

METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

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Part 1

I.—PROPERTIES OF METALS

†Service Characteristics of the Light Metals and Their Alloys. — (*Amer. Soc. Test. Mat.*, 1934, pp. 33).—Prepared by Sub-Committee VII of Committee B-7 on Light Metals and Alloys of the A.S.T.M. in conjunction with the American Foundrymen's Association. The following subjects are discussed: (1) metallurgical characteristics—compositions and forms available, applicability to fabricating processes (including methods of casting of cast alloys), types of heat-treatment possible, welding; (2) industrial requirements of the aircraft, automotive, general structural, architectural, railway equipment, and household appliance industries; (3) surface protection—painting, oxide coatings, electroplating. In tabular form are given: (1) trade designations, (2) nominal compositions, (3) typical mechanical properties of cast and of wrought alloys of aluminium and of magnesium, (4) compositions of ingot aluminium, (5) physical constants of aluminium and magnesium, (6) physical properties of magnesium alloys, (7) foundry characteristics of aluminium and magnesium casting alloys, and (8) fabricating characteristics of wrought aluminium alloys. A bibliography is included. [*Note by Abstractor*: It is impossible to do more than indicate the contents of this valuable up-to-date summary of knowledge of light alloys in use in America; especially as the booklet is itself in the nature of an abstract.]—R. B. D.

A Simple Means for Distinguishing the Various Qualities of Aluminium. A. von Zeerleder (*Aluminium*, 1934, 17, 88-90).—Two tests are made, one a scratch test with an Aldrey needle (Brinell hardness 70-80) and the other a chemical test in which a drop of 20% caustic soda solution is allowed to remain on the polished surface for 10 minutes. In the scratch test pure aluminium and its alloys with small quantities of other metals, e.g. Aluman and Anticorodal, are marked by the needle, whereas the harder alloys such as Duralumin are unaffected. The soda test reveals the presence of copper in the alloys by the production of a black spot. For distinguishing hard-worked from annealed aluminium, scratch tests may be made with hard and with annealed Aldrey needles. Examples of the use of the tests are shown in photographs.—A. R. P.

†On the Effect of Increasing the Purity on the Properties and Working of Aluminium. H. Röhrig (*Aluminium*, 1934, 17, 79-84; and (translation) *Light Metals Research*, 1934, 3, 233-242).—Recent work on the properties of 5 grades of aluminium varying in purity from 99.39 to 99.995% is reviewed and the results are tabulated. With increasing purity the surface of castings becomes smoother and brighter and the crystal structure gradually becomes less complex until finally a purely large-grained polygonal structure is obtained when the impurities are less than 0.01%; the purest metal has a Brinell hardness of 13.9 with an electrical conductivity of 38.1 m./ohm. mm.². The resistance to corrosion by a mixture of nitric and sulphuric acids decreases rapidly with increasing impurities when the metal is in the hard-rolled state, but there is relatively little difference after annealing at 500° C. and quenching. A 2% copper alloy made with pure aluminium after quenching from 590° C. shows a pure polygonal grain structure, but a similar alloy made with aluminium containing 0.2% iron after the same heat-treatment shows numerous

* Denotes a paper describing the results of original research.

† Denotes a first-class critical review.

irregularly distributed islets, a ternary iron-copper-aluminium constituent, and the grain boundaries are very irregular.—A. R. P.

***Study of the Cooling of Metals [Aluminium] by Air.** P. Vernotte and E. Blouin (*Aérotechnique* (Suppt. to *Aéronautique*), 1934, 12, 25-26).—A brief, illustrated account of methods used to study the heat exchange between a block of aluminium and currents of cold air passed at various air speeds through a passage cut down the axis of the block. Curves showing the variation of the coeff. of thermal exchange with air speed are given for holes of circular and trefoil sections.—J. C. C.

†**The Thermal Properties of Aluminium and Their Applications.** A. de Biran (*Light Metals Rev.*, 1934, 1, (3), 38-49).—Translated from *Rev. Aluminium*, 1933, 10, 2263-2278; 1934, 11, 2311-2332. See *Met. Abs.*, 1934, 1, 161, 225.—R. B. D.

The Light-Reflecting Properties of Aluminium and Its Alloys as Affected by Surface Treatment. — Hase (*Aluminium*, 1934, 17, 20-25).—The regular and diffuse reflections of light at an angle of incidence of 45° C. from surfaces of aluminium, Pantal, and Polital which have been treated in various ways, e.g. highly polished, lacquered, Eloxal-treated, pickled, and scratch-brushed, are shown graphically and briefly discussed.—A. R. P.

***The Hall and Allied Effects in Cast Bismuth Plates as Affected by the Rate of Cooling.** L. Howard Petersen (*Proc. Indiana Acad. Sci.*, 1933, 43, 185-190).—The thermomagnetic and galvano-magnetic effects in bismuth plates are influenced by the rate of solidification (structure) of the alloy. When the mould of liquid bismuth was cooled in a freezing mixture at -10° C., the expansion on solidification was rapid enough to eject portions of metal.—R. G.

***The Magnetic Moment of the Nucleus of Cæsium.** D. A. Jackson (*Proc. Roy. Soc.*, 1934, [A], 147, 500-513).—The nuclear magnetic moment of cæsium is found, from spectroscopic evidence, to be 2.75/1838 magneton to within 5%.—J. S. G. T.

***The Exact Measurement of the Specific Heats of Metals at High Temperatures. XVII.—Calorimetric Retardation Phenomena in the Case of Cerium and Chromium.** F. M. Jaeger and E. Rosenbohm (*Proc. K. Akad. Wet. Amsterdam*, 1934, 37, 489-497).—[In English.] Values of the mean specific heat of cerium between 290° and 400° C. and between 450° and 550° C. are found to depend on the preliminary thermal treatment of the metal and its subsequent cooling. It is possible that a real transition temperature exists between 360° and 370° C. This conclusion is confirmed by X-ray analysis at ordinary temperatures. The phenomenon is associated with the occurrence of so-called "one-phase transitions" as already shown to occur in beryllium and zirconium. A similar type of transition is also shown by chromium and revealed by measurement of the mean specific heat of the metal within various temperature ranges between 400° and 1066° C.—J. T.

***The Refining of Metals by Sublimation in a High Vacuum: Chromium, Aluminium, Silicon, Beryllium.** W. Kroll (*Metallwirtschaft*, 1934, 13, 725-731, 789).—These metals can be distilled in a high-frequency vacuum furnace. Good separation from impurities can be obtained readily with aluminium. Beryllium can readily be distilled free from all impurities other than aluminium and magnesium, but even so the product is always brittle.—v. G.

***Effect of Cold-Rolling on the Indentation Hardness of Copper.** John G. Thompson (*J. Res. Nat. Bur. Stand.*, 1934, 13, 745-756; *Research Paper No. 742*).—Specimens of tough-pitch electrolytic copper, commercial oxygen-free copper, and single crystals of copper of different orientations were subjected to severe cold-rolling to determine the effect on the properties, particularly on the hardness. In all cases the indentation hardness increased to a maximum value which was maintained during subsequent reduction until the hardness determinations became unreliable owing to the thinness of the specimens.

No irregularities were encountered except in the case of very thin specimens. The results were confirmed by determinations of tensile strength of some of the specimens and by the application of Meyer's analysis to some of the data. The effect of severe cold-rolling on the indentation hardness of copper was not materially affected by the initial hardness of the specimen, the presence or absence of 0.4% oxygen, the change from polycrystalline to single-crystal specimens, or the orientation of the single crystals with respect to the plane of deformation.—S. G.

***Preparation of Pure Gallium.** James I. Hoffman (*J. Res. Nat. Bur. Stand.*, 1934, 13, 665–672; *Research Paper No. 734*).—A method is described for the preparation of pure gallium. The principal operations consist in (1) preparing a hydrochloric acid solution of the metal and extracting the gallium, molybdenum, gold, iron, and thallium, together with small amounts of other elements; (2) precipitating antimony, arsenic, bismuth, cadmium, copper, germanium, gold, mercury, silver, and tin, and most of the lead, molybdenum, and rhenium, with hydrogen sulphide in an acid solution of the ether extract; (3) precipitating iron and thallium with sodium hydroxide and filtering; (4) depositing the gallium electrolytically from the alkaline filtrate; and (5) eliminating the remaining impurities by fractional crystallization of the metal. Indium and lead are the most persistent impurities, but the last traces can be removed by fractional crystallization. Gallium at least 99.999% pure, containing only very faint traces of iron, lead, and calcium, and having a melting point of $29.780 \pm 0.005^\circ \text{C}$., was obtained.—S. G.

***Freezing Point of Gallium.** Wm. F. Roeser and James I. Hoffman (*J. Res. Nat. Bur. Stand.*, 1934, 13, 673–676; *Research Paper No. 735*).—The temperature of equilibrium between solid and liquid gallium was found to be $29.780 \pm 0.005^\circ \text{C}$. Four determinations on 2 different lots of metal (99.999% pure) all yielded the same result. Difficulties ascribed to the undercooling and low thermal conductivity of the gallium prevented a satisfactory determination from ordinary heating and cooling curves. The temperature of equilibrium between the liquid and solid phases of the metal was obtained by measuring the temperature of an intimate mixture of the solid and the liquid. It was found that the presence of the oxide did not affect the freezing temperature, indicating that the oxide is not appreciably soluble in the metal.—S. G.

***The Anodic Passivation of Gold.** William James Shutt and Arthur Walton (*Trans. Faraday Soc.*, 1934, 30, 914–926).—From oscillograms of potential variations at an anodically polarized gold electrode the maximum limiting current density (c_0) for the anodic dissolution of gold and the time of passivation (T) have been measured in chloride, bromide, and sulphate solutions at 25°C . and in *N*-hydrochloric acid at 15° – 65°C . The coulombs required to passivate the electrode are given by the expression $(c - c_0)T = K$, where c is the applied current density. In halide solutions c_0 and K are approximately proportional to the halogen ion concentration, but in sulphate solutions, if the concentration of the electrolyte is kept constant by vigorous agitation, K corresponds approximately with the amount of electricity required to produce a unimolecular oxide film on the gold surface. A theoretical consideration of the results leads to the conclusion that anodic passivation takes place finally by the formation of a film of gold peroxide continuous with the lattice structure of the metal.—A. R. P.

***The Anodic Passivation of Gold in Chloride Solutions.** G. Armstrong and J. A. V. Butler (*Trans. Faraday Soc.*, 1934, 30, 1173–1177).—In unstirred chloride solutions the times of passivation of gold electrodes are approximately proportional to the concentration of chloride ion and are almost unaffected by replacing hydrochloric acid with potassium chloride. For times above 10 seconds $(c - c_0)T = K$ (cf. preceding abstract); K is regarded as the amount of electrolysis required to produce a diffusion layer through

which the diffusion of chloride ions to the electrode takes place at the constant rate c_0 . The thickness of the diffusion layer (δ) in unstirred and stirred solutions is $1.5 - 4 \times 10^{-2}$ cm. and 4×10^{-4} cm., respectively. When other factors remain constant K is proportional, and c_0 inversely proportional, to δ .—A. R. P.

***The Optical Constants of Polished and Sputtered Molybdenum Surfaces.** R. D. Summers (*J. Opt. Soc. Amer.*, 1934, 24, 261-263).—The computed reflectivity of sputtered molybdenum varied with the conditions of preparation and was considerably less than for the massive metal. The results on the massive metal were not appreciably affected by polishing under kerosene or while exposed to air.—R. G.

***The Magnetic Transformation Point of Heavily Cold-Worked Nickel.** H. Quinney (*J. Inst. Metals*, 1934, 55, 229-240; discussion, 240-245).—The Curie point of a rather low-grade sample of commercial nickel was found to be 330°C ., *i.e.* much lower than the accepted value for pure nickel. After severe torsional overstrain the Curie point on heating was raised to 365°C . but returned to the original value on cooling. The raising of the point was observed to be less on subsequent heatings, and entirely disappeared after a full anneal. In the discussion C. J. Smithells referred to the results obtained by Ransley and himself on 99.9% nickel (*J. Inst. Metals*, 1932, 49, 287) and suggested that the effects observed by Q. were probably caused by impurities which would increase the lattice distortion. Other speakers endorsed this suggestion. In reply, Q. stated that the nickel contained carbon 0.062, silicon 0.027, copper 0.08, iron 0.18, magnesium 0.08, manganese 0.30, sulphur 0.012, and nickel 99.016%; he agreed that the effects of these impurities would probably account for many of the observed results.—A. R. P.

***The Exact Measurement of the Specific Heats of Solid Metals at High Temperatures.** XV.—**A Redetermination of the Specific Heats of Palladium.** F. M. Jaeger and W. A. Veenstra (*Proc. K. Akad. Wet. Amsterdam*, 1934, 37, 280-283).—[In English.] A redetermination of the specific heats of palladium showed that the maxima previously found in the $c_p - t$ and $C_p - t$ curves were due to experimental error. The $c_p - t$ curve proves to be nearly a straight line, although a slight increase in the slope above 1125°C . is evident. No indication of an allotropic change is observed. The specific heat c_p is given by: $c_p = 0.058378 + 0.120548 \times 10^{-4}t + 0.258 \times 10^{-7}t^2$, and the atomic heat by $C_p = 6.2288 + 0.12862 \times 10^{-4}t + 0.27528 \times 10^{-7}t^2$. The value $3R$ cal. is exceeded for C_p at -150°C . and for C_v at -120°C .—S. G.

