a rod 16·5 mm. diam. is drawn down to 8·9 mm. diam. (72% work-hardened), then annealed for 1 hr. at 280° C., when the electrical resistance falls from 30·1 ohm mm.^{2}/km. to 28·5 ohm mm.^{2}/km. It is then further drawn down to 2·75 mm. diam., the resulting wire having a sp. resistance of 28·5 ohm mm.^{2}/km. and tensile strength of 17 kg./mm.^{2}.—N. A.

Copper Wire Rolling-Mills. Ch. Bernhoeft (*Z. Metallkunde*, 1932, **24**, 90–93).—B. gives a detailed summary of his own experiences in planning copper wire rolling-mills.—M. H.

The Manufacture of Chemical Sheet Lead. R. S. Russell (*Chem. Eng. and Min. Rev.*, 1931, **23**, 389–391; *C. Abs.*, 1931, **25**, 5125).—The British and the American standard specifications for "chemical lead" are regarded as not quite correct. Maximum limits for any one impurity are: silver 0·002, bismuth 0·005, iron 0·003, antimony 0·004, zinc 0·002, copper 0·001, nickel and cobalt together 0·001%, tin, cadmium, and arsenic traces, and the lead content obtained by difference must be no less than 99·99%. The rolling process is outlined. The fatigue limit of lead determined on the Haigh machine is ± 0·2 ton/in.^{2}, that is, 10,000,000 reversals of a stress of 0·2 ton/in.^{2} will cause failure at ordinary temperatures. At 100° C. the fatigue limit is about 4/5 that at ordinary temperatures, and at 150° C. it is reduced to less than half. The remedy for fatigue failure lies in: (1) eliminating vibration, (2) working at as low a temperature as possible, (3) preventing changes of temperature, and (4) supporting the lead as completely as possible.—S. G.

Variations in Microstructure Inherent in Processes of Manufacturing Extruded and Forged Brass. Ogden B. Malin (*Amer. Inst. Min. Met. Eng. Preprint*, **1932**, Feb., 1–9).—A study was made of the causes of variable machineability in extruded rods and forgings of the same material. Examination was made on material from the forward and rear ends of extruded bar, and on forgings made from similar specimens. Variation in composition between 57 and 60% copper had little effect on the variation in grain size, which was normally coarse at the forward end and fine at the rear end of the bar. Forgings made from the forward end were similarly relatively coarse-grained. The addition of aluminium (0·08–0·16%) assisted in producing accurate forgings and had no other appreciable effect. Factory practice indicated that fine-grained structures are more difficult to machine than coarse structures of the same composition (60 : 40 brass).—R. G.

The Forming of Aluminium.—I. F. V. Hartman and C. M. Craighead (*Metal Stampings*, 1932, **5**, 313–316).—General discussion of the forming and bending properties of sheet aluminium and aluminium alloys.—J. H. W.

Producing 2-Diameter Copper Stays Complete at One Operation on the Butterworth 1½-in. Bar Automatic. Anon. (*Machinery* (*Lond.*), 1930, **36**, 665–666).—Details are given of the production of locomotive firebox stays of from 4½ to 7¾ in. length and from ⅞ to 1 in. and 1¼ to 1⅜ in. diam. at the two ends. Stays 4⅝ in. long and ⅞ in. to 1 in. diam. at the threaded ends are produced in 80 seconds.—H. F. G.

Sheet Brass for Ornamental Work. Anon. (*Met. Ind.* (*Lond.*), 1932, **40**, 635–636).—The requirements of sheet brass to be used for ornamental work. and the method of removing blemishes revealed by roughing prior to polishing are discussed.—J. H. W.

Specialized Deep Drawing in Zinc.—Making a 6-in. Dry Cell Battery Can. E. H. Arnold (*Iron Age*, 1932, **129**, 971).—Zinc is not generally considered amenable to deep-drawing, but this can be successfully effected provided attention is paid to air pressure, the design and machining of the drawing tools, and the construction of the presses in addition to the usual considerations of blanking operations.—J. H. W.

The Graphical Determination of the Blank Size for Conical Cups. A. Alison (*Machinery* (*Lond.*), 1930, **37**, 69–71).—The method, which is described in detail, is based on the equating areas before and after pressing, no allowance being made for variation in thickness during the operation. It is applicable to conical cups with square, or nearly square, corners.—H. F. G.

The Use and Manufacture of Bars, Sections, and Tubes in Brass and Other Alloys by the Extrusion Process. J. E. Newson (*Proc. Cleveland Inst. Eng.*, **1927/28**, (3), 73–106).—A description of the extrusion process deals with the types of alloys suitable for extrusion, the preparation of the billet, and the plant required. An extrusion is described in detail together with the subsequent operations necessary to produce finished bars, tubes, and sections; and the various difficulties encountered, such as variation in size, variation in composition, extrusion defects, and operating difficulties, are fully considered.
—J. W. D.

XIV.—FINISHING

(Continued from p. 388.)

The Schüler Method of Surface Treatment [of Metals]. Anon. (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 39–40).—Notes on methods for colouring iron and steel brown or blue and for nickel-plating without the use of an electric current.—A. R. P.

The Colouring and Oxidation of Precious Metals. —— Rechenberg (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 57–58).—Several recipes are given for solutions in which gold and silver articles may be coloured brown, green, red, black, or various shades of gold.—A. R. P.

Chemical Colouring of Cadmium Deposits. H. Krause (*Chem.-Zeit.*, 1931, **55**, 845–846, 862–864).—A black " oxidized silver " finish on cadmium-plated articles is produced by immersion in a hot solution containing 60 grm./litre of potassium chlorate and 5–8 grm./litre of cupric chloride or in a cold solution containing 60 grm./litre of potassium chlorate, 35–40 grm./litre of cupric nitrate, and sufficient basic copper carbonate to neutralize any free acid. Immersion in a warm solution containing 30 grm./litre of cupric nitrate and 2·5 grm./litre of potassium permanganate yields a similar effect. Brown shades may be obtained by boiling the plated articles for 10–20 minutes in a 16% permanganate solution containing 6–25% of cadmium nitrate; addition of ferric chloride to this solution produces darker brown tones.—A. R. P.

Gold Solutions for Production Work. J. L. Merigold (*Brass World*, 1932, **28**, 95–97).—Nineteen recipes for solutions for depositing gold for various finishes by the salt-water method are given and the method itself is described.
—J. H. W.

Tri-chloroethylene Degreasing of Metal Parts. Hans Hebberling (*Metall-*

waren-Ind. u. Galvano-Tech., 1932, **30**, 111–112).—Apparatus for use in the large-scale removal of grease from metal surfaces by means of trichloroethylene vapour is described.—A. R. P.

The Degreasing and Cleaning of Metal Parts. A. Burg (*Z. ges. Giesserei-Praxis*: *Das Metall*, 1932, **53**, 147–148).—The action of various reagents used for chemically cleaning parts made of various metals and alloys is discussed. —J. H. W.

Alkali Solutions as Metal Cleaners. C. L. Mantell (*Metal Cleaning and Finishing*, 1931, **3**, 641–645; *C. Abs.*, 1931, **25**, 5653).—The relations between p_H, ionization, concentration, and temperature of alkali solutions containing sodium hydroxide, sodium carbonate and ammonia, and combinations of these are outlined. It is shown that such solutions have definite limitations for cleaning purposes, their saponifying action not being as important as is often supposed.—S. G.

Suggestions on Polishing. O. G. Styrie (*Zentral-Europ. Giess.-Zeit.*, 1930, **3**, 9–11).—No definite rules can be laid down which are applicable under all conditions. Gold and silver articles are best polished with iron oxide, nickel with magnesia held in clay base, steel with chromium oxide. The influence of the polishing process on the surface and internal structures is discussed. The effect of various classes of polishing materials is reviewed. Especial consideration is given to the polishing of steel with polishing media having chromium oxide as the base.—W. A. C. N.

Polishing Data. Anon. (*Abrasive Ind.*, 1929, **10**, (11), 35–36; *Ceram. Abs.*, 1930, **9**, 3).—The size of wheels runs generally from 8 to 36 in. diam. The diameters of wheels in inches and revolutions per minute for polishing wheels and buffing wheels are given in the following table :—

Diameter (in.)	Revolutions per minute	
	Polishing wheels	Buffing wheels
8	3700	4000
10	3000	3600
12	2500	3200
14	2200	2900
16	1900	2500
18	1700	2200
20	1500	2000
22	1400	1800
24	1300	1700
26	1200	1550
28	1100	1450
30	1000	1350
32	950	1250
34	900	1200
36	850	1100

Many kinds of polishing wheels are described in detail. Silicon carbide is seldom used as a polishing abrasive, because it is almost impossible to make the glue hold it satisfactorily on a wheel. The grit and grade of abrasive to be used depend entirely on the operation, so no hard and fast rule can be set. —S. G.

Polishing Times. L. E. B. (*Machinery* (*Lond.*), 1930, **37**, 140).—It is difficult to estimate the time required for an operation such as polishing, in which the skill of the individual workman plays a large part. If a curve be plotted showing the times required on a variety of such work as a function of the surface areas of the pieces, the time which will be taken on a piece of a new type may be estimated closely by interpolation.—H. F. G.

XV.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 389–392.)

Chemical and Metallurgical Bases of Metal Melting Methods and their Practical Value in Foundry Technique. Stefan Leeb (*Zentral-Europ. Giess.-Zeit.*, 1931, 4, (5), 1–8).—In the preliminary discussion the terms "oxidation" and "deoxidation" are explained and illustrated in detail. The relative effects of various deoxidants are compared, and the respective heats of formation of their oxides are tabulated. It is stated that a flux cannot exert any great deoxidizing action. A suitable flux should comply with the following conditions—a lower melting point than that of the metal; serves to cover completely the surface of the metal in order to prevent oxidation; has no reactive influence on the crucible material; resists the penetration of sulphur as sulphur dioxide. The principal properties of a deoxidizer should be: (1) its heat of formation must be greater than that of the oxide of the metal to be deoxidized; (2) the oxide form must be insoluble in the metal; (3) the oxide should be lighter than the metal bath; (4) the deoxidizer should have low viscosity; (5) a small excess of the deoxidizer must not interfere with the mechanical properties of the metal; (6) the deoxidizer must be economical in use. A short discussion of oxidizing media for certain purposes follows. Examples which illustrate the uses of the various reagents are quoted and fully explained. The control of composition by analysis is emphasized. Throughout the article the equal importance of the theoretical with the practical aspect of foundry problems is maintained.—W. A. C. N.

How Must Metal Castings be Deoxidized? R. Berger (*Z. ges. Giesserei-Praxis: Das Metall*, 1932, **53**, 144–145).—Practical considerations in the effective deoxidation of molten metal are discussed and a description is given of a plunger for rapidly immersing the deoxidizing agent when it is necessary that the action shall take place quickly.—J. H. W.

Risers and Lost Heads. Karl Grocholl (*Anz. Berg-Hütten-Masch.*, 1932, **54**, (52), 5).—If the surface of a casting is too small to attach risers and lost heads satisfactorily without enlarging the face, the riser or lost head is constricted.—B. Bl.

Comparative Study of the Use of Graphite and Cast-Iron Crucibles in Furnaces for Aluminium Foundries. P. Girod (*Bull. Assoc. Tech. Fonderie*, 1931, **5**, 145–152; *C. Abs.*, 1931, **25**, 5375).—The cause of hard grains in aluminium castings has been investigated, and they are found primarily to be due to faulty fitting of the crucible cover so that fragments may drop into the molten metal. Examination of faults in graphite crucibles shows that they are readily oxidized and cracked from the outside inwards. Hard grains may result from the layer of metal adhering to the insides of the crucible, which on the heating of a new charge may break off and fall into the melt. In addition to their fragility, graphite crucibles have a high heat conductivity and are sensitive to thermal changes and moisture. Iron crucibles are much more satisfactory, but have a tendency to dissolve in the molten aluminium. It is recommended that the interior surface of the crucible be painted before each charge, that the adhering metal film be scraped off every night, and that there be applied a very clear coat by spraying. Iron crucibles also have a tendency to swell, which may to some extent be eliminated by applying a pasty lining.—S. G.

High Quality Light Metal Castings of Secondary or Virgin Metal. H. Röhrig (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1931, **3**, 295–298).—The yield-point, tensile strength, elongation, impact strength, Brinell hardness, endurance shock strength, and endurance bending strength have been determined for chill castings of three typical secondary aluminium alloys containing silicon, iron, copper, manganese, magnesium, nickel, zinc, and tin and of three alloys containing silicon, iron, copper, and zinc prepared from virgin commercial aluminium, pure copper, and zinc. Results show that the yield-point and Brinell hardness are unsuitable for a valuation of both series of alloys; the other properties, especially the dynamic properties, however, show the great superiority of the alloys prepared with virgin metals. This is due to the high content of iron, &c., and non-metallic inclusions of the secondary alloys. High quality light alloys can be prepared only with virgin metal.—M. H.

The Casting of Aluminium. Anon. (*Zentral-Europ. Giess.-Zeit.*, 1930, 3, (9), 11–13).—A general description of the precautions to be taken in melting and casting aluminium.—W. A. C. N.

The Production of Dense Aluminium Castings. Wilhelm Herrmann (*Zentral-Europ. Giess.-Zeit.*, 1931, 4, (10), 11–12).—A review of the various methods which have been suggested from time to time to overcome porosity in aluminium castings. The following are included: use of fluxes; premelting; passing nitrogen gas through the melt; use of chlorides and chlorine gas. In certain zinc–aluminium alloys the volatilization of some of the zinc has a beneficial effect in removing entrapped gases. The use of sulphur, cadmium, tellurium, or selenium additions, which has also been advanced, is not recommended as beneficial.—W. A. C. N.

The Manufacture of Acid-Resisting Bronze. R. Berger (*Z. ges. Giesserei-Praxis*: *Das Metall*, 1932, 53, 184–185).—An alloy which is very resistant to hydrochloric and sulphurous acids, ammonia, caustic potash, sodium sulphate, and soda solutions consists of copper 83·9, tin 8, lead 6, nickel 2, and phosphorus 0·1%. The method of preparing, melting, and casting this alloy is described in some detail.—J. H. W.

The Melting and Casting of Magnesium Alloys. R. Thews (*Z. ges. Giesserei-Praxis*: *Das Metall*, 1932, 53, 165–167).—Owing to the low oxidation temperature (650° C.) and ignition point (675° C.) of magnesium, special precautions are required in melting this metal and its alloys. Since magnesium reacts with silica, siliceous refractories cannot be employed; neither are graphite or clay crucibles suitable. Only cast-iron or steel crucibles are available. Temperature regulation is important. An alloy, for example, may be melted at 730°–750° C., have the temperature raised to 825° C. for a short time for refining purposes and then lowered to 680°–780° C. A useful (English) flux consists of anhydrous magnesium chloride 68, potassium chloride 24·5, sodium fluoride 4·5, and potassium fluoride 3%, which reduces the melting loss to 1–1½%. Green-sand moulds consist of sand used for aluminium casting mixed with 3–10% sulphur and 0·35–0·75% boric acid. Further details of moulding and casting and the precautions to be taken against fire and explosions are given. —J. H. W.

Researches on the Production of Elektron Metal. S. M. Voronov, A. F. Belov, and M. E. Levitch (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), 1931, (7), 436–451; (8–9), 512–532).—[In Russian.] The melting, casting, and mechanical treatment of Elektron are described. The fluxes used in melting consist essentially of magnesium, potassium, and sodium chlorides with small quantities of the alkali and alkaline-earth fluorides. When the charge consists of new metal and heavy scrap, the German method (addition of scrap after fusion of the metal) shows every advantage, in that it results in a low consumption of flux and prevents the flux entering the mould during pouring. During the melting operation overheating to 800° C., which tends to give a purer metal, and dusting of the stream of molten metal with flowers of sulphur are indispensable. For rolling, both the metal and the rollers must be heated to 300°–350° C. Heat-treatment is directed mainly towards overcoming word-hardening and gives greater plasticity to the deformed metal.—N. A.

A Suction Apparatus for Removing Noxious Gases in Casting Elektron. A. A. Maurach (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1931**, (8–9), 592–594).—[In Russian.] The apparatus employed in the casting laboratory of the N.A.M.I. (Nautchno Avto-Motornye Institut, Scientific Automotive Institute) for sucking out through a grating in the floor, the heavy SO_2 formed during the casting of Elektron metal, is described.—N. A.

Melting of Nickel–Chromium Alloys by the Use of Hydrogen Gas. Friedrich Ritter (*Zentral-Europ. Giess.-Zeit.*, 1931, **4**, (11/12), 1–2).—Whereas in certain circumstances the presence of reducing gases, apart from diminishing the amount of oxides, may be non-beneficial, the use of hydrogen is advocated for some nickel–chromium alloys. Excess hydrogen is removed by the passage of nitrogen immediately before the metal is cast. Reference is made to the work of Smithells, Williams, and Grimwood.—W. A. C. N.

Experiences in the Casting of Rich Lead-Free Bearing Metals by Means of Injection Method. Anon. (*Zentral-Europ. Giess.-Zeit.*, 1931, **4**, (6), 7–8).—A full description of the method of casting bearings. Emphasis is laid on the necessity of using the best quality of metal. It is essential that the tinning of the surface be done efficiently, otherwise adherence is not assured. Finally the white metal is forced into place under the influence of compressed air. Ducts must be left in order to allow the excess air to escape.
—W. A. C. N.

Devices for Babbitting Bearings. J. Dwight Lloyd (*Machinery* (*N.Y.*), 1931, **37**, 346).—Descriptions are given of a gauge for checking bearing wear, a jig for Babbitting bearings, 2 devices for lining removable shells, and a mould for use in Babbitting a bearing with the shaft in place.—J. C. C.

Bronze Pressure Castings. J. E. Crown (*Met. Ind.* (*Lond.*), 1931, **39**, 127–128; and *Foundry*, 1931, **12**, (12), 39–40).—Abstracts of a paper read before the American Foundrymen's Association. See *J.*, this volume, p. 123.
—J. H. W.

From Die-Casting Practice. K. W. Peredelsky (*Liteinoe Delo* (*Foundry Practice*), **1931**, (11–12), 17–18).—[In Russian.] The optimum physical properties in die-castings are obtained under the following conditions: low temperature of the alloy during pouring, the lowest possible temperature of the moulds, correct pressure, rapidity of removal of the casting out of the mould, and a suitable design of the channels for introducing the melt and removing air.—N. A.

Design of Automatic Die-Casting Dies. Charles O. Herb (*Machinery* (*Lond.*), 1930, **37**, 41–44, 105–107, 233–236).—Details are given of the dies used for producing simultaneously 18 small lead cylindrical die-castings, $\frac{5}{8}$ in. long and $1\frac{1}{8}$ in. in diam.; a pressure of 225–250 lb./in.^{2} is used. The dies are fitted with slides which automatically shear off all surplus sprue metal. The rate of production is 100 pieces per minute. Another die described has 136 moving cores, and is used for casting accumulator plates. Details are given also of dies for producing various small zinc components, and throttle valve bodies.—H. F. G.

The Position of Die-Casting. Anon. (*Machinery* (*Lond.*), 1930, **37**, 104).—Brief note of modern developments, notably the use of air at high pressure and automatic methods. Aluminium alloy (copper 7·5, silicon 3·25%) gear boxes weighing 52 lb. are die-cast in 12 minutes, compared with 3·75 hrs. required for sand-mould casting.—H. F. G.

Madison-Kipp Large-Capacity Die-Casting Machine. Anon. (*Machinery* (*Lond.*), 1931, **37**, 553–554).—An illustrated description of a 12 in. × 16 in. die-casting machine, provided with complete automatic control.—J. C. C.