***The Action of an External Electrical Field on Hydrogen-Charged Metals [Palladium].** T. Franzini (*Atti R. Accad. Lincei (Roma)*, 1934, 19, 584-588; *C. Abs.*, 1934, 28, 7098).—A palladium wire, electrolytically charged with hydrogen in a sodium hydroxide solution, was exposed to the field of a proton rectifying transformer at 25 kv. The resistance of the wire was measured with a Wheatstone bridge. A positive potential of 15,000 v. under a vacuum (10^{-4} mm.) caused a very small loss of hydrogen, and a flow of current of less than 0.1 milliamp. A negative potential of the same magnitude, however, discharged about $\frac{2}{3}$ of the adsorbed gas in 15 minutes, and gave a current of 10-12 milliamp., because the protons were torn away from the palladium wire, and withdrawn by the high vacuum.—S. G.

***The Catalysis by Palladium of the Union of Hydrogen and Oxygen. A New Phenomenon of Contact Catalysis.** D. L. Chapman and G. Gregory (*Proc. Roy. Soc.*, 1934, [A], 147, 68-75).—The mechanism of the catalysis of the union of hydrogen and oxygen by palladium is mainly one of alternate oxidation of metal and reduction of the oxide. Adsorbed hydrogen does not react appreciably with oxygen at room temperature. By suitable treatment palladium can be rendered temporarily inert as a catalyst of the reaction between hydrogen and oxygen. This temporary inertness is attributable to a compact layer of adsorbed hydrogen.—J. S. G. T.

***The Exact Measurement of the Specific Heats of Solid Substances at Higher Temperatures.** XVI.—**The Specific Heats of Metallic Thorium and of Thorium Dioxide Between 20° and 1400° C.** F. M. Jaeger and W. A. Veenstra (*Proc. K. Akad. Wet. Amsterdam*, 1934, 37, 327-332).—[In English.] The mean specific heat of thorium has been measured between room temperature and 1200° C. The atomic heat increases continuously from 8.235 at 300° C. to 11.785 at 1200° C.—S. G.

***Resistivity of Zinc Crystals.** W. J. Poppy (*Proc. Iowa Acad. Sci.*, 1932, 39, 217; *C. Abs.*, 1934, 28, 6602).—In an attempt to settle the discrepancy between the resistivity measurements of Bridgman on the one hand and of Tyndall and Hoyem (*J. Inst. Metals*, 1931, 47, 645) on the other, single zinc crystals of 1 cm.² cross-section and 10 cm. long were grown and measured. The results agree with those of Tyndall and Hoyem. Present indications are that certain anomalous crystals (*i.e.* not truly single) have abnormally low resistivities and show great sensitivity to slight strain.—S. G.

***Influence of a Grain Boundary on the Deformation of a Single Crystal of Zinc.** Richard F. Miller (*Metals Technology*, 1934, (Oct.), *A.I.M.M.E. Tech. Publ.* No. 576, 1-9).—From tensile experiments at 180° C. on single-crystal rods of zinc terminated by a transverse grain boundary adjoining polycrystalline metal it is shown that the influence of the grain boundary is confined to glide planes which it directly intersects and is composed of two distinct parts. In the first part, the glide layers are held motionless and the maximum extent of this influence is the distance p , such that $d = p/[\tan \frac{1}{2}(\alpha + \alpha')] + p/[\tan(90^\circ - \alpha)]$, where d is the original diameter of the rod, α is the original angle of the basal planes to the axis of the rod, and α' is their final angle thereto. In the second part, the glide layers have passed through a flexure and slid over one another to a small extent but not sufficient to form a uniform band; the maximum extent of the influence of the grain boundary is q , where $q = d \cos \alpha' \cdot \cos(\alpha - \alpha')/\sin \alpha$. Hence the grain-boundary influence varies regularly with the size of the boundary, the amount of deformation, and the ductility of the crystal.—A. R. P.

***Influence of Chemically- and Mechanically-Formed Notches on Fatigue of Metals.** Dunlap J. McAdam, Jr., and Robert W. Clyne (*J. Res. Nat. Bur. Stand.*, 1934, 13, 527-572; *Research Paper* No. 725).—An introductory section discusses the importance of stress concentration due to notches, as a cause of failure in service. Resistance of a notched specimen to fatigue and to impact may depend on entirely different properties. The influence of notches on fatigue is considered in the present paper. In section II the effect of chemically-formed notches is considered, attention being confined to the influence of pitting caused by stressless corrosion. Relationship between tensile strength and the % decrease in the fatigue limit of steels and aluminium alloys is illustrated by composite curves, each of which is presumed to represent this relationship for a notch of fairly constant effective sharpness. The 3-dimensional relationship between corrosion time, % damage, and the tensile strength is illustrated and discussed. The general object of section III is to determine whether composite curves of similar form may be obtained by a study of experimental data obtained by a number of investigators with mechanically-formed notches. The fact that such graphs have been obtained, each representing the influence of one form of notch on one kind of metal, confirms the conclusion that a stressless corrosion graph of this type represents the influence of a notch of fairly constant effective sharpness. Reasons are discussed for the deviation of individual results from the ideal composite curve for a mechanically formed notch. In section IV is considered the relationship between notch sensitivity (as measured by % damage) and other properties of metals. The properties considered are: hysteresis, ductility, and work-hardening capacity. Evidence is presented that scatter of individual results in a composite graph of the type used is due

largely to differences in tensile work-hardening capacity. Evidence is also presented that notch sensitivity, while depending somewhat on elastic hysteresis, depends largely on work-hardening capacity. The influence of notches in diminishing the advantage of superior strength is dealt with in section V. A bibliography of 33 selected references is appended.—S. G.

***Elasticity.** Arthur Cecil Vivian (*Inst. Civil Eng. Selected Eng. Papers*, 1934, (150), 1-32).—An extension of Hooke's law to enable more exact use to be made of materials for constructional purposes is proposed. Elasticity is taken to be that property which determines that a material will completely or partially resume its original shape when the applied force is removed, and

Hooke's law is written: stress = $\left\{ \left(\frac{S}{S_m} + 1 \right)^{J-1} - 1 \right\} \cdot f_i$, where S is

elastic strain, S_m ultimate elastic tensile strain, J a form factor denoting elastic character, and f_i ultimate tensile stress. When $J = 2$, this reduces to Hooke's law. Examples of the application of the method are given.—J. C.

***Elastic Failure of Thick Cylinders.** Harris Booth (*Inst. Civil Eng. Selected Eng. Papers*, 1934, (138), 1-40).—The conditions of failure are examined for thick cylinders subjected to internal pressure, to radial temperature gradient, and (for cylinders closed at one end) to both internal and external pressures. It is shown that no stresses are induced in a thick cylinder subjected to a uniform longitudinal temperature gradient.—J. C. C.

***On Hardening Phenomena in Pressed Metal Bodies.** W. Trzebiatowski (*Z. physikal. Chem.*, 1934, [B], 24, 75-86).—Bodies made by pressing very finely-divided gold and copper powders at pressures up to 30,000 atm. show considerable hardening effects, characterized by a broadening of the interference lines in the röntgenogram and a high degree of dispersion; no true texture is, however, produced. The hardness values obtained are much higher than those observed on either metal after severe working; this is attributed to the very fine crystal structure of the pressed bodies. The fall in hardness which occurs on annealing is produced by recovery and recrystallization phenomena.—K. S.

***On the Problem of the Electrical Conductivity of Synthetic Metal Bodies.** W. Trzebiatowski (*Z. physikal. Chem.*, 1934, [B], 24, 87-97).—Compared with massive metals, pressed bodies made from metal powders show peculiar anomalies in the electrical conductivity. For pressed bodies of gold and copper the temperature coeff. of resistance is positive up to 100° C., negative between 100° and 300° C., and positive again at higher temperatures; this behaviour is attributed to gas films and to recrystallization phenomena, which have been confirmed by dilatometric measurements.—K. S.

***Researches on the Thermal Conductivity of Metals (Wire or Tape) at High Temperatures.** M. Conard (*Aérotechnique* (Suppl. to *Aéronautique*), 1934, 12, 26-27).—A method is briefly described and illustrated in which the wire is mounted in an evacuated tube between 2 tapes so that it can be heated by a current passed either through it or through the supporting tapes alone.

—J. C. C.

A Classical Model of a Ferromagnetic Material and Its Subsequent Quantization in the Region of Low Temperatures. G. Heller and H. A. Kramers (*Proc. K. Akad. Wet. Amsterdam*, 1934, 37, 378-385).—[In German.] The classical model of a ferromagnetic material is defined; only when conceived in terms of a space lattice does the model indicate the occurrence of ferromagnetic saturation. Quantization of the model produces the formulæ of Bloch and Møller exactly.—J. S. G. T.

***Drift of Magnetic Permeability at Low Inductions after Magnetization.** Raymond L. Sanford (*J. Res. Nat. Bur. Stand.*, 1934, 13, 371-376; *Research Paper No. 714*).—The magnetic permeability of ferromagnetic materials at low values of induction depends on the time which elapses between demagnetization and testing. The change may be of the order of 10 or 12%. In order to

obtain consistent and reproducible results in testing at low inductions, a period of from 18 to 24 hrs. should elapse after demagnetization before the test is made.—S. G.

II.—PROPERTIES OF ALLOYS

***Correlation of Equilibrium Conditions in Binary Aluminium Alloys.** W. L. Fink and H. R. Freche (*Metals Technology*, 1934, (Oct.), *A.I.M.M.E. Tech. Publ.* No. 530, 1-14).—The results obtained previously for the equilibria at the aluminium end of binary systems of that metal with other metals of high purity have been analyzed mathematically, and the solid solubility and hypereutectic liquidus curves are shown to be in agreement with those deduced from the thermodynamic equation $\log x' = -L/RT + C$, where x' is the mol. fraction of alloying element, L the molal heat of solution, R the gas constant, T the absolute temperature, and C the integration constant. The systems with magnesium and with magnesium silicide, however, do not obey this rule. A straight line is obtained by joining the points obtained by plotting the logarithm of the eutectic lowering against the logarithm of the atomic-% of solute in solution at the eutectic temperature, the point for manganese being the only one not near this line. The reciprocal of the slope of the solubility line for all binary systems is a linear function of the logarithm of the concentration of the solute, and therefore the slope of the solid solubility curve for any binary aluminium system can be determined from any point on it by means of the expression :

$$\frac{1}{S} = \frac{T \log x'}{0.0003T - 1} + \frac{T}{0.417 - 0.000125T}. \text{—A. R. P.}$$

***Effect of Quenching Strains on Lattice Parameter and Hardness Values of High-Purity Aluminium-Copper Alloys.** Arthur Phillips and R. M. Brick (*Metals Technology*, 1934, (Sept.), *A.I.M.M.E. Tech. Publ.* No. 563, 1-19).—Copper-aluminium alloys made from very pure metals may show an abnormally large lattice parameter when quenched from the solid solution range due to strain resulting from quenching stresses. The parameter is greater the more severe the quench, the greater the diameter of the specimen up to 0.5 in., and the higher the copper content of the solid solution. The maximum age-hardening capacity at 20° C. is shown by drastically quenched alloys with 5.4% copper; during ageing there is first a slight decrease in the lattice parameter, but the constant value ultimately obtained is sufficiently high to indicate that partial precipitation is the cause of the observed hardening. The initial decrease in parameter is attributed to gradual relief of stress. When the quenching is only just sufficient to retain the metastable solid solution without producing severe quenching strains the alloys do not exhibit any hardening after 30 days at 20° C., which suggests that the presence of these strains is essential for hardening to occur at room temperature. Precipitation of CuAl_2 at 275°-325° C. is more rapid the greater the quenching strain and the greater the degree of supersaturation; when the alloys are again quenched after precipitation is complete the parameter of the residual solution is greater than that of pure aluminium, but when they are air-cooled or quenched in boiling water a normal reaction curve is obtained. Reheating at the precipitation temperature followed by a drastic quench again produces a distended lattice, which cannot, therefore, be due to strain induced by the precipitation process. Maximum hardness after ageing at 275°-300° C. is obtained when precipitation is practically complete.—A. R. P.

***Ternary Diagram of the Aluminium-Copper-Silicon System.** Kanji Matsuyama (*Kinzoku no Kenkyu*, 1934, 11, (10), 461-490).—[In Japanese.] The diagrams of the binary systems aluminium-copper, copper-silicon, and

aluminium-silicon have been carefully redetermined by means of thermal analysis, electrical resistance determinations, and microscopic examination. The aluminium-copper-silicon system was then investigated from melt to room temperature, and the ternary diagram of the whole system was constructed.—S. G.

***The Influence of Pickling on the Fatigue-Strength of Duralumin.** H. Sutton and W. J. Taylor (*J. Inst. Metals*, 1934, 55, 149-158; discussion, 158-164).—The effect on the fatigue limit of Duralumin in Wohler-type fatigue tests of the following pickling treatments has been determined: (A) 2½ minutes in 10% caustic soda solution at 60°-70° C., rinse, 1 minute in 10% nitric acid containing 10% of sulphuric acid; (B) 2 minutes in a solution containing 10% each of nitric and hydrofluoric acids; (C) 3 minutes in a 4 : 1 mixture of 10% sulphuric and hydrofluoric acids, rinse, 1 minute in 50% nitric acid. The percentage decreases in the fatigue limits observed were (A) 31%, (B) 15%, (C) 6%; immersion in boiling water after the pickling treatment reduced these decreases to (A) 10% and (C) 3.8%. Treatment (A) produces a rough serrated surface, and treatment (C) reveals the macrostructure of the alloy and is, therefore, suitable for the examination of the alloy for defects in manufacture. Removal of the pickled surface layer by machining completely eliminates the effects of pickling on the fatigue limit, indicating, as suggested by D. Hanson and by I. G. Slater in the discussion, that pickling produces a weakening of the surface layer either by gas adsorption or by setting up internal stresses, or that inter-crystalline penetration of the pickle occurs and induces corrosion-fatigue (suggested by R. Seligman). E. Wood stated that for commercial work a mixture of sodium fluoride and sulphuric acid was preferable to hydrofluoric acid for pickling light alloys.—A. R. P.