Moulding a Ship's Propeller. Anon. (*Met. Ind.* (*Lond.*), 1932, **40**, 441–442, 448).—Abstract from *Z. ges. Giesserei-Praxis*: *Der Modellbau*, 1932, **53**, 88–90, 108–110. See *J.*, this volume, p. 391.—J. H. W.

Modern Machine Moulding Practice. F. H. (*Machinery* (*Lond.*), 1930, 37, 129–134, 193–198).—An account is given of the advantages of machine moulding, the procedure, the design of moulding boxes, and of many types of machine actually in use.—H. F. G.

Modern Machine Moulding Practice. F. H. (*Machinery* (*Lond.*), 1931, 37, 569–573).—Illustrated descriptions are given of a number of typical jolt-squeezing machines (in which the jolting acts on the sand from the bottom and the pressing from the top) and simple jolting machines (both " plain," which transmit the shocks to the ground, and " shockless," which keep the shocks within the machine).—J. C. C.

Electro-Magnetic Moulding Machine. Anon. (*Machinery* (*Lond.*), 1931, 37, 656–658).—An illustrated description of a 4-in. stroke power-squeeze type of moulding machine operated through a solenoid, marketed by Pneulec, Ltd., Birmingham.—J. C. C.

Report of A.F.A. Committee on Moulding Sand Research. H. Ries (*Trans. Bull. Amer. Found. Assoc.*, 1931, 2, (12), 541–567; discussion, 567–568).—A general report on the work of the Committee for the year 1931. Details of laboratory core-baking ovens and of grips for breaking tensile test specimens of cores and refractory materials generally have been worked out. The use of distilled water in the determination of the clay in sands is recommended. In the testing of bonding clays a standard sand should be used—4% when testing bentonite and 12% when using other clays to be added in the mixture. The water content of mixtures is to be 1–4%. The optimum water content may not represent the best working condition. The sand and clay are mixed dry for 3 minutes, then mulled for 5 minutes, and finally mulled wet for 5 minutes. About 0·25% excess moisture should be added. Allow the mixture to stand 24 hrs. in sealed jars; then pass it through a $\frac{1}{4}$-in. sieve and return to the jars. Moisture is determined and triplicate tests are run for green compression, green permeability, and green tension. 3 cores are rammed for the baked compression test and 3 for the baked permeability test. They are baked for 2 hrs. at 150° C. and then cooled in a desiccator. A series of foundry terms with their definitions is given. The Tyler graphic method and a calculative method of grading sands have been compared. The latter is recommended and the relative reliability of the two variations is now being considered. In the discussion it is mentioned that highly mineralized waters may saponify the oil in cores and thus destroy its bonding properties. In compression tests it is recommended that the load be applied at the rate of about 30 lb. per minute.
—W. A. C. N.

Foundry Sand Preparation. Anon. (*Iron and Steel Ind.*, 1932, 5, 341–343).—A description of a sand preparation plant installed in a foundry, consisting of two 8-ft. diam. mills capable of dealing with 20 tons per hr. The mills are of special design in order to cope with differences in sand mixtures, and to adjust satisfactory milling of the sand with proper mixing. After screening, old sand is treated on a belt type of magnetic separator to remove wires, sprigs, &c., before passing to the mills. It is claimed that the plant is economical to operate and gives a large saving in new sand.—J. W. D.

Study of Moulding Sands. L. Gasquard (*Fonderie mod.*, 1932, 26, 95–104).—Abstract of a paper read before the Association Amicale et Mutuelle de Fonderie. Describes investigations into the structure of moulding sands, the application of this study to the regeneration of old sand, and the physico-mechanical separation of clay, sand, and colloidal material in moulding sands.—J. H. W.

The Relation Between Shape of Grain and Structure of Sand. H. Ries and H. V. Lee (*Found. Trade J.*, 1932, 46, 220).—Abstract of a paper read at the 1931 Convention of the American Foundrymen's Association. See *J.*, this volume, p. 268.—J. H. W.

Some Experiences in Sand Control. E. F. Wilson (*Refract. J.*, 1929, **5**, 29–30).—Abstract of a paper read before the American Foundrymen's Association. See this *J.*, 1929, **41**, 651; **42**, 669.—J. H. W.

Foundry Sand Control. A. A. Grubb (*Trans. Bull. Amer. Found. Assoc.*, 1931, **2**, (11), 8–17).—Intelligent and systematic testing of foundry sand is advocated. Four distinct problems are to be met—the observation of the properties of the sand most satisfactory for the castings that are being made and for the equipment that is available; the recording of changes in the sand heaps by frequent tests; obtaining new sands of known properties to replenish the heaps; properly incorporating, according to predetermined tests, the additions which become necessary. Many variables are involved in the determination of sand characteristics, and definite conclusions are usually possible only after the expiration of long periods of trial. Permeability and moisture tests are most widely used for foundry control. Green and dry strength tests are also employed. Both upper and lower limits on bond strength values are advisable. In large plants regular hourly examinations are recommended. Clay content and fineness of the sand are the most widely used tests for controlling and purchasing of new supplies. Refractory properties are most often measured by fusion or sintering tests.—W. A. C. N.

A Heavy Sand Slinging Machine. Anon. (*Met. Ind.* (*Lond.*), 1932, **40**, 571). —A brief description is given of a heavy sand slinging machine in which sand is fed into a hopper at the base and lifted by a short continuous bucket elevator to a higher level, discharging into chutes, down which it descends to the ramming head, whence it is forcibly thrown into the mould. The advantages of these machines are uniformity of product and big reduction of labour. —J. H. W.

Electrical Drying in the Foundry. Anon. (*Zentral-Europ. Giess.-Zeit.*, 1931, **4**, (11/12), 2–3).—A summary of the investigations undertaken by the Berlin Electricity Company. The results are considered satisfactory. Special arrangements were made to remove the moisture from drying cores by a current of air. A comparison is made with a coke-fired oven.—W. A. C. N.

XVI.—FURNACES AND FUELS

(Continued from pp. 392–395.)

FURNACES

Industrial Furnace. F. Johnstone Taylor (*Iron and Steel Ind.*, 1932, **5**, 269–272, and 276).—Recent developments in the gas firing of industrial furnaces are considered ranging from small portable equipment fired with town's gas to large reheating and annealing furnaces supplied with producer or other cheap gas from a central plant or utilizing blast-furnace gas. Various types of furnaces are described, including self-contained type consisting of producer and furnace for small plants, continuous push type furnaces for annealing, and reheating furnaces with pressure burners.—J. W. D.

Immersion Melting with Gas. E. B. Dunkak (*Metal Progress*, 1932, **21**, (3), 73–77).—The development of alloys resistant to high-temperature corrosion has rendered possible the melting and heating of metals, salts, and liquids from a heating unit placed within the container. The application of gas-fired units to this work is claimed to give 35% fuel economy, precise control, uniform heat distribution, longer life of containers, reduced dross formation, and improved working conditions. Detailed applications are given and illustrated, and the limitations of the method are discussed.—P. M. C. R.

A New Single-Point Control Gas Furnace. The "Novopress" Furnace. Anon. (*Gas World* (*Indust. Gas Suppt.*), 1932, **4**, (4), 16).—A type of gas-fired furnace, characterized by control of gas, air, and damper being effected by movement of a single hand-wheel, is briefly described.—J. S. G. T.

Kathner Normalizing Furnaces. C. P. Mills (*Proc. Eng. Soc. Western Pennsylvania*, 1928, 44, 305–329).—The Kathner normalizing furnace is described. Important points are the sectional construction, with allowance for expansion, the interchangeable sets of easily controlled burners for either oil or natural gas, and the insistence on thorough insulation in the heating zone, whilst in the cooling zone heat storage is avoided, as causing grain-growth. Conveying mechanism, methods of access, and temperature control are described, and economical running, uniform heating, small fuel and water consumption, and uniformity of product are claimed.—P. M. C. R.

Metal Melting Furnaces (Without Crucibles) Fired with Coal Dust. O. Beckmann (*Metallwirtschaft*, 1932, 11, 154–155).—Furnaces to melt 1000 kg. charges at temperatures up to 1200° C. are described; they are fired with a brown coal-dust–compressed air flame entering the furnace through a tangential tuyère in such a way that the flame forms a 3–4 coil spiral inside the furnace. The air is preheated to 400°–500° C. in a recuperator. In melting red brass in a 500-kg. furnace the fuel consumption is 7·5 kg. of coal dust per 100 kg. of brass for heating and 15 kg. for melting. The charge reaches the melting point in 30 minutes and is completely molten in a further 50 minutes. —v. G.

Combustion Chamber and Furnace Design. Anon. (*Fuel Economist*, 1932, 7, 271–276).—The principles of design of furnace settings, the effect of steam boiler design on furnace design, the use and purpose of furnace arches, the air factor in stoking practice, furnace design in relation to pulverized fuel burners and ash are briefly discussed.—J. S. G. T.

Developments in Electric Furnaces. C. R. Copp (*Fuels and Furnaces*, 1932, **10**, 59–64, 78).—An illustrated description of some modern furnaces for annealing copper coils and for heat-treating aluminium sheets.—A. R. P.

On the Calculations of Electric Resistance Furnaces. R. Levi (*Metallurgia italiana*, 1931, 23, (4), 292–302).—The general laws for the rational construction of electrically heated furnaces are enumerated and discussed. In particular some rules for the calculation of the power necessary to heat the furnaces to, and to maintain them at given temperatures, are fully discussed. All the possible cases are analyzed.—L. L.

An Electric Furnace Installation in France. E. Fr. Russ (*Metallwirtschaft*, 1932, **11**, 151–152).—The installation comprises 10 induction furnaces of 185 kva. each, using alternating current at 50 periods and having a capacity of 600 kg. Current consumption for 63 : 37 brass is 170 kw.-hr./ton and for bronze 200 kw.-hr./ton.—v. G.

A Material and Heat Balance of an Ajax–Wyatt Furnace No. 2 for Melting Muntz Metal. —— Kotcharovsky, —— Klein, —— Rubinstein, —— Fomin, —— Chanojian, and —— Tzenter (*Metallurg* (*The Metallurgist*), 1931, **6**, (5), 601–609).—[In Russian.] Tables are given showing the composition of the materials used (new metal, scrap, &c.) in the production of Muntz metal (copper 58·75, zinc 40, lead 1·25%) and the products obtained from the furnace. The heat available is calculated from the electrical data and amount of carbon consumed and the proportions usefully employed and wasted are investigated in detail. The possibility of improving the current efficiency by determining the electrical coeff. of efficient operation is also examined.—M. Z.

Some Metallurgical Characteristics of Induction Furnaces as Determined by the Absorption of Oxygen by Molten Nickel. F. R. Hensel and J. A. Scott (*Amer. Inst. Min. Met. Eng. Preprint*, 1932, Feb., 1–15).—The solubility of oxygen in nickel was first determined by melting nickel in an induction furnace, adding excess of NiO, and removing the metal to a ladle for deoxidation with aluminium. The oxygen content was calculated from determinations of

Al_2O_3 on the nickel, as varying from 0·294% at 1465° C. to 0·526% at 1650° C. An electrolytic method for determining Al_2O_3 in nickel is described. A tentative nickel–oxygen phase diagram is given. The effect of varying degrees of turbulence on absorption of oxygen by nickel melted in a 5000-cycle and a 60-cycle furnace was determined by sampling the bath. In the 60-cycle furnace the oxygen content was low during melting down, and reached saturation within an hour of complete melting. In the 5000-cycle furnace, where the turbulence is relatively slight, the absorption of oxygen occurred at only one third of the rate in the 60-cycle furnace. Melting under an oxygen-free atmosphere prevented oxidation in both types of furnace and provided the most satisfactory means of control.—R. G.

The Birlec Continuous Conveyor Furnace. Anon. (*Machinery* (*Lond.*), 1931, **37**, 658–659).—A continuous cast-link conveyor furnace made by Birmingham Electric Furnaces, Ltd., is illustrated and briefly described.—J. C. C.

Plant for the Heat-Treatment of Koltchugalumin at Aviation Works. S. S. Chetverikov (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1929**, (5), 328–332).—[In Russian.] Description of furnaces employed in U.S.S.R. for the heat-treatment of Koltchugalumin.—N. A.

Heat-Treating and Annealing Non-Ferrous Metals. A. H. Vaughan (*Fuels and Furnaces*, 1931, **9**, 939–941).—Cf. this *J.*, 1931, **47**, 47. Various types of electric furnace for the heat-treatment of brass, copper, nickel, nickel alloys, and aluminium alloys are briefly described.—A. R. P.

Electrical Annealing Furnaces in the Metal Working Industries. Alfred Schau (*Zentral-Europ. Giess.-Zeit.*, 1931, **4**, (6), 1–7).—See this *J.*, 1931, **47**, 410.—W. A. C. N.

FUELS

Industrial Heating Processes. C. Foster Clark (*Amer. Gas J.*, 1932, **136**, (5), 25–27).—The advantages of gas over oil and electricity in industrial heating processes, including stereotype metal melting, carburizing, annealing, japanning, and case-hardening, are briefly discussed.—J. S. G. T.

Experiments with Town Gas in a Modern Tin-Plate Works. W. Clark Jackson (*Gas World* (*Indust. Gas Suppt.*), 1932, **4**, (5), 11–15).—The application of town-gas firing to tin-melting, annealing, and normalizing in tin-plate works is discussed with illustrations and economics of the process derived from experience at the works of Messrs. Baldwin, Swansea.—J. S. G. T.

Advantages of [Town] Gas in the Motor-Cycle Industry. W. Hind (*Gas World* (*Indust. Gas Suppt.*), 1932, **4**, (4), 12–14).—The use of towns gas for brazing, degreasing, rust-proofing, enamelling, normalizing, and carburizing operations in the motor-cycle industry is briefly described and illustrated.
—J. S. G. T.

Recent Developments in Gas Burners. W. Trinks (*Blast-Fur. and Steel Plant*, 1932, **20**, 274–279, 352–354, 436–438).—The induction and luminous flame types of burner are analyzed mathematically and practical examples given of the application of the theories. The causes of back-firing in a venturi or diverging tube are explained. Two-stage and multi-jet induction types of burners are dealt with. It is stated that the multi-jet type of inspirator burner will probably come into commercial use.—R. Gr.

Report of Committee D-5 on Coal and Coke. A. C. Fieldner, H. C. Porter, and W. A. Selvig (*Amer. Soc. Test. Mat. Preprint*, **1932**, 1–12).—Agglutinating values are expressed in kilograms pressure required to crush the buttons obtained by carbonizing mixtures of Ottawa sand in definite proportions with finely ground coal at 950° C. for 20 minutes, in an electric furnace. Coke is defined as " the infusible cellular coherent solid material obtained as a residue by the destructive distillation of certain organic materials, whereby the physical

structure results from the decomposition and hardening of a fused or liquid mass." A proposed method of sampling coke for analysis is published tentatively. Owing to the generally more uniform character of coke than coal smaller gross samples of the former are permitted. Sampling should be done during loading or unloading. Surface samples are unreliable in the majority of instances; where they cannot be avoided, they should be taken at regular intervals from points about 1 ft. below the top. Minimum weights for gross samples of coke are given, *e.g.* 500 lb. for coke where more than 10% remains on a ¼-in sieve; 250 lb. for coke, not less than 90% of which passes a ¼-in ring; 125 lb. for coke breeze. The samples are progressively crushed and subdivided according to a stated schedule. A 50-lb. moisture sample to be dried to constant weight at a temperature not less than 104° C. and not more than 200° C. is recommended. A Ball mill method of sampling coal is described. After air drying the coal is finely ground in an air-tight ball mill. Total moisture is computed from the air-drying loss and the residual moisture in the sample prepared for analysis. An explanation is given of the methods of calculation of the various factors on "as-received" and "dry coal" bases.
—W. A. C. N.

Solid and Gaseous Fuels in the Iron and Steel Industry. Harald Nielsen (*Fuel Economist*, 1932, 7, 279–285).—The possibility of reducing costs in the iron and steel industry by using and upgrading low-grade fuel is discussed. The scheme outlined comprises coal-handling and drying plant, a low-temperature distillation retort, screening plant, pulverizing equipment and centralized gas producers. A flow sheet showing powdered fuel, producer gas, and crude oil is given, and analyses of coal gas, producer gas, and costs are discussed.
—J. S. G. T.

XVII.—REFRACTORIES AND FURNACE MATERIALS

(Continued from pp. 395–398.)

Report of Committee C–8 [of A.S.T.M.] on Refractories. G. A. Bole and C. E. Bales (*Amer. Soc. Test. Mat. Preprint*, 1932, 1–8).—The principal part of this report is the proposed tentative method of testing particle size of ground refractory materials. The object is to maintain uniformity in the manufacturing process, in development work, and in the purchase or sale of certain finished products. Samples at least 500 grm. in weight are necessary. In the dry sieve analysis the material is heated to 120° C. for 2 hrs. Sieving may be done by hand or by machine, and instructions for performing this operation are given. In wet sieving for material containing more than 5% of water, 100 grm. are washed into a 500-c.c. container and water is added to form a slurry, after which the mixture is allowed to stand for 1 hr. It is then transferred to the finest sieve and washed until the water going through shows no traces of particles. The sieve containing the sample is then heated to 130° C. for 2 hrs., the sample afterwards weighed, and then carried through the ordinary dry sieving operation.—W. A. C. N.

Advances in Refractory Field in U.S.A. in Year 1931. W. Steger (*Feuerfest*, 1932, 8, (2), 17–21; (3), 37–42).—A review.—v. G.

Impervious Crucibles of Magnesium Oxide. Paul S. Roller and David Rittenberg (*Indust. and Eng. Chem.*, 1932, 24, 436–440).—The preparation of magnesium oxide refractory crucibles which are recrystallized to translucence and impervious to air under pressure at room temperature is described. The moistened refractory powder is pressed in 2 stages in a steel mould (which is illustrated) in such a way that the base is welded on to the walls, a structure of uniform density and strength being obtained. The crucibles are fired in the high-frequency induction furnace, using a graphite inductor at about 2600° C. The methods of arranging the furnace for the firing are illustrated and described. Significant variables are the relative pressures in forming the base and walls, the duration of firing above 1800° C., and the degree of fineness of the powder, the latter being passed through a 200-mesh sieve. A C.P. magnesium oxide gave a better recrystallized crucible than a high-grade fused periclase powder. The dense structure of the crucibles gave them better resistance to slag attack than porous crucibles.—F. J.

Properties and Tests of Refractories Used in Metallurgy. P. Gilard (*Rev. mat. constr. trav. pub.*, 1929, (241), 213–217B; *Ceram. Abs.*, 1930, 9, 40).—Various properties and tests are presented. The refractories may be arranged as follows in the order of increasing thermal expansion (0°–900° C.): calcined bauxite, clay, chromite, magnesite, and silica.—S. G.

Refractory Formers for Electric Heating Elements. P. Cooper (*Trans. Ceram. Soc.*, 1929, 28, 333–337; *Ceram. Abs.*, 1930, 9, 283).—The chief qualities of a first-class refractory former for electric heating are: (1) good thermal strength; (2) reasonable mechanical strength; (3) sufficient electrical resistance at maximum running temperatures; (4) negligible variation in size; (5) material such as will enable production to be carried out easily and cheaply; and in some cases, (6) colour according to demand. It is desirable that the materials and mixtures used should have in service a low coeff. of expansion, particularly as, owing to design, many articles are very fragile. The mechanical strength is important so that the made article will stand up to reasonable treatment while being handled, not only in the factory, but also in the assembling with metal work. For refractory elements of the types under discussion the voltage used is not high, but the pressure is quite sufficient to cause serious leakage of current and short circuiting if the refractory is not a reasonably good electrical insulator at the maximum temperature employed. The low resistance sometimes experienced may be brought about by another factor—the occurrence of a green coating on the refractory. This green deposit has given serious trouble, and its cause has been the subject of considerable investigation. The presence of some alkalis (sodium in particular) in or on the refractory is extremely detrimental to the nickel–chrome wire used in the element. From the samples discussed, it will be seen that all refractory formers cannot be made from one formula. The necessity of almost continual adjustment or mixture of bodies is due to variation in design, size, electrical loading, colour, and different processes of manufacture. The results of many tests have shown that to produce satisfactory articles the same care must be exercised and the same precautions taken with the materials as when making the highest-class ceramic porcelains.—S. G.