***Studies on the Decomposition of Supersaturated [Solid Solutions] in Light Metal Alloys.** E. Schmid and G. Siebel (*Metallwirtschaft*, 1934, 13, 765-768).—The decomposition of quenched alloys of magnesium with zinc and aluminium at 218° C., and of aluminium with magnesium at 218° and 155° C. has been followed by X-rays. The precipitation takes place the more rapidly the greater the degree of supersaturation of the solid solution and more slowly with single crystals than with polycrystalline aggregates. In zinc-magnesium alloys and in single crystals of aluminium alloys the composition of the solid solution decreases steadily from the beginning to the end of the reaction. In polycrystalline aluminium-magnesium and magnesium-aluminium alloys the initial and final concentrations are close together. The changes in the mechanical properties follow closely the progress of precipitation.—v. G.

Electrometallurgical Research and Its Relation to the Grand Coulee Power Development (Some Facts on the Ultra-Light Structural Alloys of Magnesium and Aluminium). A. E. Drucker (*State Coll. Washington, Met. Res. Bur. Information Circ. No. 8*, 1934, 6 pp.).—S. G.

Silumin-Gamma. J. Dornauf (*Aluminium*, 1934, 17, 26-31).—See also *Met. Abs.*, 1934, 1, 414. Silumin- γ is the eutectic silicon-aluminium alloy containing small additions of magnesium and manganese and modified by the usual sodium treatment just prior to pouring. After quenching from just below the solidus the alloy can be hardened by an ageing treatment. Sand-castings have a Brinell hardness of 80-100, a yield-point of 18-25 kg./mm.², a tensile strength of 25-29 kg./mm.², and an elongation of 4-0.5%; the corresponding values for chill-castings are 85-110, 20-28, 26-32, and 1.5-0.5, and for die-castings 110-130, —, 30-37, and 1-1.5. The alloy finds extensive use in the manufacture of housings for aero- and automobile engines and similar intricate castings where lightness, strength, and a high yield-point are desirable.—A. R. P.

Change of Mechanical Properties of Copper-Rich Alloys Due to the Grain-Refinement by the Peritectic Reaction. Ju-n Asato (*Kinzoku no Kenkyu*, 1934, 11, (8), 365-376).—[In Japanese.] The mechanical properties such as

Brinell hardness, tensile strength, elongation, yield-point, and limit of proportionality of some copper-rich alloys were determined to show how these properties are modified by grain-refinement caused by peritectic reaction.

—S. G.

***Crystal Densities of Industrial Brasses from X-Ray Data.** E. A. Owen and Llewelyn Pickup (*J. Inst. Metals*, 1934, 55, 215–222; discussion, 223–228).—The density of homogeneous alloys of copper and zinc in the α , $\alpha + \beta$, and β regions have been calculated from the lattice parameter as measured by X-rays, and the results obtained are shown to be superior to those obtained by weighing in air and water, since they are unaffected by porosity, cold-work, and grain-size, as well as by heat-treatment in the case of pure α - or pure β -alloys. The density of α -alloys is not a linear function of the composition, but that of β - and that of $(\alpha + \beta)$ -alloys can be taken as linear to a high degree of accuracy; at the phase boundaries, however, discontinuities in this relation occur. The values obtained are tabulated and the effect of quenching temperature on the density of duplex alloys is shown graphically.—A. R. P.

***Gold–Chromium Resistance Alloys.** James L. Thomas (*J. Res. Nat. Bur. Stand.*, 1934, 13, 681–688; *Research Paper No. 737*).—The addition of from 1.6 to 2.4% or more of chromium to gold produces alloys having very small temperature coeff. of electrical resistance. In particular, 2.1% chromium in gold gives an alloy whose resistance has been made independent of temperature, to a few parts in 10 million, over at least the interval 20°–30° C. These alloys are also exceptionally stable in resistance. They have, however, a thermo-electric power against copper which is 3 or 4 times as large as that of Manganin. The preparation and heat-treatment of some of these alloys are described.

—S. G.

***Age-Hardening of Lead Alloys.** H. Hariba (*Sumitomo-Densen Iho*, 1934, 1, (2), 49–57; *C. Abs.*, 1934, 28, 7229).—Lead–calcium alloys containing 0.02% calcium undergo age-hardening; the maximum hardening effect is at 0.1% calcium. The rate of change in hardness and in electrical resistance of lead containing calcium on ageing varies according to the calcium content; the volume of lead containing calcium contracts a little on age-hardening. In lead containing antimony expansion is shown.—S. G.

Bearing Metals in Use on the Railways of the U.S.A. [Sateo Metal]. [Fr.] Witte (*Organ Fortschr. Eisenbahnwesens*, 1934, 89, 400–402).—See *Met. Abs.*, 1934, 1, 416.—P. M. C. R.

***Solubility of Carbon in Iron–Manganese–Silicon Alloys.** C. H. Herty, Jr., and M. B. Royer (*U.S. Bur. Mines, Rept. Invest. No. 3230*, 1934, 22 pp.).—The solubility of carbon in iron–manganese alloys up to 75% manganese, in iron–silicon alloys up to 50% silicon, and in iron–manganese–silicon alloys with a 4–10 : 1 manganese–silicon ratio has been determined at 1300°–1700° C., and the results are shown in tables and graphs. Manganese, having a carbide-stabilizing action, increases the solubility of carbon, whereas silicon, having a graphitizing action, has the opposite effect, only 0.1% carbon being retained in solution in the 50 : 50 silicon–iron alloy. A 3-page table is given showing the carbon solubility at 1300°, 1500°, and 1700° C. in alloys containing 0–80% manganese and 0–20% silicon in 5% steps. The bearing of the results on the composition and use of these alloys as steel deoxidizers is discussed.—A. R. P.

***On Anomalous Properties of New Magnetic Materials [Copper–Nickel–Iron Alloys].** Martin Kersten (*Wiss. Veröff. Siemens-Konzern*, 1934, 13, (3), 1–9).—The magnetic properties of 45 : 55 nickel–iron alloys with additions of 0, 3, 6, 9, 12, and 15% copper have been determined after annealing, in the form of 3 mm. wires, at 900° C. for 2 hrs., slowly cooling, and rolling to strips 0.08 mm. thick without further annealing. Without addition of copper the alloys give a normal magnetization curve and a remanence of about 50% of the saturation magnetization, whereas the 9% copper alloy gives a linear magnetization

curve and a remanence of only 6%, which, however, is increased almost to 100% if the alloy is subjected to a tensile stress of about 60 kg./mm.² in the direction of the magnetizing field. Analysis of the magnetic stresses in these alloys indicates that the stress rises sharply with increasing copper content; annealing tests indicate that this increase in stress is due to precipitations similar to those which occur in precipitation-hardening. Very high remanence values approaching closely to the saturation magnetization can be obtained in the 12 and 15% copper alloys by annealing the hard-rolled strip at 600° C.—A. P.

***Torsional Moduli Variations of Spring Materials with Temperature [Konel].** Joseph W. Ludewig (*Trans. Amer. Soc. Metals*, 1934, 22, 833-860).—The behaviour of springs at elevated temperatures involves knowledge of the values of the modulus of rigidity and proportional limits of materials at such temperatures. A summary of previous work on the variation of the modulus of rigidity with temperature, and on the behaviour of springs at elevated temperatures is given. The torsional moduli of a number of materials are plotted against temperature, and in accordance with the procedure outlined in the paper the following results were obtained: (1) Materials maintaining highest absolute value of the modulus of rigidity up to 450° F. (232° C.) are high-speed steel, stainless (cutlery) steel, and Konel. (2) Material maintaining highest absolute value of the modulus of rigidity up to 985° F. (529° C.) is high-speed steel. (3) Material showing lowest absolute value of the modulus of rigidity at all temperatures is carbon spring steel. (4) The remaining material tested was Silcrome steel. A discussion of the factors found in spring formulae and behaviour under temperature variations is included.—S. G.

Metallurgical Applications of Silicon. J. W. Donaldson (*Metallurgia*, 1934, 11, 20-22).—The uses of silicon as an alloying metal are considered and its applications in steels, cast irons, corrosion-resisting alloys, and non-ferrous alloys are discussed. The non-ferrous alloys referred to are the silicon-aluminium alloys of the Duralumin, R.R. alloys, Alpax (Silumin), and hypoeutectic aluminium-silicon alloy types; the copper-silicon alloys, both silicon-bronzes and silicon-brasses, and nickel-silicon alloys.—J. W. D.

Recent Development in Main and Connecting-Rod Bearings. Stanwood W. Sparrow (*Soc. Automotive Eng. Preprint*, 1934, June, 7 pp.; and (summary) *Automotive Ind.*, 1934, 70, 772-773).—Evidence is given which indicates that flexing and faulty bonding are not the primary causes of cracking in main and connecting-rod bearings of automobile engines, but that cracking is produced by a tangential force between the journal and the bearing at spots where the oil-film is inadequate to prevent metal to metal contact. A minimum thickness of 0.03 in. of Babbitt metal is recommended, and undercutting has been found to extend the life of the bearing since it prevents the cracks from spreading and permitting the Babbitt metal to escape. Copper-lead bearings (lead 45, nickel 2, copper 53%) crush as readily as Babbitt metals, and metal to metal contact produces a lead film which has sufficient lubricating value to prevent seizing; failure of copper-lead bearings occurs by disintegration of parts where it is difficult to maintain an oil-film or when an unsuitable oil is used. Lubrication of bearings and the effects of "dirt" are briefly discussed.—A. R. P.

†The Improvement of White Bearing Metals for Severe Service: Some General Considerations. D. J. Macnaughtan (*J. Inst. Metals*, 1934, 55, 33-47).—Development in the internal combustion engine is imposing increasingly severe conditions on bearings. Consideration is given to the theoretical functions of an ideal white metal, and the manner in which the stresses produced in service tend to cause failure by cracking. Since the normal action of the stresses is compressive, special attention is given to the tension stresses which are shown to lower the fatigue range of the metal and to open up incipient cracks. Based on this analysis the mechanism of crack formation is discussed. The following

directions in which improvement in service behaviour may be secured are considered: (1) diminishing the intensity of the stresses in the metal by modifications in (a) certain features in design; (b) the material used for the liner; (2) increasing the fatigue-resisting properties of the white bearing metal, in respect to which results obtained in preliminary investigations of the fatigue properties of high tin-antimony-copper alloys with and without addition of a further element are given.—D. J. M.

***The Behaviour of White Bearing Metals when Subjected to Various Deformation Tests. Introduction.** —(*J. Inst. Metals*, 1934, 55, 49-50).—The scope of the investigation and compositions of the materials used are given. The results of the research are described in 3 parts; for abstracts see below.—S. G.

***The Behaviour of White Bearing Metals when Subjected to Various Deformation Tests. Part I.—Indentation Tests.** A. S. Kenneford and Hugh O'Neill (*J. Inst. Metals*, 1934, 55, 51-69).—The effect of viscous flow, ageing, and prolonged heating on the resistance to indentation of tin- and lead-base bearing metals has been investigated. Flow tests with a 120° steel cone at 19° and 96° C. show that Babbitt metal containing 1% cadmium or 2% nickel, or a lead-alkali bearing metal, give better indentation results than a plain Babbitt alloy. The hardness of the different metallographic constituents of bearing metals and their softening on heating to 100° C. were measured by scratch and micro-indentation tests. The matrices lose 40-45%, and the cuboids 20% of their hardness, but the cuboids in a Babbitt remain somewhat harder than those in a lead-base alloy. Two new simple tests are suggested. In the first a lubricated 60° conical casting of the alloy is flattened under 100 kg. load for 30 seconds, and the Mallock hardness number determined. By increasing the duration of loading a flow index may be measured on lines similar to "Hargreaves' analysis." Then, by compressing until cracks appear on the extruded edge, the ductility of the specimen and its cracking stress may be measured. At room temperatures the lead-base alloys show relatively low ductility, and this agrees with their low work-hardening capacity as determined by specially conducted ball tests and repeated impact tests with the scleroscope. The second method employs an instrument similar to the Herbert pendulum, and measures the damping effect. It may not only be used to give rapid indications of hardness at different temperatures, but is also sensitive to the effect of different lubricants.—A. S. K.

***An X-Ray Examination of the Phases in Babbitt Metal, and of the Age-Hardening of Cast Lead-Alkali Alloy.** G. S. Farnham (*J. Inst. Metals*, 1934, 55, 69-70).—Appendix to a paper by Kenneford and O'Neill (see preceding abstract). An alloy of the composition SnSb after annealing for 1 week has a structure of the NaCl type with $a = 4.099 \text{ \AA}$. The presence of this compound in Babbitt metal has been confirmed by X-ray tests. The needle constituent of Babbitt metal has been isolated by liquation and its composition proved to be CuSn or the η -phase of the copper-tin system. X-ray examination of a sodium-calcium-lead bearing alloy in the newly cast and in the aged condition shows that the cast alloy consists of two phases, one of which changes with ageing whilst the other does not; the latter is face-centred cubic with $a = 4.889 \text{ \AA}$, and is probably CaPb_3 . The former is a supersaturated solution of sodium in lead which deposits a sodium-rich phase (possibly Na_2Pb_5) on ageing.—A. R. P.