Graphite.—Its Winning and Use in the Metallurgical Industry. Karl Dopf (*Zentral.-Europ. Giess.-Zeit.*, 1931, 4, (11/12), 8–10).—It is not definitely established what geological or chemical processes have contributed to the formation of this mineral—the two principal theories are that it is the product of vulcanism and that it has resulted from the decomposition of carbon dioxide at low temperatures with the intermediate formation of iron and manganese carbonyls. Another theory postulates the transitory production of titanium–cyanogen compounds. The first graphite deposits were found in Borrowdale in 1564. Other deposits have since been discovered in many other countries. Graphite to be used in crucible manufacture must be free from sulphur and low in ash content.—W. A. C. N.

Refractories for Work at High Temperatures. Eugen Ryschkewitzch (*Chem. and Met. Eng.*, 1932, 39, 85).—Unlike clay, the refractory oxides are not markedly plastic in themselves, but have to be subjected to a suitable preliminary treatment, which consists of choosing the right size of grain, proper addition of electrolyte, admixture of protective colloid, favourable hydrogen-ion concentration, and so on. The Deutsche Gold-und-Silber Scheideanstalt, Frankfurt, has worked systematically to increase the availability and applicability of such oxides. The properties of the following commercial refractories are discussed, viz. zirconium silicate, pure alumina, spinel ($MgO.SiO_2$), beryllium oxide, zirconium oxide, magnesium oxide, and thorium oxide. A high-temperature gas-fired furnace was developed to test the applicability of these materials; the principle of its construction is briefly outlined.—F. J.

Modern Viewpoints on Heat-Resistant Brick and its Applications. Gunnar Hult (*Tekniska Foreningens i Finland Forhandlingar*, 1931, **51**, 45–53, 79–85, 117–120; *C. Abs.*, 1931, **25**, 5530).—The important characteristics to be considered in heat-resistant brick are: the melting point, or softening point, resistance to attack by the material treated, low coeff. of expansion, ability to stand temperature changes, and permanence of shape on drying after erection of furnace. The discussion is illustrated with examples from Finnish practice. —S. G.

Heat-Resisting Cement and Concrete. Colin Presswood (*Fuel Economist*, 1932, **7**, 340–341).—Properties of heat-resisting cements and the manufacture and use of refractory concretes are briefly discussed.—J. S. G. T.

Load Test for Refractories. C. E. Bales (*Blast Fur. and Steel Plant*, 1929, **17**, 321; *Ceram. Abs.*, 1929, **8**, 342).—The A.S.T.M. specifies a load of 26 lb./in.^{2} with the brick placed on end and heating to 2642° F. (1450° C.) in 4½ hrs., maintaining this temperature for 1½ hrs. The load is applied by means of a calibrated coil spring in the furnace used by the Refractories Fellowship at Mellon Institute, whilst some furnaces employ levers and weights for the loading. Several points in the operation of the spring-type furnace make it superior to the lever type. This test was developed to show the refractoriness of brick, but it does not fulfil its objective nor does it show what the actual performance will be in service. Hard firing and fine grinding will give the best results in the experiments, but not necessarily the best results for all types of service. This test, while good for control purposes, must be used carefully in specification. A test made with brick under a pressure of 25 lb./in.^{2} and heated throughout to 2642° F. (1450° C.) for 7 hrs. does not compare with a test duplicating this time and temperature conducted on the same brick but with only one face heated, as would be the case in actual practice. Furthermore, most furnaces have an insufficient load to bring about failure in this way, and it was stated that this test is not suitable for specification purposes except where the bricks are heated throughout. It is often impossible to secure different qualities in the same brick; therefore the most important qualities for the individual case should be specified. Users should make suitability tests and from them develop control tests. The final answer in every case is the furnace trial. When a brick gives good service, the properties should be noted and used as specifications for control of further shipments.—S. G.

The Deformation of Refractories under Heavy Loads at High Temperatures. E. Keler (*Trudi Gosudarstvenogo Issledovatelskogo Keramicheskogo Instituta* (*Transactions of the State Research Ceramic Institute*), **1928**, (12), 1–123).—[In Russian.] A comprehensive survey of the literature is followed by a description of the apparatus used for the investigations at the Institute of Ceramics. The pressure used in testing refractories is 1 kg./cm.^{2}, and the rise in temperature 4° C./minute. The experiments showed that after a high fire, kaolin acquires a remarkably high endurance strength under load, due to its low flux content, and its specific property of forming at high temperatures, large numbers of crystals which become interlaced into a firm structure. Examples of tests on refractory appliances are given.—N. A.

On the Question of the Rate of Rise in Temperature during Tests on Deformation under Load at High Temperatures. W. Zegzhda (*Trudi Gosudarstvenogo Issledovatelskogo Keramicheskogo Instituta* (*Transactions of the State Research

Ceramical Institute), 1930, (24), 66–73).—[In Russian.] Tests on the deformation under load of refractory materials at high temperatures were carried out with rises in temperature of 1°, 5°, and 10° C. per minute, and the temperatures were noted at which the specimen first became compressed and at which compression reached 40%, when the specimen became completely softened and irretrievably deformed. With variations in the rate of temperature rise the results of the tests may differ markedly from one another, the difference being mainly noticeable between rates of 5° and 10° per minute and almost negligible between 1° and 5°. Therefore, with a rise of 5° per minute, the processes which cause softening of the specimen have time to approximate to the condition of equilibrium and at lower rates develop further only very slightly. A rate of 5° per minute is therefore recommended for the test, as lower rates cause considerable technical difficulties and economic inefficiency. Raising the rate to 10°/minute distorts the results.—N. A.

Slagging and Fluxing of Firebrick. G. A. Richter (*Blast. Fur. and Steel Plant*, 1929, 17, 321–322; *Ceram. Abs.*, 1929, 8, 342).—No satisfactory laboratory test has yet been devised to simulate fluxing or slagging in actual practice. In service of some kinds, as for instance in cement kiln work in which the fluxing agent is quite definitely known, the cone test is used. In this test an equal proportion of the fluxing agent, such as cement clinker, in the case of cement work, is mixed with an equal proportion of firebrick, finely ground, and formed into tetrahedra and fired in the clay testing furnace until soft. By comparison, knowledge is obtained as to fluxing resistances of different kinds and grades of firebrick. The use of specifications in purchasing firebrick and the use of laboratory test methods in predicting service qualities have not eliminated all the uncertainties. Of a number of brands of brick which might meet specifications, some are found to give satisfactory service in one installation and fail to do so in another. Some brands have been found to give best service in one plant and some in another. The reason for these variations lies in the almost countless combinations of conditions, many of which are not understood. But the intelligent use of specifications and test work has eliminated the entirely unsuitable product and increased the margin of safety. Better interpretations of causes of failures, with improved specifications, are certain to develop rapidly.—S. G.

Determination of the Specific Gravity of Refractory Material. E. Kühn (*Feuerfest*, 1929, 5, 5; *Ceram. Abs.*, 1929, 8, 343).—A description is given of a gas expansion apparatus used for determining the porosity and sp. gr. of silica brick.—S. G.

Refractories.—I. R. M. Doidge (*Blast Fur. and Steel Plant*, 1929, 17, 1854–1858; *Ceram. Abs.*, 1930, 9, 283).—Some of the chief causes which determine the life of refractories, or cause premature failures are as follow: (1) lack of refractoriness; (2) shrinkage or expansion in use; (3) softening under load; (4) mechanical erosion or breakage; (5) cracking or spalling; and (6) erosion by slags or fluxes. These factors are considered in detail.—S. G.

A Method of Determining Free Alumina in Silicate Mixtures, and some of its Applications to the Study of Clays. L. A. Shmelev (*Trudi Gosudarstvenogo Issledovatelskogo Keramicheskogo Instituta* (*Transactions of the State Research Ceramic Institute*), 1928, (14), 1–24).—[In Russian.] A small amount of the powdered silicate is boiled in a test-tube with a hot solution of alizarine saturated with boric acid. After settling the coloured mother-liquor is decanted and the precipitate washed with a hot, saturated alcoholic solution of boric acid until the supernatant liquid is almost colourless. If free alumina is present, the precipitate is coloured pinkish-violet to dark red. As little as 0·04% of alumina gives a brightly tinted precipitate.—N. A.

Chemical Researches on Refractory Materials.—I.–II. H. I. von Rohen (*Ber. Chemikerausschuss*, Nos. 48 and 50; *Tonind.-Zeit.*, 1929, 53, 1518;

Ceram. Abs., 1930, 9, 230).—The first part deals with methods for analyzing quartzites, silicates, grog, and clay. The procedures given by the Chemical Commission of the Society of German Iron Smelters are not to be considered as rules, but have been worked out as reliable methods in order to settle existing disagreements. Certain important points are taken up in connection with the methods recommended. There follows the determination of silicic acid by evaporation with fluoric acid, taking care to have a sufficient excess of sulphuric acid to prevent volatilization of titanium and aluminium. If the substance contains calcium oxide, the quantity of sulphuric acid taken up by the formation of calcium sulphate in the residue evaporated to dryness must be ascertained. The reduction procedure with titanium trichloride is selected to find the iron content, and the colorimetric method for titanium. Aluminium can be separated out as a phosphate. Determining the alkalis by indirect methods gave great variation in results, so that by weighing together as chlorides the potassium was determined directly. The second part contains methods for analyzing raw and fired dolomite and magnesite. A solution is made by using concentrated hydrochloric acid, the silicic acid is separated out by evaporation, and the filtrate examined by the usual methods. When the quantity of the insoluble residue is too great to complete the analysis with hydrofluoric acid, the sodium treatment is used. The results of the different researches are tabulated.—S. G.