***The Behaviour of White Bearing Metals when Subjected to Various Deformation Tests. Part II.—Tensile Tests.** R. Arrowsmith (*J. Inst. Metals*, 1934, 55, 71-76).—The tensile properties of white metal specimens, prepared by gravity die-casting and without any machining, have been determined at room temperature on a Hounsfield "Tensometer." Various casting conditions were examined for each alloy. Babbitt metal with additions of cadmium gave the highest values of limit of proportionality and ultimate stress. The greatest ductility was obtained from an alloy containing 89% of tin.—R. A.

***The Behaviour of White Bearing Metals when Subjected to Various Deformation Tests. Part III.—Pounding Tests.** H. Greenwood (*J. Inst. Metals*, 1934, 55, 77-87).—A modified form of the Stanton impact tester suitable for the testing of white metals by pounding at different temperatures is described. Results on cylindrical specimens are given, and the unsuitability of this type of test-piece is shown. The use of bearing-shaped specimens with a cylindrical indenter is described. Results are recorded for 8 different white-metal bearing alloys and a lead-alkali alloy, cast under various conditions, and tested at 18°, 100°, and 150° C. A Babbitt metal with an addition of cadmium gave the greatest resistance to pounding.—H. G.

Joint Discussion [on the Improvement of White Bearing Metals for Severe Service]. — (*J. Inst. Metals*, 1934, 55, 88-113). See 6 preceding abstracts.—*A. J. Murphy* and *J. Cartland* expressed the opinion that failure of bearings was frequently due to stresses set up by the different contraction of the lining and shell on cooling and not primarily to the formation of a brittle tin-iron compound at the junction of the two metals. *R. Chadwick* stated that, when a bearing is "run in," the metal is in a cold-worked condition in which the rate of creep under load is much greater than when the metal was cast; figures and curves were given to illustrate this behaviour. He had found that addition of cadmium to Babbitt alloys prevents cracking during cold-rolling by suppressing the cuboids at the edges of which cracking commenced. *H. Sutton* considered that the failure of big-end bearings is due to fatigue-cracking and stated that addition of 0.5% nickel to Babbitt alloys improves their behaviour in this respect. *H. L. Evans* said that annealing improves the stress conditions in cadmium-base bearing metals; these alloys can now be readily cast on to steel or bronze liners to give values of 6.5 tons/in.² in the shear of bond test and to withstand 15 million reversals of stress at a stress of 18.9 tons/in.² on the inner surface of the steel shell. *R. W. Bailey* gave a mathematical proof that there is a definite relation between indenter flow tests and tensile creep tests. *H. N. Bassett* described a case of failure of a 50 : 38 : 10 : 2 tin-lead-antimony-copper alloy used as a bearing metal in the axles of railway wagons. Other speakers put forward various theories to account for the cracking of Babbitt metal bearings subject to high duty, and *Macnaughtan*, *Kenneford*, *O'Neill*, and *Greenwood* in replying to the discussion, critically reviewed all these theories as well as the whole subject of testing bearing metals, and put forward suggestions for future research.—A. R. P.

***Some Properties of Tin Containing Small Amounts of Silver, Iron, Nickel, or Copper.** D. Hanson, E. J. Sandford, and H. Stevens (*J. Inst. Metals*, 1934, 55, 115-131; discussion, 131-133).—The tin-rich ends of the silver-tin, nickel-tin, and copper-tin equilibrium diagrams were investigated. With the first, the eutectic occurs at 3.5% silver, at 221.3° C.; with the second, at 0.18% nickel at a temperature which does not vary appreciably from the melting point of pure tin; with the last, between 0.70 and 0.75% copper at 226.9° C. The solid solubility of silver in tin is approximately 0.02% at room temperature, increasing to 0.06% at 210° C. The solid solubility of nickel is less than 0.005%, and that of copper less than 0.01% at 220° C. The method of making additions to tin is discussed; no particular difficulties are met with in the case of silver, iron, copper, and nickel. The influence of additions of these metals on the tensile strength of tin is discussed. A great increase produced by quenching silver-tin alloys is not permanent at room temperature, whilst with the other 3 alloys quenching has no effect. Additions of iron above 0.4% are without effect, although up to this percentage an increase of 40% in the tensile strength is found. Nickel up to 0.3% produces an increase up to 2.1 tons/in.², but further additions have no influence. Copper up to 2% greatly increases the tensile strength after all heat-treatments investigated. Silver refines the grain of tin, but does not prevent grain-growth at high temperatures. The addition of iron

above 0.05% or of nickel above 0.06% prevents such grain-growth, although below these compositions germination takes place. 0.35% and more of copper prevents recrystallization of cold-rolled tin at room temperature, but annealing at temperatures from 110° C. upwards produces larger grains than in alloys of slightly lower copper content.—D. H.

***Studies of Phase Changes During Ageing of Zinc-Alloy Die-Castings. I.—Eutectoidal Decomposition of Beta Aluminium-Zinc Phase and Its Relation to Dimensional Changes in Die-Castings.** M. L. Fuller and R. L. Wilcox (*Metals Technology*, 1934, (Sept.), *A.I.M.M.E. Tech. Publ.* No. 572, 1-17; and (abstract), *Iron Age*, 1934, 134, (15), 30-31).—On ageing the quenched β -aluminium-zinc alloy at 0° C. decomposition into $\alpha + \gamma$ is complete in $3\frac{1}{4}$ minutes and the temperature rises to 84° C.; the corresponding figures for ageing at 20° C. are $1\frac{1}{2}$ minutes and 108° C., and at 50° C. $1\frac{1}{2}$ minutes and 133° C. After quenching from 350°-375° C. in water at 20° C., the 20% aluminium-zinc alloy decomposes into $\alpha + \gamma$ in $1\frac{1}{2}$ minutes with an increase in temperature to 99.3° C.; with 1% copper the time required is 58 minutes and the temperature reaches 78° C., and with 0.1% magnesium decomposition starts in 3 days at 20° C. and is completed in about 35-40 days at 20° C., but at 100° C. decomposition is complete in 1 day. The change in length on ageing the β -alloy with 0.1% magnesium is 0.29%. The β -phase in commercial zinc-base die-casting alloys with 0.3% copper and 0.04% magnesium is completely decomposed in less than 1 day; this may be due to the slower rate of cooling or to the acceleration of the decomposition by the large amount of α present. The shrinkage of the commercial alloys cannot be due entirely to decomposition of β ; it is highly probable that other phase changes occur which also cause shrinkage. The heat of decomposition of pure β is 7.39 grm.-cal./grm. for the 20% aluminium alloy and the decomposition temperature is about 277° C.—A. R. P.

***An Analogy Between Plastic Deformation and Certain Cooling Rates in Causing "Premature" Precipitation in Supersaturated Solid Solutions. The Incubation Period.**—I. J. L. Burns (*Trans. Amer. Soc. Metals*, 1934, 22, 728-736).—Reports a study of the age-hardening of Duralumin. The effect of rate of cooling on age-hardening and on the incubation period was investigated. It was found that if a supersaturated solid solution is plastically deformed immediately after the quenching operation, ageing begins earlier, there is no incubation period, and the final hardening due to precipitation is less. If a particular rate of cooling is used in quenching from the temperature of maximum solubility, ageing begins earlier, there is no incubation period, and the final hardening will usually be less. From this it is concluded that plastic deformation does not increase the rate of hardening, but merely causes the hardening to start earlier. Precipitation may take place during a cold-working operation or during quenching. When an incubation period ensues after quenching, it is suggested that the solute has been retained in its entirety during the quenching operation. The hardness of quenched steel is probably due to the same cause as that of oil- or air-cooled Duralumin, namely, ageing during the cooling operation. This analogy, if true, obviates any sharp line of demarcation between ferrous and non-ferrous alloys.—S. G.

†***The Present Status of Age-Hardening.** Richards H. Harrington (*Trans. Amer. Soc. Metals*, 1934, 22, 505-524; discussion, 525-531).—The theoretical aspects of age-hardening are briefly outlined for 3 general types: (a) simple precipitation age-hardening, (b) simple lattice-strain age-hardening, and (c) complications due to allotropy. The practical significance of age-hardening alloys at elevated temperatures in relation to tensile strength and for spring properties is discussed, and an interesting plan is given for exploring an unknown system. Cobalt added to age-hardening alloys acts in general further to increase the age-hardness and often to increase the temperature of

maximum age-hardness. It may act generally in 2 ways: (1) as a "desolvent," reducing the solubility of the precipitating constituent, at least part of the cobalt going into solid solution in the solvent lattice; (2) almost all of the cobalt (if correctly added) enters into a ternary constituent with the precipitating agent, thus usually decreasing the solubility of this precipitant. —S. G.

†**Age-Hardening Alloys.** — (*Metallurgist* (Suppt. to *Engineer*), 1934, 10, 149-150).—A brief review of the subject and a summary of a paper by R. H. Harrington (preceding abstract).—R. G.

***Method of Radiation-Calorimetry for Determining the Thermal Conductivity of Metal Bars.** P. Vernotte (*Aérotechnique* (Suppt. to *Aéronautique*), 1934, 12, 25).—A brief, illustrated note of a method for determining thermal conductivities by observing the power dissipated by a small electric furnace when a bar of the metal is inserted in the furnace in different positions. The conductivity of a brass bar 50 mm. long and 4 mm. in diameter was found to be 0.29 cal./deg./cm./sec.—J. C. C.

†**Alloys [The Hume-Rothery Rules].** Anon. (*Metallurgist* (Suppt. to *Engineer*), 1934, 10, 174-176).—A brief review of the subjects of codification of data relating to equilibria in alloy systems and the formulation of rules on which to base reliable predictions. A paper by Hume-Rothery, Mabbott, and Evans (*Met. Abs.*, 1934, 1, 296) is critically discussed. It is pointed out that the false valency factor or "liquidus factor" of Hume-Rothery and his collaborators, calculated from data on copper and silver alloys, is not a whole number as claimed. In consequence, theoretical arguments based on this premise must be regarded as invalid, and the scientific basis of liquidus curves as not yet known. In the prediction of the freezing points of ternary alloys, the authors referred to have been singularly successful, and though their results are regarded as empirical, the line of investigation followed should provide a measure by which experimental results may be compared and codified.—R. G.

Metallic Alloys. Anon. (*Werkstatt u. Betrieb*, 1934, 67, 353-354).—A summary, giving the average composition of a number of alloys, classified as: copper alloys (not bronzes), bronzes, aluminium alloys, nickel alloys, zinc alloys, tin alloys, lead alloys, white (bearing) metals, fusible alloys, light alloys, amalgams, silver and gold alloys.—P. M. C. R.

A Metallurgical Survey of Engineering Material. Josiah W. Jones (*Met. Ind. (Lond.)*, 1934, 45, 537-541).—An abstract of the "non-ferrous" portion of a paper dealing with both ferrous and non-ferrous metals, read before the Birmingham Branch of the Institution of Production Engineers. The strength to weight ratio of heavy and light alloys, the "shapeability" of alloys, the theory of hardening of Duralumin, the hardening of copper alloys, particularly of Kunial, permanence as regards the fracture of defective material and the weakening of section due to corrosion, quenching non-ferrous alloys, and the properties of heat-resisting alloys are discussed.—J. H. W.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

Etching Polish for the Preparation of Metallographic Samples. N. Zarubin, M. Suitin, and N. Golikov (*Zavodskaya Lab.*, 1933, (7), 49-53; *C. Abs.*, 1934, 28, 7231).—[In Russian.] Osmond's method of polishing samples for metallographic analysis with an etching polish was used successfully not only for metals such as tungsten, molybdenum, tantalum, vanadium, &c., but for non-ferrous metals and alloys such as copper, aluminium, nickel, tin, lead, bronze, &c. 16 references are given.—S. G.

***The Deformation Lines in Alpha Brass.** Carl H. Samans (*J. Inst. Metals*, 1934, 55, 209–213).—A microscopic study of 70 : 30 brass single crystals of 2 different orientations which had been reduced 50% in thickness by cold-rolling revealed the presence of many of the so-called “lines of deformation.” X-ray determinations in the rolling plane showed conclusively that the markings were mechanical twins parallel to octahedral planes.—C. H. S.

***An X-Ray Study of Orientation Changes in Cold-Rolled Single Crystals of Alpha Brass.** Carl H. Samans (*Metals Technology*, 1934, (Oct.), *A.I.M.M.E. Tech. Publ. No. 579*, 1–15).—The lattice rotations found in rolled single crystals of 70 : 30 brass of 5 different initial orientations have been successfully explained on the basis of plane parallelepipedal compression representation of the forces of rolling. The active slip plane can be determined both from the maximum shear-stress law and the manner of rotation. One of 3 slip systems will be active according to the rolling plane and direction of rolling chosen, and the lattice rotations produced by deformation will be a variation of one of the following ideal positions of rolling plane and rolling direction : (110), [112]; (110), [001]; (110), [011]; (001), [010]; (112), [111].—A. R. P.

***Crystal Orientation in Drawn Brass Cups.** L. Herrmann and G. Sachs (*Metallwirtschaft*, 1934, 13, 745–752).—The degree of deformation and the orientation of the crystals at various parts of a drawn 63 : 37 brass cup have been investigated; the observed textures correspond with those observed in simple deformation processes, thus where pure compression occurs the corresponding fibre texture is found with [110] as the axis of the films, and where elongation occurs a double-fibre texture is formed with the [111] and [200] orientation. In the other zones the complex textures formed correspond with the complex nature of the deformation; no texture equivalent to the rolling texture can be found in any part of the drawn cup.—v. G.

***Crystal Re-Orientation on Heating Drawn Copper Wires.** G. S. Farnham and Hugh O'Neill (*J. Inst. Metals*, 1934, 55, 201–208).—The behaviour of a silver-free copper wire reduced 59% by cold-drawing, has been compared after “low-temperature treatment” (L.T.T.) with that of 2 silver-bearing wires reduced 59 and 49%, respectively. L.T.T. hardening occurs in the first, but not in the second of these. X-ray spectroscopy makes it evident that preferred orientation is less developed in these silver-bearing wires. The general effect of L.T.T. at 130° C. is to reduce the amount of [111] preferment, but to cause an increase of [100] preferment. This change-over probably causes “orientation hardening.” In these silver-bearing wires, however, the change is only relatively small in extent, and this appears to explain the differences as regards L.T.T. hardening.—G. S. F.

***An X-Ray Study of the Effect of Heat on the Structure of Sputtered Films of Gold.** S. Rama Swamy (*Proc. Phys. Soc. (Lond.)*, 1934, 46, 739–746).—Sputtered films of gold of different thicknesses were heated to various temperatures up to 800° C. and their Debye-Scherrer X-ray photographs determined at each stage of heating. The photographs indicated that on being heated the gold crystals in the films oriented themselves so that their 111 planes were parallel to the surface of deposition. The crystals grew when the films were heated. The degree of orientation and size of crystals depended on the thickness of film and on the temperature to which the film was heated.—J. T.

***The Crystal Structure of the Intermediate Phase Au₂Pb.** Harald Perltz (*Keemiateated*, 1934, 2, (1), 11–16; *Chem. Zentr.*, 1934, 105, II, 2656–2657).—The phase is cubic face-centred, $a = 7.910 \text{ \AA}$., with 24 atoms in the unit cell. The structure of the cell is analogous to that of MgCu₂ and KBi₂.—A. R. P.

***The Growth of Metal Crystals in Metal Vapours. III. [—Magnesium].** M. Straumanis (*Z. physikal. Chem.*, 1934, [B], 26, 246–254).—To test Kossel and Stranski's theory of the homopolar growth of crystals, experiments have been made on the sublimation of magnesium in hydrogen at 0.001–300 mm. pressure

at temperatures below the melting point. Earlier work on cadmium under similar conditions is reviewed and amplified by new measurements of the crystals produced. The magnesium crystals are bounded by [0001], [1010], and [1011] planes; unlike zinc and cadmium crystals they do not grow in layers. The results are in accordance with theory if the calculations take into consideration only the nearest neighbours to a particular lattice point.—K. S.

Crystal Structure of Tl_3Sb_2 . F. R. Morral and A. Westgren (*Svensk Kem. Tids.*, 1934, 46, 153–156; *C. Abs.*, 1934, 28, 7102).—The diagrams of ideal and real molecular structure of Tl_3Sb_2 are given, together with a table of constants.—S. G.

***Crystal Structure of Thallium-Bismuth Alloys.** Arne Ölander (*Z. Krist.*, 1934, 89, 89–92; *C. Abs.*, 1934, 28, 7229).—[In German.] Two intermediate phases in the thallium-bismuth system were observed. With a composition between 73 and 96% thallium, the structure is face-centred cubic, with a varying from 4.928 to 4.842 Å. Between 34 and 46% thallium the structure is hexagonal, with $a = 5.670$ – 5.642 Å. and $c = 3.369$ – 3.375 Å.—S. G.

***The Mechanism of the Transformation of Body-Centred Cubic Zirconium into the Hexagonal Modification.** W. G. Burgers (*Metallwirtschaft*, 1934, 13, 785–786).—Recent work has shown that structural changes take place by an ordered translation in the lattice. The transition from a body-centred cubic to a close-packed hexagonal lattice can therefore occur only by the formation of a face-centred cubic lattice as an intermediate phase; this appears to be the case with calcium (cf. Graf, *Met. Abs.*, 1934, 1, 496).—v. G.

***On the Influence of the Method of Working on the Orientation of Crystals of Wire.** G. von Vargha and G. Wassermann (*Z. Metallkunde*, 1933, 25, 310–313).—The textures produced in the inside of metal wires by rolling, drawing, or free stretching are exactly the same, but the outer layers of rolled wires show considerable differences from those of drawn wires, owing to the inequalities in the deformation of various parts produced by the rolling. In drawn wires the similarly oriented crystal axes in the outer layers are inclined at a few degrees to the axis of the wire, owing to the metal of the outer layers having a direction of flow in the die inclined to the wire axis. The X-ray tests were made on copper, aluminium, iron, and β -brass.—B. Bl.

***X-Ray Line Broadness of Metals and Alloys, and Its Relation to High-Temperature Stability.** J. E. Wilson and L. Thomassen (*Trans. Amer. Soc. Metals*, 1934, 22, 769–809).—Recovery of X-ray line sharpness in cold-worked metals and alloys is studied as a function of time and temperature of annealing. Line sharpening is caused by diffusion of displaced atoms to normal lattice positions; in the case of nickel at low annealing temperatures the process involves a long induction period. A quantitative time-temperature relationship for line sharpening is determined for nickel, copper, and the α -brasses. A mechanism of recovery is described, based on correlations with hardness, electrical conductivity, and other data. Line sharpening temperatures may be used to predict immunity from *season-cracking* in brasses. Creep data on brasses, copper-nickel alloys, and a series of pearlitic manganese and manganese-molybdenum steels are correlated with line broadness data. In a continuous series of solid solutions, the alloy of maximum line-sharpening temperature has the optimum creep characteristics. The poor creep strength of 60:40 brass above 500° F. (260° C.) is due to inferior temperature stability of the β -phase. A secondary maximum in creep strength at 900° F. (482° C.) in one of the manganese-molybdenum steels is paralleled by a maximum in a precipitation-hardening effect which is disclosed by X-ray and hardness measurements.—S. G.

Various Modes of Attack in Crystallographic Investigations. J. D. H. Donnay, G. Tunell, and T. F. W. Barth (*Amer. Mineralogist*, 1934, 19, 437–458).—Descriptive methods are classified as either determinative, morpho-

logical, or structural. The goniometric methods of Fedorov and of T. W. Barker are reviewed. A system of morphological description, based on the work of Häüy and of Bravais, is summarized. The structural classification of crystals is based on the X-ray determination of the space-lattice, and the present state of röntgenographic identification is discussed. Cases illustrate, respectively, the agreement and disagreement of the "determinative" lattice with that arrived at by structural methods; it appears, however, that in the case of chemical elements such disagreement is not to be expected.—P. M. C. R.

IV.—CORROSION

***Weathering of Aluminium Sheet Used in Aircraft.** Willard Mutchler (*Nat. Advisory Cttee. Aeronautics, Rep. No. 490, 1934, 34 pp.*; *C. Abs., 1934, 28, 7228*).—The results of numerous laboratory corrosion and weather-exposure tests conducted over a period of more than 5 years, at Washington, D.C., Hampton Roads, Va., and Coco Solo, Canal Zone, are given in tabulated form, with many illustrations. The effects of variable factors in the heat-treatment and the application of various protective coatings are discussed. Properly heat-treated sheet material of the Duralumin type is entirely reliable. Protective coatings of pure aluminium are recommended if severe corrosive conditions are to be met.—S. G.

***Aluminium in Bleaching with Hydrogen Peroxide.** R. W. Müller (*Deut. Färber-Zeit., 1934, 70, 327-328*; *J. Textile Inst., 1934, 25, 446A*).—The disadvantages of the materials generally used for the construction of bleaching apparatus are discussed, and a brief account is given of laboratory tests of the value of aluminium for the construction of apparatus for the hydrogen peroxide bleaching process. The tests showed that aluminium is only attacked to a very slight extent by dilute ammonia solutions of p_H of the order of 8. Commercial hydrogen peroxide solutions which are slightly acid produce a small loss in weight at first, but further attack is prevented by the formation of a protective oxide film. The addition of dilute ammonia reduces the attack and addition of sodium silicate encourages the formation of the protective film. No attack of the metal occurs when the silicate and alkali amounts are adjusted to give a p_H of 7.5-9 in solutions containing 1-6% by volume of hydrogen peroxide even when heated to 90°-95° C. Determinations of the oxygen loss from hydrogen peroxide solutions stored in different types of vessels showed that the solutions were as stable in aluminium vessels as in porcelain ones, and more stable in these than in glass ones. Large losses of oxygen were observed on storing in iron and copper vessels.—S. G.

***On the Interesting Special Case of the Use of Silumin.** G. Eckert (*Aluminium, 1934, 17, 31-34*).—The effect of boiling linseed oil on aluminium and its alloys has been determined at temperatures up to 370° C. Overheated oil rapidly attacks pure aluminium and most of its alloys, producing severe pitting and eventually perforation; Silumin is, however, quite unattacked even with severe overheating. Boiling stearic, oleic, and palmitic acids are also entirely without action on Silumin but rapidly dissolve aluminium; boiling phenol has relatively little action, and boiling aniline no action at all on Silumin.—A. R. P.

***Pipe Corrosion Experiments, Catskill Supply, New York City.** Frank E. Hale (*J. Amer. Water Works Assoc., 1934, 26, 1315-1347*).—For 2 years, water was allowed to flow through $\frac{3}{4}$ -in. diameter pipes of steel, wrought iron, galvanized steel, Plumrite (60 : 40 brass), Cuprite (85 : 15 brass), and lead. In a second two-year experiment, pipes of wrought iron, galvanized wrought iron, copper, and cement-lined steel were used. Seven series of tests were run in each experiment, using raw Catskill water, and water treated with

sodium silicate to 5 p.p.m. and 10 p.p.m. of silica, respectively, with 5 p.p.m. and 10 p.p.m. of soda ash, 4.5 p.p.m. of lime hydrate, and 4 p.p.m. of sodium hydrate. Rate of flow was regulated, and, in all pipes except the lead, lengths maintained at 150°–160° F. (65.5°–71° C.) were included in the system. Weekly determinations (twice monthly after several months) were made on the emerging water for oxygen, free carbon dioxide, p_H value, iron, alkalinity to phenolphthalein and methyl orange, turbidity, and colour. Every 6 months lengths of piping were removed for examination and total clogging of the system measured. General averages for each pipe are tabulated. None of the water treatments reduced oxygen consumption in the cold systems in any pipes, and in the hot systems the silicate treatments alone reduced oxygen consumption in the wrought iron and steel pipes. The treatments—particularly the silicate treatments—caused worst clogging in the hot wrought-iron pipes, less in black steel, cement-lined steel, galvanized steel, and galvanized wrought iron (in that order), and practically none in lead, copper, brass, and red brass. Oxygen consumption (and corrosion) is very much greater in the ferrous than in the non-ferrous pipes.—J. C. C.

***Rate of Solubility of Gold, Silver, and Copper Alloys in Cyanide Solutions.** I. N. Plaksin and S. V. Shibaev (*Sovet. Zolotoprom*, 1934, (3/4), 40–41; *C. Abs.*, 1934, 28, 7230).—[In Russian.] A brief report is given of a study of solubility of the systems gold-copper, silver-copper, and gold-silver in cyanide solution.—S. G.

***Printed Matter for Nickel Articles.** — (*Printing Ind. Res. Assoc. Memo.* No. 7, 1934, 7 pp.).—Labels printed with a black ink on a glassine paper caused fogging of nickel-plated articles to which they were attached. The paper contained a trace of sulphur dioxide and appreciable quantities of sulphates. The mechanism of fogging is explained by reference to the work of Vernon (*J. Inst. Metals*, 1932, 48, 121–136). In order to prevent fogging it is recommended that a thin film of lanoline should be applied to the nickel prior to attaching the label and that 0.1% of ammonium sulphide be added to the solution used to damp the gum at the back of the label. Printed matter brought into contact with nickel articles should be as free as is feasible from materials likely to give rise to sulphur dioxide, and should contain the minimum of sulphides, *i.e.* in the case of paper it should have as low an acid value as possible.—S. G.

***On Some Ancient Copper-Coated Silver Coins of Cyprus.** Stanley G. Willimott (*J. Inst. Metals*, 1934, 55, 291–294).—A number of authentic Greek and Roman coins of Cyprus having the appearance of copper or bronze have been found at different times and places. On archaeological grounds these coins would have been expected to have been silver, and laboratory investigation proved this to be the case, 92.3% silver being found in one case and 94% in another. The cause of this phenomenon was studied and 3 possibilities were considered: (1) galvanic action due to the chance contact of silver coins with a less noble metal, *e.g.* iron, in the presence of water containing copper sulphate as an electrolyte; (2) the electrolytic (cathodic) deposition of copper on silver as a result of contact with an electrolyte charged with copper salts derived from cupriferous pyrites; (3) chemical alteration of the surface of the silver coins by pyro-oxidation of the contained copper as a result of accidental fires. With regard to cause (1) it was possible to demonstrate this in the laboratory and to coat silver coins with a tenacious film of copper.

—S. G. W.