Value of Scientific Research on Refractory Materials. F. West (*Refract. J.*, 1930, **5**, 131–132; *Ceram. Abs.*, 1930, **9**, 282).—Research to-day is not the production of petty graphs, it is a practical scientific process which no progressive firm can afford to ignore. The increased demands for refractory materials during the War, particularly in the manufacture of steel and glass, have shown the need for further scientific investigation. The assistance of the scientists is essential in determining the composition and the chemical, physical, and other properties of such substances, having in view the purpose to which they will be applied. It is also necessary to explore systematically the failures of refractories in use so as to get a better understanding of the conditions which are favourable or inimical to a long life. This work is not confined to known refractories, but is extended to the discovery and utilization of new combinations of refractories, produced by new methods of manufacture, to cope with the growing demands of the users of refractories in many industries. —S. G.

Research in Technology of Refractory Materials. A. T. Green (*Refract. J.*, 1930, **5**, 133–134; *Ceram. Abs.*, 1930, **9**, 282).—The technology of clay and silica products has progressed considerably during the past decade. Much of this progress in the laboratory and fundamental data on the importance to industrial usage of these products have been realized. Further research into the problems concerning the manufacture and industrial usage of refractories is imperative. Together with investigations of fundamental properties, the definition of the actual conditions obtained in the use of refractory products is essential. This phase of the work has not received much attention. Many apparently superior products have failed in specific duties, whereas the so-called inferior material has given comparative success in the same field of utility. This emphasizes the need for the adequate definition of working conditions. Endeavours to overcome this state of affairs must be made if the refractories industry is to meet its demands more accurately. G. discusses refractories research in relation to the iron and steel and carbonizing industries.—S. G.

Research Work in Refractories Industry. S. R. Hind (*Refract. J.*, 1930, **5**, 134–141; *Ceram. Abs.*, 1930, **9**, 281).—There are many different classes of materials used to withstand conditions inside furnaces. The definition of these materials is primarily chemical, but without close control of physical factors, such as grain-size and shape, porosity, and heat-treatment, it would be impossible to maintain satisfactory or uniform quality. Where sufficiently accurate records do not exist in the literature, the first aim must be to obtain expert personal knowledge of every aspect of manufacture and use. Accurate descriptions, with all necessary data, must be accumulated and presented in a scientific manner. It is important that such primary data should be freely available to other workers. In connection with the use of refractory materials, investigations centre chiefly around the following tests : (1) rigidity or strength, cold and hot; refractoriness, or ability to withstand temperature, with and without load; (2) analysis, chemical, physical, and mineralogical; (3) porosity, density, after-contraction or expansion, permeability; (4) specific heat, thermal expansion (reversible), thermal conductivity, and elasticity at various temperatures; (5) simulative tests of various kinds, among which may be mentioned empirical tests for abrasion, slagging, and spalling. The use of these tests is of the greatest assistance in maintaining uniform products, and leads the investigator and user to combine in making specifications which form a concrete basis for steady improvement.—S. G.

XVIII.—MISCELLANEOUS

(Continued from pp. 398–402.)

Charles Thomas Heycock. W. J. Pope (*J. Chem. Soc.*, **1931**, 3368–3371).—An obituary notice, with portrait.—S. G.

The Research Laboratories of the Metallgesellschaft. H. von Halban (*Metallgesellschaft Periodic Rev.*, 1930, **4**, 3–16).—[In English.] The layout of this very extensive series of research laboratories is given and there are added details of importance in construction. The article is worthy of attention from those who are contemplating equipping laboratories on similar lines. So far as metallurgical work is concerned, the plant includes a full complement of mechanical testing machines, metallographic microscopes, a metal microtome, spectrographs for visible and for ultra-violet spectral rays, an X-ray room, a corrosion testing plant, 2 smelting rooms with four 22-kva. Tammann furnaces and a high-frequency furnace. There are also rolling and extrusion plants, plant for testing bearings, and a large workshop. A colloid chemical laboratory is also provided.—W. A. C. N.

Metallography and General Physico-Chemical Metallurgy at the Technische Hochschule, Breslau. F. Sauerwald (*Metallwirtschaft*, 1931, **10**, 951–952).—v. G.

Non-Ferrous Metals. A. R. Powell (*Ann. Rep. Prog. Applied Chem.*, 1931, **16**, 300–330).—A detailed review of papers published during 1931, especially on the properties of metals and alloys, the constitution of alloys, corrosion, and protection. Full references are given.—H. F. G.

Non-Ferrous Metallurgy in 1931. Sam Tour (*Min. and Met.*, 1932, **13**, 41–46, 84–85).—A review.—A. R. P.

Rare Metal Developments in 1931. G. S. Riddell and Donald M. Liddell (*Min. and Met.*, 1932, **13**, 36–38, 76).—A review.—A. R. P.

Metals and Alloys of the Future. W. H. Hatfield (*Aluminium Broadcast*, 1930, **2**, (47), 8–9).—A report of a lecture to the Birmingham Local Section of the Institute of Metals.—J. C. C.

Powder Metallurgy. Charles Hardy (*Met. Ind.* (*N.Y.*), 1932, **30**, 179–180).—The preparation of solid pieces of metals and alloys by pressing the powdered metal or metals into bars which are then sintered and worked, is described briefly.—A. R. P.

Scrap. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 65–66).—A discussion of the problems arising in the use of scrap metals.—R. G.

The Laboratories of the German Aluminium Industry. H. Röhrig (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1931, **3**, 357–362).—An illustrated article.—M. H.

Aluminum Company of America. S. K. Colby (*Indust. and Eng. Chem.*, 1931, **23**, 1318–1320).—The history of the development of the Aluminum Company of America is briefly discussed and illustrated.—F. J.

The Cost of Working Up Aluminium Brass, Red Brass, and Bronze Residues to New Ingot Metal. H. Reininger (*Giesserei*, 1932, **19**, 5–9).—Tabulated cost data (in R.M./metric ton).—A. R. P.

Occurrence of Beryllium in Austria. Anon. (*Giesserei Zeit.*, 1930, **3**, (5), 1–3).—Large deposits of pegmatite have been found in Austria. The principal function of beryllium, which is mentioned, is as a deoxidant. Additions of the metal to the heavy metals have a very marked effect on the physical properties of the latter. Various electrolytic methods for the extraction of the metal are described.—W. A. C. N.

The Refining of Bismuth. Anon. (*Metallbörse*, 1931, **21**, 1705–1706).—A review of the various methods which have been proposed for the removal of arsenic, antimony, tin, lead, copper, zinc, gold, silver, tellurium, and selenium from crude bismuth by treatment of the molten metal with chlorinating, oxidizing, or sulphurizing fluxes.—A. R. P.

The Metallurgy of Copper in 1930. Carle R. Hayward (*Mineral Ind.*, 1931, **39**, 179–212).—Recent developments are discussed under the following heads: reverberatory smelting, smelting and smelting plants, converting, leaching, electrolytic refining, fire-refining, properties of refined copper (deoxidation, influence of gases, working, electrical conductivity, corrosion), properties of alloys of copper–tin, copper–phosphorus, copper–manganese–silicon, copper–zinc–silicon, silicon bronze, and silicon–copper, extrusion of copper and copper alloys, unsoundness of bronze castings.—E. S. H.

Reduction and Refining of Copper During 1931. C. R. Kuzell (*Min. and Met.*, 1932, **13**, 30–32).—A review.—A. R. P.

The Osnabrück Copper and Wire Works. History and Construction. The Metal Works. The Cable and Conductor Works. Anon. (*Metallwirtschaft*, 1932, **11**, 11–13, 24–26, 39–40, 54–55).—Descriptive.—v. G.

The Bessemerization of Bell Bronze. Recovery of Copper and Tin. John B. Kasey (*Met. Ind.* (*Lond.*), 1932, **40**, 613–614).—Experiments carried out by the Non-Ferrous and Gold Research Institute of Moscow, U.S.S.R., for the recovery of metallic tin from bell bronze are described. Numerous methods were tried, but only electro-disintegration and bessemerizing were promising, and the extremely low efficiency with common electrolytes ruled out the former. In the latter process, the composition of the flux was found to be of paramount importance, and sodium carbonate (soda ash) was selected as the best. Alumina dissolved from the sides of the clay-sand crucibles was the most detrimental compound, owing to the high melting point of its soda salt. Silica had to be added to the soda ash to reduce the corrosion of the acid linings of the crucibles, magnesite crucibles not being available, but the corrosion was nevertheless serious. A mono- or di-silicate slag was found to be the most suitable. Bessemerizing was carried out with a small, motor-driven air-compressor, a calibrated mercury manometer measuring the volume of air injected (to enable the bessemerizing efficiency to be calculated). The air was injected into the crucible, heated in a gas-fired furnace, by means of a long, unglazed, narrow-bore porcelain tube. The results of the experiments are tabulated and a flow sheet shows the steps of the process. The final products are pure tin (by the reduction of tin fume), electrolytic copper (from anode copper containing 1% tin), and machine bronze alloys.—J. H. W.

The Finow Brass Foundry. Anon. (*Metallwirtschaft*, 1932, **11**, 170–171).—A description of the foundry, annealing plant, and rolling mills of the Finow brass foundry at Eberswalde.—v. G.

The Antimony Content of Scrap Railway Red Brass and the Problem of Working Up the Scrap. Anon. (*Metallbörse*, 1931, 21, 2122–2123).—A letter to the Editor, pointing out that during repeated remelting of scrap railway red brass the antimony content appears to increase considerably above the 0·3% limit, probably owing to contamination of the scrap with white metal containing antimony. No satisfactory procedure is known for removing the antimony without completely refining the alloy.—A. R. P.

On the Volatility of Antimony in the Converter. W. Kroll (*Metall u. Erz*, 1931, **28**, 521–523).—The removal of antimony from bronze scrap by blowing it in a converter is discussed. Tin and lead are readily removed in this way, but antimony is not completely removed if the metal is covered with a highly basic slag as is usually the case. Lime and ferrous sulphide in the slag hinder volatilization.—A. R. P.