***The Corrosion of Tin and Its Alloys. I.—The Tin-Rich Tin-Antimony-Copper Alloys.** T. P. Hoar (*J. Inst. Metals*, 1934, 55, 135–146; discussion, 146–147).—The tin-rich tin-antimony-copper alloys were examined with regard to their resistance to corrosion by dilute hydrochloric and citric acids and by various tap-waters. The straight 5% antimony alloy containing no

copper is found to be usually somewhat more resistant to these types of corrosion than alloys containing copper. Soft water produces tarnishing; hard water gives no tarnish, but may give localized attack if there is much chalky deposit.—T. P. H.

***A Reflectivity Method for Measuring the Tarnishing of Highly-Polished Metals.** L. Kenworthy and J. M. Waldram (*J. Inst. Metals*, 1934, **55**, 247–256; discussion, 256–263).—An optical apparatus and method are described for determining the specular and diffuse components of reflection of light from the surface of polished metals and thereby measuring the degree of tarnishing when such specimens are subjected to prolonged exposure to the air. If R_s and R_D are respectively the specular and diffuse reflectivities, a "figure of merit" (M) may be calculated by the expression $M = 10\sqrt{R_s(R_s + R_D)/(R_D + 1)}$. For pure tin exposed to the air M decreases almost hyperbolically from 300 to 100 in 16 weeks, for ordinary tin from about 180 to 110, and for Britannia metal from about 320 to 140 in the same time; periodic washing in soap and water increases M again but never to the original value, for tin M after each washing returns to 200–250 and for Britannia metal falls slowly to 240. The fall in M produced by washing is attributed mainly to the effect of scratching. In the discussion A. Portevin adversely criticized the "figure of merit" as a criterion of the reflectivity of a metal and described a method of measuring the brilliance or polish of a metal by means of the Toussaint photocolourimeter; this method was claimed to overcome difficulties due to colour variations when the metal tarnished, and to be less liable to error since observations were made with the photoelectric cell. Some results on the colour changes of industrial metals on exposure to air and on the changes in reflectivity thus produced were described and illustrated graphically.—A. R. P.

***Some Optical Observations on the Effect of Ozone and Air on Metals.** L. Tronstadt and T. Höverstad (*Trans. Faraday Soc.*, 1934, **30**, 1114–1127).—The formation of films on silver, copper, zinc, iron, and steel in dry and moist ozone has been followed by Drude's optical method; in the moist gas no highly protective films are formed on any of these metals, and the attack is partly due to ordinary atmospheric corrosion, but in dry ozone such films are formed on silver, iron, and steel. The films formed on copper and zinc in dry ozone are not completely protective, no stationary state being attained. The growth of films on zinc in moist and dry ozone and pure air is a linear function of the time of exposure; their formation is discussed from the point of view of recent work on electron diffraction. Films produced on copper and iron in an atmosphere containing iodine have only a poor resistance to the diffusion of the reagent and hence must be regarded as porous or liable to crack.—A. R. P.

On the Corrosion of Welds. Francis Meunier (*Bull. tech. Suisse Romande*, 1934, **60**, 253–255, 269–272).—A brief, general consideration of the phenomena of corrosion and of the formation either of a protective film of oxide or of "passivating" ions is followed by a discussion of the best methods of securing homogeneity of structure at the weld. Electrolytic potentials and results of impact tests on a series of welds are tabulated, and impact figures are compared with the amount of dissolved gas (oxygen and nitrogen) present in the welds. The proportion of dissolved oxygen is found to increase the brittleness of the material. In the case of aluminium, corrosion is comparatively slight if suitably coated electrodes are employed. Stainless steels are then discussed, their remarkable immunity being correlated with the intrusion of chromium into the γ -iron space-lattice.—P. M. C. R.

V.—PROTECTION

(Other than Electrodeposition.)

†**Technical Applications of the Eloxal Process.** H. Schmitt and L. Lux (*Aluminium*, 1934, 17, 191-195).—A review of the chemical and physical properties of the oxide coating on aluminium produced by the electrolytic process and of the uses of metal so treated in the chemical, electrical, and other industries.—A. R. P.

***On the Prevention of Attack of Water on Light Metals.** H. Röhrig and K. Krekeler (*Aluminium*, 1934, 17, 140-141).—Experiments are described to show that the addition of about 1% of an emulsified oil to water in which light alloys are immersed reduces considerably the rate of corrosion and increases the fatigue limit by forming a thin film of oil over the metal, thus preventing intercrystalline attack.—A. R. P.

Corrosion Protection in Hot-Water Apparatus. Erich Naumann (*Z.V.d.I.*, 1934, 78, 472-476).—Corrosion of hot-water apparatus is caused principally by oxygen. The behaviour of steel, copper, and tinned copper as constructional materials is discussed, and various types of apparatus, methods of degassing the water, and chemical means for deoxygenating the water are described.—v. G.

***Protective Value of Nickel and Chromium Plating on Steel.** William Blum, Paul W. C. Strausser, and Abner Brenner (*J. Res. Nat. Bur. Stand.*, 1934, 13, 331-355; *Research Paper No. 712*).—Exposure tests of plated steel were conducted in co-operation with the American Electroplaters' Society and the American Society for Testing Materials, in rural, suburban, industrial, and marine locations. The protective value of nickel coatings depends almost entirely on their thickness. The conditions of nickel deposition and of the cleaning have no marked effects on protective value. An intermediate layer of copper decreases the protective value of thin deposits but is not detrimental in thick coatings, especially if they are chromium plated. The customary thin chromium coatings (0.00002 in. or 0.0005 mm.) increase the resistance to tarnish, but not the protection against corrosion. Relatively thick chromium coatings (0.00005-0.0001 in.; 0.0013-0.0025 mm.) improve the protection against corrosion, especially in industrial atmospheres. The protective value of chromium over nickel or composite coatings is somewhat improved by using a bath with a high ratio CrO_3/SO_4 (grm./litre). Deposits produced at 35°C. are slightly superior to those made at somewhat higher temperatures. The use of zinc under nickel makes the protective value less than that of either metal alone. Cadmium has very little effect under nickel. The use of zinc or cadmium under nickel tends to produce white stains and blisters.—S. G.

***Accelerated Tests of Nickel and Chromium Plating on Steel.** Paul W. C. Strausser, Abner Brenner, and William Blum (*J. Res. Nat. Bur. Stand.*, 1934, 13, 519-526; *Research Paper No. 724*).—Plated specimens similar to those used in atmospheric exposure tests were subjected to accelerated tests, especially by means of a salt-spray and by intermittent immersion in salt solution. The time required in these tests for the first appearance of slight rust was not consistent and had no direct relation to the protective value of the coatings. When the extent of rust at the end of a definite period, e.g. 100 hrs., was recorded, the results were approximately parallel to those of atmospheric exposure. The protective value of a metallic coating of this type depends principally on its freedom from porosity. The latter can be determined in a few minutes by the ferroxyl test.—S. G.

***Summary: Protective Value of Plated Coatings on Steel.** W. Blum, P. W. C. Strausser, and A. Brenner (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, **21**, (2), 8-10).—See preceding abstracts.—A. R. P.

The Electrolytic Production of Nickel Matrices. A. Wogrinz (*Metallwaren-Ind. u. Galvano-Tech.*, 1934, **32**, 497-498).—A brief account is given of the production by electrolytic methods of letter matrices for printing.—A. R. P.

The Testing of Tinplate for Food Preservation. H. Serger and Fritz Fleischer (*Illust. Zeit. Blechindustrie*, 1934, **63**, 1165-1167).—Tinplate intended for the sterilization and preservation of food must be soft, elastic, and non-porous; the depth of tinning should correspond to a deposit per 100 cm.² of 0.3 gm. on each side, and the lead content should not exceed 1%. The method of testing for brittleness by hammering is described, and the classification of its results explained. The thickness of the deposit is measured by a micrometer. A description is given of chemical methods of estimating the thickness, both of deposit and of the bonding layer of tin-iron compound. Porosity tests are also described, and the properties and application of suitable varnishes are outlined, as are the causes of certain common defects and their influence on the contents of the vessel.—P. M. C. R.

Painting of Aluminium and Its Alloys. H. Röhrig and W. Nicolini (*Maschinenbau*, 1934, **13**, 293-294; and (translation) *Light Metals Rev.*, 1934, **1**, (2), 19-24).—Various points of view are discussed.—K. S.

VI.—ELECTRODEPOSITION

Electrodeposition of Aluminium and Other Metals. C. L. Mantell (*Metal Cleaning and Finishing*, 1934, **6**, 397-400; *C. Abs.*, 1934, **28**, 7172).—Recent progress is described.—S. G.

***Alkaline Plating Baths for Cobalt and Nickel with High Throwing Power.** F. C. Mathers, G. F. Webb, and C. W. Schaff (*Metal Cleaning and Finishing*, 1934, **6**, 412, 418-419; *C. Abs.*, 1934, **28**, 7171).—Sodium-potassium tartrate (Rochelle salt) and ethanalamine gave complex salts of cobalt and nickel which were soluble in alkaline solutions. The results with cobalt were much better than with nickel, but in no case was the quality of any deposit equal to that from the ordinary, practically neutral, baths. The best cobalt bath contained (in gm./litre) cobalt sulphate 10, Rochelle salt 100, and sodium carbonate 100. A current density as low as 0.03 amp./dm.² is recommended for bright deposits. The cobalt anodes did not corrode; hence the anode efficiency was zero. Cobalt salts were added, therefore, in order to maintain a suitable metal concentration. The bath seemed to be stable at room temperature but at 70° C. a precipitate formed, causing dark deposits. Operated at room temperature these baths had an average throwing power of +65 at a 3:1 ratio. The best nickel bath contained (in gm./litre) nickel chloride 20, ethanalamine 200, sodium chloride 100, and sodium carbonate 100. The cathode current efficiencies averaged 50% and the throwing power was 40-60 at a 3:1 ratio as compared with 0-20 for ordinary nickel baths. A current density of 0.24 amp./dm.² was used. The baths could be maintained only by additions of nickel salts because of a gradual precipitation. Further additions of ethanalamine would not redissolve this precipitate or prevent its formation. Rochelle salt in place of ethanalamine gave thin, dark deposits.—S. G.

Copper Electroplating Procedure. W. A. Koehler (*Metal Cleaning and Finishing*, 1934, **6**, 401-404, 419-420).—A review.—S. G.

Practical Plating. Deposition of Copper. II.—Acid Copper Solution. E. A. Ollard and J. W. Perring (*Met. Ind. (Lond.)*, 1934, **45**, 519-521).—The use of phenol-sulphonic acid as an addition agent, and the operation, control,

and purification of the solution are described. (See *Met. Abs.*, 1934, 1, 596.)—J. H. W.

***The Effect of Oxidizing Agents on Nickel Deposition. I.—Hydrogen Peroxide and Nickel Nitrate.** A. W. Hothersall and R. A. F. Hammond (*Trans. Faraday Soc.*, 1934, 30, 1079–1094).—The effects of additions of pure hydrogen peroxide and nickel nitrate on the cathode efficiency, hardness, appearance, cathode potential, and gas discharge at the cathode have been determined in electrolytes of nickel sulphate buffered with boric acid or ammonium sulphate. The action of the oxidizing agents is primarily one of hydrogen depolarization, the cathode efficiency being decreased linearly with increasing concentration of the oxidizing agent to an extent which is slightly greater with high than with low p_H . The effects of the two oxidizing agents are proportional to their oxidizing power, *i.e.* $1NO_2' = 4H_2O_2$, the NO_2' being reduced to ammonia. The hardness, stress, and bright appearance of the deposits are increased by the addition of oxidizing agents, probably owing to the greater amount of colloidal basic substances which are included in the deposit, hence an excess of these agents should be avoided to prevent cracking and exfoliation of the deposits. As the concentration of oxidizing agent is increased the amount of gas discharged at the cathode decreases to zero over a wide range of concentration, but at higher concentrations gas discharge begins again, except in solutions containing ammonium sulphate and nickel nitrate. The function of hydrogen peroxide in preventing pitting of deposits from impure solutions is discussed.—A. R. P.

The Nickel-Plating of Aluminium and of Light Alloys. Anon. (*Illust. Zeit. Blechindustrie*, 1934, 63, 1229–1232).—Solutions previously used for the preparation of aluminium and light-alloy surfaces for nickel-plating were so strongly acid as to produce marked surface attack. A hot solution of ferric chloride, acidulated with hydrochloric acid, is proposed as a substitute. Hydrolysis may be prevented by the addition of tartaric acid. Suitable concentrations are given for the plating of aluminium and of Duralumin, and cleaning and preparation are described.—P. M. C. R.

***The Throwing Power of Zinc Sulphate Solutions.** Masami Nakajima (*J. Electrochem. Assoc. (Japan)*, 1934, 2, 176–181; *C. Abs.*, 1934, 28, 7171).—[In Japanese.] Cf. *Met. Abs.*, 1934, 1, 309, 421. The relationship between the current density and the throwing power of zinc sulphate solution was determined for 0.5*N* solution by the gravimetric and potentiometric methods, and for 1.5 and 2.5*N* solutions by potentiometric determination. In every solution the throwing power increases with increase in the current density, and with increasing p_H value for solutions of the same concentration. The conductivity of the bath and the cathodic polarization potential do not greatly affect the throwing power. Thus 1.5 and 2.5 *N* solutions with a p_H of 3.4 gave the highest throwing power. The conductivity of the baths bears a linear relation to its temperature.—S. G.

Controlling the Character of Electrodeposits. W. A. Koehler (*Metal Cleaning and Finishing*, 1934, 6, 345–348; *C. Abs.*, 1934, 28, 7172).—A discussion of the influence of current density, temperature, ionization, addition agents, and throwing power on the character of electrodeposits.—S. G.

VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

Relation of Research to the Establishment of Electrometallurgical Industries in the State of Washington. The Development of a Magnesium Industry. Carl F. Floe (*State Coll. Washington, Met. Res. Bur. Information Circ. No. 9*, 1934, 5 pp.).—General.—S. G.

*Arcs in Air Between Metallic Electrodes. H. Dziejwski (*Acta Phys. Polonica*, 1933, 2, 51-58; *C. Abs.*, 1934, 28, 7173).—[In French.] In arcs between similarly shaped electrodes of tungsten, tantalum, molybdenum, copper, nickel, and iron the force opposed to the e.m.f. is independent of, or only slightly dependent on, the arc length, and in the range between 3 and 4 amp. it is independent of the current intensity. Since this force is equal at both electrodes, irrespective of the combinations studied, it is assumed that it is localized in the layer adhering to the electrodes.—S. G.

VIII.—REFINING

The Electrolytic Refining of Tin. Werner Frölich (*Metallbörse*, 1934, 24, 826-827, 859).—The use of the following electrolytes is briefly described and their advantages and disadvantages are pointed out: sulphate, cresolsulphonate, fluosilicate, and thio-stannate.—A. R. P.

IX.—ANALYSIS

*The Spectrographic Analysis of Some Alloys of Aluminium. Ernest H. S. van Someren (*J. Inst. Metals*, 1934, 55, 265-272; discussion, 272-274).—Describes the technique of the analysis of Al alloys by means of their spark spectra in the ultra-violet, using the method of internal standards. Tables are given for the estimation of Cu, Zn, Fe, Si, Mn, Mg, Ni, Sn, and Cd, and also for the detection of Pb, Sb, Cr, Ti, and Bi.—E. H. v. S.

Qualitative Spectral Analysis of Pure Metals. R. Breckpot (*Natuurw. Tijdschr.*, 1934, 16, 139-143; *C. Abs.*, 1934, 28, 7194).—A previously described method was used with an arc as spectral source, overheating being avoided. The limit of accuracy was 0.001-0.0001%. In some cases concentration of small amounts of impurities is necessary, e.g. by evaporation with $\text{Cu}(\text{NO}_3)_2$ and ignition of the residue. Details are given of the analysis of commercial and electrolytic Cu, commercial Sn, Al, &c.—S. G.

Precision Methods for X-Ray Examination of Metals. S. T. Konobievskii (*Zavodskaya Lab.*, 1933, (6), 23-28; *C. Abs.*, 1934, 28, 7194).—[In Russian.] A general discussion of the apparatus and a few examples of the application of the method.—S. G.

The Application of Radiographic Methods in Chemistry. Otto Hahn (*Ber. deut. chem. Ges.*, 1934, [A], 67, 150-163).—Radio-chemistry may be applied to the elucidation of certain processes by the aid of radiographic indications, e.g. the phenomena of "inner adsorption" during the crystallization of mixtures of constituents of widely differing concentration, of "anomalous" solid solutions, and of radioactive alloys. A further field of application includes the study of the surface conditions of solids as affecting their retention of radio-emissions.—P. M. C. R.

Microanalysis. H. W. Hermance (*Bell Lab. Record*, 1934, 13, 81-87).—A general, illustrated account of the special methods used in microanalysis, with particular reference to the work of the microchemical section of the Bell Telephone Laboratories.—J. C. C.

*Researches on the Limits of the Spectrographic Detectability of Cadmium and Palladium in Silver. Georg Baiersdorf (*Sitzungsber. Akad. Wiss. Wien*, 1934, IIa, 143, 19-29).—The limiting amounts of Cd and Pd which can be detected in Ag vary with the means used in exciting the spectrum. Using Gerlach's method the limits are: for Cd 0.1 p.p.m., and for Pd about 1 p.p.m.—A. R. P.

***Detection of Calcium in the Presence of Strontium and Barium.** Earle R. Caley (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 445-447).—The detection depends on the precipitation of $\text{Ca}(\text{OH})_2$ by the reaction: $\text{CaCl}_2 + \text{HgO} + 4\text{KI} + \text{H}_2\text{O} = \text{Ca}(\text{OH})_2 + 2\text{KCl} + \text{K}_2\text{HgI}_4$; Ba and Sr are not precipitated since their hydroxides are much more soluble.—A. R. P.

***Compounds of Vanadium with 8-Hydroxyquinoline and Their Use in Analysis.** R. Montequi and M. Gallego (*Anal. soc. fis. quim.*, 1934, 32, 134-135).—In $\text{CH}_3\text{CO}_2\text{H}$ solutions V as vanadate gives a violet coloration or precipitate with 8-hydroxyquinoline; on shaking with CHCl_3 the latter develops a characteristic red colour: sensitivity $1.5 \mu\text{g. V/c.c.}$ —A. R. P.

Precipitation of Barium in the Copper-Tin Group of Qualitative Analysis. William T. Hall and Robert B. Woodward (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 478).—In separating As from Ba by H_2S the solution should be 0.3N with respect to HCl; in the presence of HNO_3 BaSO_4 is coprecipitated with the As_2S_3 .—A. R. P.

Separation of Iron from Indium with Cupferron. Frank C. Mathers and Clarence E. Prichard (*Proc. Indiana Acad. Sci.*, 1933, 43, 125-127).—Cupferron precipitates Fe, Cu, &c., leaving Al in solution. In is closely related to Al and the same separation may be used. The In is precipitated with NH_4OH , and the residue ignited and weighed as In_2O_3 . Since InCl_3 is soluble in ether + HCl, the method of Gooch and Havens for the separation of Fe and Al cannot be applied to Fe and In.—R. G.

***Studies on the Anthranilic Acid Method for the Gravimetric Determination of Metals by Means of the Thermobalance.** Saburo Ishimaru (*Kinzoku no Kenkyu*, 1934, 11, (10), 500-504).—[In Japanese.] See *Met. Abs.*, 1934, 1, 605.—S. G.

Determination of Antimony in Solder. Clifford L. Barber (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 443-445).—The presence of as little as 0.01% of Sb in solder may be detected by boiling 1 grm. of the filings with 50 c.c. of HCl; if fine bubbles of H_2 are evolved and the alloy disintegrates Sb is present. For its determination 2 grm. of sawings are dissolved in boiling H_2SO_4 , the As expelled by boiling with 15 c.c. of H_2O and 15 c.c. of HCl, and the Sb determined by titration of the cold, diluted solution with 0.05N- KMnO_4 .—A. R. P.

Determination of Small Quantities of Antimony in White Metals: A Volumetric Method. C. W. Anderson (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 456-457).—The alloy is dissolved in HCl and Br and the solution evaporated with Na_2SO_3 to volatilize As; the Sb is then determined by titration with KBrO_3 .—A. R. P.

***Reducing Action of Mercurous Chloride. Separation, Detection, and Estimation of Arsenic, Gold, Platinum, Palladium, Selenium, Tellurium, and Iodine.** Gordon G. Pierson (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 437-439).—Traces of the precious metals in a mixed solution may be detected and determined as follows: the solution is boiled with 5% of $\text{H}_2\text{C}_2\text{O}_4$; any precipitate is collected and dissolved in HCl + Cl_2 , and the solution, after expulsion of Cl_2 , is boiled with Hg_2Cl_2 which becomes coloured pink to purple if Au is present. The filtrate from the $\text{H}_2\text{C}_2\text{O}_4$ treatment is evaporated to fumes with H_2SO_4 , the solution is diluted with 2-3% HCl, treated with $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ to give a 5% solution, and shaken with 0.1 grm. of Hg_2Cl_2 which precipitates the Pd; the filtrate from this treatment when boiled with Hg_2Cl_2 for 5 minutes gives a precipitate of Pt. Ignition of the Hg_2Cl_2 precipitates affords the pure metal (Au, Pd, or Pt). Te and Se can be precipitated in 20% HCl by warming with Hg_2Cl_2 , and As can similarly be precipitated from 30% HCl.—A. R. P.

***The Spectrographic Detection and Estimation of Minute Quantities of Impurities in Copper.** M. Milbourn (*J. Inst. Metals*, 1934, 55, 275-281; discussion, 281-282).—An accurate and convenient method is described for

the detection and estimation of small quantities of Bi, As, Pb, Fe, Ni, Ag, Sb, and Sn in Cu. Details of technique, sensitivity, and line intensity comparisons are given.—M. M.

*A "Synthetic Spectrum" Method of Analysis and Its Application to the Quantitative Estimation of Small Quantities of Bismuth in Copper. D. M. Smith (*J. Inst. Metals*, 1934, 55, 283-289; discussion, 289-290).—A method has been devised for the production of "synthetic" spectra as standards of comparison, the spectrum of a standard alloy being exactly superimposed on that of the pure metal which forms the main constituent. The total time of the 2 exposures is equal to the normal time of exposure of a sample which is being analyzed, and a series of spectra is obtained in which the impurity lines show a systematic increase in intensity. While the method was originally applied to the checking of the reliability of standard samples, it can be used for the quantitative determination of impurities in metals, once the standard calibration curve has been obtained. The application to the determination of 0.0001-0.004% of Bi in Cu is described.—D. M. S.

A Volumetric Method for the Determination of Cobalt and Nickel. J. T. Dobbins and J. P. Sanders (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 459-460).—The method depends on the precipitation of the metal with NH_4CNS and $\text{C}_5\text{H}_5\text{N}$ and titration of the excess of the former in an aliquot part of the filtrate with AgNO_3 .—A. R. P.

*Rapid Potentiometric Method for the Quantitative Determination of Copper in Alloys. Henry B. Hope and Madeline Ross (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 316-318).—The sample containing 0.1-0.2 gm. of Cu is dissolved in HNO_3 and the solution evaporated with 3 c.c. of H_2SO_4 until copious fumes of the latter are evolved; the cold acid is diluted with 15 c.c. of H_2O , neutralized with NH_4OH , and poured into 10 c.c. of saturated H_2SO_3 solution. A measured volume of KCNS is added, the solution boiled to expel SO_2 , cooled, and filtered. The excess of KCNS is then titrated in HCl solution with KIO_3 .—A. R. P.

Flame Determination of Copper by Carbon Tetrachloride. Peter Gabriel (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 420).—Cu in an alloy may be detected by holding a portion in a Bunsen flame and admitting CCl_4 into the air inlet of the burner; a blue flame appears even when only traces of Cu are present and none of the other metals interferes.—A. R. P.

*Quantitative Determination of Lead as Periodate. Hobart H. Willard and J. J. Thompson (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 425-426).—Pb can be separated from Ni, Cu, Zn, Cd, Al, Ca, and Mg by addition of NaIO_4 to the boiling solution of the nitrates in 0.025N- HNO_3 . After cooling to 0° C. the precipitate of $\text{Pb}_3\text{H}_4(\text{IO}_6)_2$ is collected in a porous filter crucible, washed with ice-cold H_2O , dried for 2 hrs. at 110° C., and weighed. Alternatively, the precipitate may be dissolved in HCl and excess of H_3AsO_3 , and the excess of the latter titrated with KIO_3 using CHCl_3 as indicator.—A. R. P.

[Estimation of] Lead, Antimony, and Tin in Type Metals and Similar Alloys. Louis Cudroff (*Chemist-Analyst*, 1934, 23, (4), 6, 8-9).—The alloy (0.5 gm.) is dissolved by heating with 15 c.c. of H_2SO_4 and 5 gm. of KHSO_4 , and the product is dissolved in 100 c.c. of cold 10% tartaric acid solution. After boiling for 10 minutes and cooling for 2 hrs. the PbSO_4 is collected and converted into PbCrO_4 for weighing. The filtrate is evaporated to 50 c.c., treated with 60 c.c. of HCl, boiled 1 hr. to expel As, diluted to 150 c.c., titrated with KBrO_3 for Sb, reduced with a Ni coil, and titrated with KI_3 for Sn.

—A. R. P.

Cyclohexanol in Colorimetric Determination of Molybdenum. Loren C. Hurd and Fred Reynolds (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 477-478).—The colorimetric determination of Mo with SnCl_2 and KCNS is improved by extracting the coloured complex with cyclohexanol.—A. R. P.

***Determination of Tellurium in Tellurium-Lead and Tellurium-Antimonial-Lead.** W. J. Brown (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 428-429).—Te-lead (12.5 gm.) is dissolved in 100 c.c. of HNO_3 and the Pb precipitated with 25 c.c. of H_2SO_4 ; after dilution to 500 c.c., 400 c.c. are filtered through a dry paper and evaporated until H_2SO_4 fumes are evolved. The acid is diluted with 50 c.c. of H_2O , 5 gm. of tartaric acid are added, and the solution is boiled, cooled, and filtered. The filtrate is saturated with H_2S , the precipitate collected, washed, and digested with 1 gm. of NaHCO_3 and 5 c.c. of 10% Na_2S solution, and the filtered solution acidified with H_2SO_4 and saturated with H_2S . The Te precipitate is dissolved in HCl and KClO_3 and the solution evaporated to dryness with HNO_3 ; the residue is dissolved in 100 c.c. of 9:1 HCl, the solution boiled with 1-2 gm. of tartaric acid, and the Te precipitated with SO_2 , collected, washed with H_2O , then with $\text{C}_2\text{H}_5\text{OH}$, dried at 100°C . for 1 hr., and weighed. Antimonial-Pb is dissolved in *aqua regia* containing KCl, the PbCl_2 removed, and the filtrate evaporated to dryness; the residue is dissolved in 9:1 HCl and the Te separated with SO_2 . The precipitate is dissolved in HNO_3 and purified as for Te-lead. The CuS or Bi_2S_3 residue from the Na_2S digestion must be worked up to recover traces of Te.—A. R. P.