Finds of Metallurgical Interest in the Zimbabwe Ruins. G. H. Stanley (*J. S. African Chem. Inst.*, 1931, **14**, 52–58).—Articles of copper and bronze are described. The composition of the bronze is not far removed from the 90 : 10 ratio and the alloy was probably made by melting copper and tin together in the required amounts and not by smelting a mixture of copper and tin ores. Some small ornaments and beads were made of a lower tin alloy (97 : 3). Pieces of metallic copper and tin, probably raw materials, have been found. For the manufacture of ornaments it seems that the metal was first cast in a bar and then hammered or drawn to the required form. Some larger sections showed twinning under the microscope, indicating annealing after, and probably during, manufacture. Apparently both annealing and drawing were practised. Wire was not always of circular cross-section, but was sometimes elliptical or rectangular. Beads were made by cutting short lengths of thin rod or wire and bending or hammering into circular form; some of them were of hollow or tubular metal. One is described as having a copper core and an outer casing of thin bronze plate.—E. S. H.

Copper Objects Brought to Light after 5,000 Years. Anon. (*Bull. Copper and Brass Res. Assoc.*, 1930, (57), 4–5).—Copper and bronze antiques excavated at Ur and attributed to the Sumerian dynasty are referred to and illustrated.
—J. S. G. T.

Copper Frog Buried 5,500 Years. Anon. (*Bull. Copper and Brass Res. Assoc.*, 1930, (57), 11).—Copper antiques excavated at Kish are illustrated.
—J. S. G. T.

Seismoscope [Made of Copper] Recorded Earthquakes 2,000 Years Ago. Anon. (*Bull. Copper and Brass Res. Assoc.*, 1930, (57), 12).—A Chinese seismoscope made of copper in 136 B.C. is illustrated.—J. S. G. T.

Gold and Silver Recovery from Tin Slime. John B. Kasey (*Eng. Min. J.*, 1931, **132**, 217–218; *C. Abs.*, 1931, **25**, 5647).—The tin slime dealt with in this work originated from the electrolysis of scrap brass and bronze containing small quantities of lead, tin, zinc, antimony, iron oxides, and admixed sand. The wet slime, which originated in a solution of sulphuric acid, consists of sulphates, basic sulphates, metallics, and free acid. The problem of treating the slime was to separate and recover 4 different metals and alloys; an alloy of gold and silver, pure copper, a white metal alloy of tin, lead, and antimony, and nickel and its salts. The recovery of gold and silver is discussed. Copper in the slime was made the collector. Experimental work is outlined.—S. G.

Lead. G. W. Thompson (*Amer. Metal Market*, 1931, **38**, (35), 3, 5, 10).—See this *J.*, 1931, **47**, 627.—S. G.

Reduction and Refining of Lead During 1931. Anon. (*Min. and Met.*, 1932, **13**, 33–34).—A review.—A. R. P.

Theory and Practice of the Harris [Lead Refining] Process. W. Jensen (*Metallbörse*, 1931, **21**, 1737–1738, 1769–1770, 1801–1802, 1865–1866, 1897–1898).—A detailed account of the process with special reference to the quantities of chemicals required and to the recovery of tin, arsenic, and antimony from the slags.—A. R. P.

The New Lead Refinery and Its Operation at the Bunker Hill Smelter. A. F. Beasley, H. B. Schuettenhelm, and J. W. Johnson (*Amer. Inst. Min. Met. Eng. Preprint*, 1932, Feb., 1–11).—A description of the process work of a new plant, including refining, copper drossing, degolding, and desilverizing, treatment of liquated silver and gold dross, and production of antimonial lead. —R. G.

Practical Hints for Recognition and Judgment of Lead Poisoning. Fr. Riesenfeld-Hirschberg (*Soz. Med.*, 1931, **4**, 585–590; *C. Abs.*, 1932, **26**, 2531).—Symptoms are detailed.—S. G.

Nickel: Deposits, Metallurgy, and Future Prospects. Léon Guillet and Léopold Weill (*Génie civil*, 1932, **100**, 482–588).—A series of three articles dealing with the history, the mining, and the metallurgy of nickel. The roasting and reduction processes are described as well as the electrolytic methods of refining. The methods for the recovery of the precious metals are also briefly discussed, and the production of Monel metal from the copper-nickel ore receives a short description.—W. P. R.

Losses of White Gold which Occur during Magnetic Purifications of Filings Containing this Alloy. K. Bihlmaier (*Mitt. Forschungs-Inst. Edelmetalle*, 1931, **4**, 111–112; *C. Abs.*, 1931, **25**, 5649).—After elimination of substances which are combustible at red heat, the filings are treated magnetically to remove iron, but the magnet can also remove part of the white gold containing nickel, as it is frequently magnetic. B.'s tests showed that the loss of white gold increases with the strength of the magnet and the white gold content of the filings. In order to eliminate losses of white gold, B. advises using as weak a magnet as is compatible with separation of the iron, treating the latter with hot hydrochloric acid (the separated iron always contains a small amount of white gold), filtering and washing to recover the entrained white gold.—S. G.

On the Treatment of White Metal Ashes and Residues containing Metal Prills. Edmund Richard Thews (*Metallbörse*, 1931, **21**, 1443–1444).—Practical hints are given for working up tin–lead–antimony alloy scrap by mechanical and metallurgical methods.—A. R. P.

Investigations into the Conductivity of Molten Silicon. M. Blaschke (*Zentral-Europ. Giess.-Zeit.*, 1930, **3**, (10), 7).—The specific resistance of vacuum-melted silicon is 0·071 ohm./cm.^{3} at 20° C.—W. A. C. N.

The Recovery of Tin from Tinplate Scrap. B. Smolnikov (*Uralskiy Tehnik* (*Ural Technologist*), 1931, **7**, (8–9), 38–39).—[In Russian.] Tinplate scrap is treated in a bath of boiling caustic soda and sodium nitrate solution. On completion of the de-tinning process, the steel scrap which is left is removed, washed, and used in Martens furnaces; the solution is used continuously until it is saturated with tin and then pumped into a settling tank where tin hydroxide is precipitated by boiling with sodium bicarbonate; the precipitate is washed by decantation and dried. The composition is stannous oxide 88·67, iron 1·05, zinc oxide 0·51, sodium carbonate 9–12%. The cost of recovery is calculated.—N. A.

Metallurgy of Zinc in 1930. W. R. Ingalls (*Mineral Ind.*, 1931, **39**, 646–652).—Notes are given on recent developments in construction of plant, roasting, sintering, distilling, fuming methods, and electrolytic methods. —E. S. H.

Zinc Metallurgy in 1931. Anon. (*Min. and Met.*, 1932, **13**, 35–36).—A review.—A. R. P.

Tentative Proposals for Researches of a Basic Character. Anon. (*Bull. Brit. N.-F. Metals Res. Assoc.*, 1931, (**39**), 3–6).—Proposals are made for fundamental research supplementary to work already in progress in the National Physical Laboratory and Universities. This includes: (1) properties of molten metals :—fluidity, sp. heat, latent heat of fusion, electrical and thermal conductivities, coeff. of expansion, boiling points and vapour pressures; (2) solidification of metal from molten state :—volume changes, macrostructure, strength just below melting point; (3) gases in metals from a fundamental point of view; (4) investigation of surface films; (5) non-metallic inclusions with special reference to their removal; (6) mechanism of age-hardening; (7) properties of worked metals; (8) oxidation and scaling; (9) surface finish; (10) thermodynamics of metallurgical reactions especially in connection with affinity for oxygen.—W. H.-R.

Report on the Department of Metallurgy and Metallurgical Chemistry [of the National Physical Laboratory] for the Year 1931. Anon. (*Nat. Phys. Lab. Rep.*, **1931**, 270–287).—Iron in a state of great purity—99·985% iron—has been prepared by fusing electrolytic iron in a low-pressure hydrogen atmosphere, and by melting finally in a high vacuum, at the same time adding a small quantity of carbon to the melt to take up residual oxygen. The measurements of surface tension in the liquid state have been extended to a series of lead–tin alloys. X-ray examination of various metals and alloys—including those of copper–aluminium and iron–chromium—has been undertaken. The gold–copper series of alloys has been examined. The existence of AuCu and $AuCu_3$ has been confirmed and that of Au_2Cu_3 has been established. A research on the properties of cadmium has been concluded. Investigations in the reduction of fatigue resistance of spring steels owing to surface decarburization are being conducted jointly with the Engineering Department. Extensive examination is being made of alloys for use at high temperatures, *e.g.* those of the nickel–chromium and iron–nickel–chromium series. The most suitable alloys for resistance to prolonged stress at high temperatures appear to be those which maintain a fairly constant Brinell hardness after repeated exposure to high temperature. The series of standard steel samples for laboratory purposes has been enlarged. It has been shown that the addition of 0·35% iron inhibits age-hardening at room temperature in copper–aluminium alloys. This effect is partly removed by an addition of 0·25% silicon and wholly by that of 0·5% magnesium. The mechanism of the various methods for the removal of gases from metals has been studied. Titanium and carbon tetrachlorides are effective in removing gas from magnesium. Alloys of magnesium with nickel, manganese, and beryllium are under investigation.—W. A. C. N.

Report on the Engineering Department [of the National Physical Laboratory] for the Year 1931. H. J. Gough (*Nat. Phys. Lab. Rep.*, **1931**, 197–231).—A satisfactory scratch hardness test, using loads of 10–30 grm., for testing metal coatings and thin sections has been developed. It has been shown that scratch tests produced by flow of the metal under pressure are particular applications of ordinary hardness tests. Static diamond pyramid indentation hardness tests employing loads of 30–100 grm. have been devised. Standard conditions for the dimensions of test-pieces for Brinell hardness measurements have been ascertained. An abrasion machine for the undertaking of wear tests has been constructed. The relative merits of various types of cupping tests are under investigation. Attention is being paid to a test in which a sheet specimen is deformed by oil pressure applied on one side of the sheet until fracture occurs. It is proposed to attempt to correlate stress, strain, and time, and to review the effect of time on stress and strain during both elastic and plastic deformation. The measurement of force in this test involves the piezo-electric property of quartz crystals in conjunction with a cathode-ray oscillograph. Various transmission problems are under review. Among other investigations mentioned in the report are the following: design and standardization of lifting gear components; effect of rate of loading on tensile test results for wrought iron; effect of small changes in the angle of pyramidal diamonds on the diamond pyramid hardness number; fatigue phenomena exhibited by large single metallic crystals; mechanical properties of materials at high temperatures; causes of failure of lifting gear; the phenomenon of creep; application of electric welding to buildings and structures; specific heat of gases at high temperatures; the effect of speed, load, and clearance on the seizing temperature and friction of continuously rotating cylindrical journals under forced lubrication; corrosion fatigue.—W. A. C. N.

Report on the Physics Department [of the National Physical Laboratory] for the Year 1931. G. W. C. Kaye (*Nat. Phys. Lab. Rep.*, **1931**, 68–109).—Progress has been made in the establishment of an international temperature scale. In future all measurements of gauges, micrometers, &c., will be referred to a temperature of 20° C. instead of 17° C. (as heretofore). The results of experiments on the ventilated wet and dry bulb hygrometer for the range 40°–100° C. are to be published in the form of tables showing relative humidity as a function of dry bulb temperature and wet bulb depression. The thermal and electrical conductivity of single crystals—especially of bismuth—in a magnetic field have been determined. A close analogy has been revealed between the type of variation in the change in thermal and in electrical resistance in transverse fields. A continuation of the investigation into the thermal and electrical conductivity of alloys from room temperature up to 800° C. is reported. Thermal conductivities at high temperatures of furnace constructional materials have also been examined. Calorimetric equipment to deal with the problem of the heat of formation and of combustion of gases has been installed. The specific heats of gases at temperatures up to 2000° C. are being ascertained by the velocity of sound method. In the general work on the maintenance of standards the melting point of platinum is at present the focus of investigation, the object of which is to obtain a black body which can be held at the melting point and used for the following measurements of radiation: (1) the determination of relative luminosity, for a particular wave-length, of a black body at the melting points of platinum and gold; (2) the measurement of candle power per unit area; (3) the colour matching with the black body, of tungsten lamps used as standards of colour temperature. A black body radiator of special design has been installed. Various investigations for Government departments, including those on the thermo-physical properties of refrigerants, the relative permeability of materials to water vapour, the heat transfer between metal pipes and a stream of air, and the measurement of the temperature of aero-engine cylinders have been undertaken. In the radiological branch the researches include the following: the structure of electrodeposited chromium, crystal lattice distortion, large metal crystals, X-ray intensity and dosage, a comparison of the X-ray and radium protection, the scattering of X-rays, tungsten magnet steels, transformer steels, the structure of protective scales on steels. Optical and acoustical researches are also a very noticeable feature.—W. A. C. N.

Report on the Electricity Department [of the National Physical Laboratory] for the Year 1931. E. H. Rayner (*Nat. Phys. Lab. Rep.*, **1931**, 110–167).—The report is divided into the following sections: (1) electrical standards and measurements; (2) electrotechnics; (3) wireless; (4) photometry. In the first section are included investigations on the following: (*a*) the magnetic properties of alloys of iron–chromium and iron–manganese. The latter all show low permeability, but complications arise owing to the fact that the outer layers are richer in iron owing to the distillation of manganese during heat-treatment; (*b*) the maintenance of electrical standards; (*c*) primary turning fork standard; the quartz oscillator frequency standard; the radio frequency bridge; the electrical properties of electrolytic cells used in corrosion work; (*d*) characteristics of X-ray tubes; Manganin alloys as resistance materials; the heating and resistance of cables carrying current. Photometry researches embrace those on suitable photo-electric cells, the primary standard of light, the optical properties of glass ware, and the luminescent properties of zinc sulphide.—W. A. C. N.

Report on the Metrology Department [of the National Physical Laboratory] for the Year 1931. J. E. Sears, Jr. (*Nat. Phys. Lab. Rep.*, 1931, 168–196).—By means of a wave-length comparator a series of preliminary measurements has been made of the length of the metre in terms of the red line of cadmium. Further work on the production of standard surveying tapes and wires is recorded. The necessity for the production and maintenance of standard steel gauges has called for much research into the properties of suitable steels. On heating hardened steel balls at 150° C. for long periods, it is found there is first a rapid decrease in size to a minimum in a few hours, a subsequent increase to a maximum after about 10 weeks, and then a persistent gradual decrease. The heating of similar balls at 75° C. does not show a minimum, and a subsequent rise to a maximum, but a sharp descent, and then, after 20 weeks, a very slow rate of decrease. These phenomena do not appear to be characteristic for balls of all makes. Stellite is favoured as a material for rise in end gauges. It is shown that "stainless" steel can be plastically deformed in compression without incurring any serious instability, and that even the small initial changes which occur can be eliminated by suitable heat-treatment. Wear tests on pivots and jewels in instruments are being conducted. It is interesting to note that when using steel pivots and diamond jewels no trace of rust formation was noticed after 9,000,000 revolutions, whereas a steel and sapphire jewel under the same conditions would have produced copious rust. It is tentatively suggested that in the latter case the oxidation of the iron is brought about by a transference of oxygen from the sapphire which is of aluminium oxide.—W. A. C. N.

XIX.—BIBLIOGRAPHY

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XX.—BOOK REVIEWS

(Continued from pp. 460–461.)

Stainless Iron and Steel. By J. H. G. Monypenny. Second and revised edition. Roy. 8vo. Pp. ix + 575, with 236 illustrations. 1931. London: Chapman & Hall, Ltd. (25*s.* net.)

The first edition of this book has become a standard work, and the necessity which has arisen for a second edition points, in the first place, to its proved usefulness and, in the second place, to the progressive nature of the particular branch of metallurgy with which it deals. The latter is exemplified by the increase of 270 pages and of 127 illustrations that have been found essential in order fully to describe the advances which have been made in the theoretical and practical investigation of stainless steel during the last five years. In order to deal in a systematic manner with the many new developments, the author has found it advisable to re-draft the book and to re-write certain sections entirely. The opportunity has been taken to bring the information presented completely up to date. The notable character of the book remains unchanged. The discussions and the diagrams and illustrations which accompany them maintain the same high standard as before.—W. A. C. NEWMAN.

Spektroskopie der Röntgenstrahlen. Von Manne Siegbahn. Zweite umgearbeitete Auflage. Roy. 8vo. Pp. vi + 575, with 255 illustrations. 1931. Berlin: Julius Springer. (Geh. R.M. 47; geb. R.M. 49.60.)

This work on Röntgen spectroscopy by Dr. K. M. G. Siegbahn, the Nobel Laureate for Physics in 1924, has, since the appearance of the first edition in 1923, deservedly been regarded by physicists as the standard work on the subject. Broadly speaking, it comprises two parts: first, the description of instruments and methods, developed largely in the author's laboratory at Upsala, for the precision measurement of the wave-lengths of X-rays, and secondly, the bearing of these measurements on atomic theory. Professor Siegbahn's measurements of the wave-lengths of characteristic X-rays are probably the most precise that have hitherto been made. Here the technique developed by him, his co-workers, and investigators in all countries are described with a modesty characteristic of the author. Nowhere are his own contributions stressed even duly. The contents of the book may be briefly indicated: a short review of X-ray literature up to the time of Laue's discovery, interference of X-rays, technique of X-ray spectroscopy, emission and absorption spectra, and their theory, extension of Röntgen spectra in the direction of longer wave-lengths, and the continuous Röntgen spectrum. Appendices are devoted to excitation potentials, the periodic classification of the elements, absorption coefficients, lengths of spark gap between spherical electrodes, and angles of reflection and wave-lengths characteristic of rock salt, calcspar, quartz, gypsum, mica, and sugar. All are done with the thoroughness and clearness that one expects, but so seldom gets, from authors so distinguished as Dr. Siegbahn. There is an exceedingly valuable bibliography of the subject extending over 73 pages, and adequate name and subject indexes are included. The scattering of X-rays, with related subjects, *e.g.* the Compton effect, is not discussed in the volume. The book is well printed on good paper; there are very few "printer's" errors (I mention only the number of illustrations incorrectly given as 225 on the fly leaf); its price is high but reasonable. It should and will find its way into all scientific libraries; it is really indispensable to all research workers in the subject.—J. S. G. THOMAS.

Röntgenstrahlen und Struktur der Materie. Von H. Kulenkampff. (Schriftenreihe "Deutsches Museum, Abhandlungen und Berichte," 3 Jahrgang, Heft 2.) Med. 8vo. Pp. 27–74, with 32 illustrations in the text. 1931. Berlin: Verein deutsche Ingenieure-Verlag G.m.b.H. (R.M. 1.)

This little booklet is one of a series—14 numbers have already appeared—written by specialists in conjunction with the authorities of the Munich Museum of Technology and Science and of the German Society of Engineers, to permit an intelligent person to understand the development of science, and its application to industry and to appreciate the treasures of the Museum. From the titles of the booklets already available, the series appears to be conceived on very generous and broad lines. The present booklet is a case in point. It is not a "guide to the exhibits," but it gives the reader, within the limited space available, a very clear-cut impression of the nature and present-day applications of Röntgen rays. It is a sort of "Röntgen rays for the busy business man," and not least for the metallurgist, for the examination of castings, alloys, &c. is briefly discussed and illustrated. Other subjects treated include interference of Röntgen rays and crystal structures, molecular configurations, Röntgen spectra, and chemical analysis. All are well discussed, without appeal to mathematics. The book is well got up, is well printed on good paper, and is well illustrated. An illustration (p. 73), thrown in apparently as overweight, would appear to show that in the matter of mixed bathing in public baths, we moderns are a backward lot compared with the people of the Middle Ages! One other minor point: pages in the table of contents are numbered from 1 to 40; actually in the text the pages run from 27 to 74. Altogether a very good shillingsworth.

—J. S. G. THOMAS.