Ceric Sulphate for Estimating Tin in Bearing Metals. L. G. Bassett and L. F. Stumpf (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 477).— $\text{Ce}(\text{SO}_4)_2$ with starch-KI indicator may be used instead of KI_3 for titrating Sn in bearing metals.—A. R. P.

Volumetric Determination of Tungsten. M. Leslie Holt (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, 6, 476).—Reduction of the WO_3 with Zn and HCl, either with or without H_3PO_4 , addition of $\text{Fe}_3(\text{SO}_4)_2$, and titration with KMnO_4 of the FeSO_4 produced, leads to results which are 7-20% too low. No modifications could be found to improve the results.—A. R. P.

X.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

***Autographic Thermal Expansion Apparatus.** Wilmer Souder, Peter Hidnert, and James Fulton Fox (*J. Res. Nat. Bur. Stand.*, 1934, 13, 497-513; *Research Paper No. 722*).—Describes an autographic thermal expansion apparatus improved and constructed at the National Bureau of Standards, U.S.A., and indicates the methods used in its calibration and comparison with the Bureau's precision expansion apparatus. The autographic expansion apparatus employs the optical lever method of measuring expansion, and is suitable for many purposes in industrial laboratories. Continuous expansion curves can be obtained photographically, or they can be observed during the progress of the test. Coeff. of expansion can be determined from these curves. Transformation regions, if present, can also be located. For ordinary materials such as steel the error of the autographic expansion apparatus is about 6% for the range from 20° to 100°C . and about 3% for the range from 20° to 500°C . This apparatus does not give as accurate results as the fused quartz tube expansion apparatus also designed at the Bureau for use in commercial laboratories. The autographic expansion apparatus yields certain information regarding transformation regions not readily obtainable by the other type of apparatus.—S. G.

***Study of an Electrically-Maintained Vibrating Reed and Its Application to the Determination of Young's Modulus.** E. G. James and R. M. Davies (*Phil. Mag.*, 1934, [vii], 18, 1053-1086).—An apparatus designed for the study of the transverse vibrations of a reed of dimensions of the order, length 2-3 cm.,

breadth 0.5 cm., and thickness 0.1 cm., is described. The apparatus is eminently suitable for use in the determination of the values of Young's modulus of short crystals with an accuracy of about 1 part in 1000. The value of Young's modulus for phosphor-bronze at 25° C. is found to be $11.99_8 \times 10^{11}$ dynes/cm.².—J. S. G. T.

*A Simple Apparatus for the Continuous Variation of Current, Suitable for Experiments on Magnetic Hysteresis. R. W. B. Stevens (*J. Sci. Instruments*, 1934, 11, 334–336).—A note. A simplified form of the electrical circuit used by Morris and Langford (*Proc. Phys. Soc. (Lond.)*, 1910–1911, 23, 277) is described, and details are given of the construction of contacts, and use of the method for hysteresis experiments.—W. H. R.

A New Method of Determining the Electron Diffraction Patterns Produced by Thin Films. William Cochrane (*Phil. Mag.*, 1934, [vii], 18, 956).—An electrical method of detecting the diffraction of cathode rays by thin films is described. The diffracted electron beam passes into a Faraday cylinder and is measured with an electrometer. Results obtained with thin films of celluloid, gold, aluminium, and silver agree with those given by Born's theory.—J. S. G. T.

A New Method of Investigating the Diffraction of Slow Electrons by Crystals. W. Ehrenberg (*Phil. Mag.*, 1934, [vii], 18, 878–901).—A form of electron diffraction apparatus using a fluorescent screen, capable of withstanding heat, for visual observation of the diffracted beam is described. Experimental results relating to a copper crystal are detailed and compared with those of Farnsworth.—J. S. G. T.

*A Technique for the Photographic Determination of the Intensities of X-Ray Reflections from Powders. G. W. Brindley and F. W. Spiers (*Proc. Phys. Soc. (Lond.)*, 1934, 46, 841–852).—A simple and accurate method of measuring the intensities of X-ray reflections from plane, stationary layers of powder is described.—J. S. G. T.

A Two-Crystal Moving Film Spectrometer for Comparative Intensity Measurements in X-Ray Crystal Analysis. J. Monteath Robertson (*Phil. Mag.*, 1934, [vii], 18, 729–745).—A two-crystal moving film spectrometer for general use in photographic X-ray crystal analysis is described. The two crystals are alternately exposed to X-rays so as to average out any fluctuations in the output of the X-ray tube, and the reflections are recorded side by side on a moving film of the roller type by means of automatic shutters.—J. S. G. T.

Considerations on Micro-Calorimetry. Brian Whipp (*Phil. Mag.*, 1934, [vii], 18, 745–759).—A form of differential micro-calorimeter designed to detect 10^{-6} calories is described. The main advance consists in the use of a small number (about 5) of thermocouples and a low-resistance circuit (about 2 ohms).—J. S. G. T.

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

*Elongation Values of Copper and Copper-Rich Alloys. Maurice Cook and Eustace C. Larke (*J. Inst. Metals*, 1934, 55, 165–184; discussion, 184–188).—Elongation tests have been made on flat pieces of H.C. copper, 70 : 30 brass, 64 : 36 brass, 80 : 20 cupro-nickel, and 95 : 5 gilding metal. Variations in the length of the parallel portion from 1.5 to 8.5 in. has no appreciable effect on the total elongation values on 1-in. gauge-lengths; variations in the thickness between 0.125 and 0.02 in. are similarly without effect on 0.5-in. wide specimens with a 2-in. gauge-length; with specimens less than 0.02 in. thick the elongation decreases rapidly with decrease in thickness. On specimens 0.06 in. thick the elongation increases with increasing width

between 0.25 and 1.5 in., but the effect decreases with increasing gauge-length. A detailed study has been made of the effect of gauge-length on elongation values, and of the distribution of elongation along the gauge-length of all the materials in the soft state, and of 70 : 30 brass after various degrees of cold-rolling. The results for total elongation on gauge-lengths of more than 0.75 in. agree closely with those calculated by the formulæ of Unwin (*Proc. Inst. Civil Eng.*, 1903-1904, 155, (1), 170) and of Krupkowski (*Rev. Mét.*, 1931, 28, 529). The value for total elongation is not appreciably affected by the position of fracture provided that this occurs not nearer than 0.5 in. of a gauge-mark. The logarithmic relation between the gauge-length and elongation (Bertella, *Giorn. Gen. Civ.*, 1922, 60, 343) is shown to be invalid. In the discussion, H. O'Neill gave a table showing that the decrease of "extensibility" with increasing deformation, i.e. the change in work-hardening capacity for 70 : 30 brass, is very much the same as for H.C. copper. R. L. Kenyon pointed out that other workers had found that the percentage elongation decreases with an increase in the ratio L/\sqrt{A} , and constructed a curve showing that the results of C. and L. for 70 : 30 brass given in one part of the paper agreed with this, whereas others did not; he suggested that minute variations in thickness might account for this.—A. R. P.

***Comparison of Single-Step Long-Time Creep Results with Hatfield's Time-Yield Stress.** A. E. White and C. L. Clark (*Trans. Amer. Soc. Metals*, 1934, 22, 481-494; discussion, 494-504).—Data are presented to show whether or not one of the short-time methods advocated by certain metallurgists for determining creep characteristics of metals at elevated temperatures yields results comparable to those obtained from a carefully conducted long-time creep test. Results are given for 3 steels at 850° F. (454° C.) and 11 at 1000° F. (538° C.). It is concluded that while the time-yield method does not give results which are in exact agreement with those from the long-time test, it does offer possibilities as a qualitative test for classifying, for example, a series of steels of a given type, at any temperature.—S. G.

***New Methods of Testing by Impact.** John Hardie Lavery and Richard Vynne Southwell (*Inst. Civil Eng. Selected Eng. Papers*, 1934, (142), 1-35).—The "Oxford" impact machine is described, and an account given of its development. The "hammer" is suspended by wires to avoid errors through transmission of energy by the anvil-specimen-hammer system to earth. Gentle release is effected by an electro-magnet, and the extreme position determined by a thread passing between felt pads and attached to the hammer. A cylindrical specimen, notched with a concentric groove and supported at its ends, is used. The blow is struck by two projections acting on each side of the notch to give "four-point loading." With this machine, plastic deformation is localized, and the energy absorbed is found to be almost exactly proportional to the area of fracture. The influences of root radius and depth of notch, eccentric setting of yoke, and span of support were studied by tests on "Super VNCA" steel.—J. C. C.

Photo-Elasticity Apparatus Embodies Novel Features. Elmer K. Timby (*Eng. News-Record*, 1934, 113, 647).—A universal straining machine developed at Princeton University for straining clear Bakelite models for photo-elastic work can be used for torsion, compression, bending, or shear, with a maximum total load of 1000 lb. Centralized control of all adjustments to the loading and optical systems is a feature of the equipment.—J. C. C.

†**Materials Testing Machines.** C. H. Gibbons (*Baldwin Locomotives*, 1934, 13, (1), 24-31; and *Instruments*, 1934, 7, 223-226).—An illustrated historical review of the development of tensile, compression, and transverse testing machines from about 1638 (Galileo) to 1817 (Peter Barlow).—J. C. C.

XII.—TEMPERATURE MEASUREMENT AND CONTROL

The Pneumatic Pyrometer. A Variation of the Air-Gauging Process Applied to Pyrometry. Anon. (*Met. Ind. (Lond.)*, 1934, 45, 318).—The method of measuring furnace temperatures by pneumatic gauging is described. The principle of the method is that if a constant air pressure is connected to a pipe with an orifice at each end, a pressure will be set up in the pipe which will be a measure of the difference in the temperature of the air at the two orifices. In the apparatus described, one of the orifices is situated in the furnace whose temperature is required, and the pressure difference scale is calibrated to give the temperature direct.—J. H. W.

Measurements of High Temperature. Karl Stein (*Naturforscher*, 1934, (11), 403-409; *C. Abs.*, 1934, 28, 6595).—A description is given of various pyrometers in use and of the Ardrometer for measuring total radiation.—S. G.

New Pyrometer for Very Hot Gases. E. O. Mattocks (*Metal Progress*, 1934, 26, (5), 30-33).—The spectral-line reversal method of gas pyrometry consists in the injection into the hot gas of a small amount of sodium chloride. A tungsten band lamp is so adjusted that the sodium lines in the hot-gas spectrum disappear against the spectrum from the calibrated tungsten filament, the temperature of which is registered by an optical pyrometer.—P. M. C. R.

XIII.—FOUNDRY PRACTICE AND APPLIANCES

***Effect of Melting Conditions on the Running Quality of Aluminium Cast in Sand Moulds.** A. I. Krynitsky and C. M. Saeger, Jr. (*J. Res. Nat. Bur. Stand.*, 1934, 13, 579-588; *Research Paper No. 727*).—The effect of maximum heating temperature on the running quality of liquid metal has been studied for 2 grades of aluminium and an aluminium-8% copper alloy. The running quality was measured in terms of a length of a spiral casting obtained by pouring the metal under carefully controlled conditions. The effect of various treatments of the metal was also investigated. It was found that the relation between length of the spiral and the pouring temperature is linear. The running quality of the metals which had been heated to a maximum temperature of 850° C. was in all cases less than when the metal had been heated to 750° C. Pure aluminium (99.8%) was found to have markedly higher running qualities than commercial (99.2%) aluminium. The running quality of the aluminium-8% copper alloy was not much different from that of commercial aluminium.—S. G.

Shrinkage Cracks in a Light Metal Casting Caused by the Casting-In of a Bearing Bush. M. Widemann (*Giesserei*, 1932, 19, 332-333).—X-Ray photographs are given of a bearing composed of a light metal case into which a keyed-in bush of another light metal alloy has been cast (no details are given of the composition of either alloy); they show that during cooling of the inner alloy shrinkage cracks are produced in the neighbouring parts of the case, and therefore that, even with careful work, the foundry cannot guarantee the life of such castings under high-frequency vibrational stresses.—A. R. P.

Methods of Manufacture and Their Influence on Design. Aluminium Alloys—Wrought and Cast Parts. W. C. Devereux (*Met. Ind. (Lond.)*, 1934, 45, 489-493, 513-516).—A paper (slightly condensed) read before the Scottish Local Section of the Institute of Metals. A discussion of the effect of feeding, heat-treating characteristics, precautions to be taken in high-temperature heat-treatment, casting and grain growth, test results, the influence of various treatments and the effects of cold-working on those results, with respect to wrought and cast aluminium alloys.—J. H. W.

†**The Practice of Aluminium Melting.** A. von Zeerleder (*Aluminium*, 1934, 17, 196-201).—A critical review of modern practice in melting aluminium and its alloys, and in the prevention of contamination by impurities introduced by the atmosphere of the furnace, the fuel, and the container.—A. R. P.

Production of Ternary Aluminium-Copper Hardeners. Edmund R. Thews (*Metallurgist* (Suppt. to *Engineer*), 1934, 10, 162-163).—The relative merits of different methods of preparing aluminium-copper-manganese and aluminium-copper-iron hardener alloys are discussed. The method recommended is to add the manganese or iron to molten copper previously deoxidized with phosphorus. The melt is then allowed to cool and is poured into molten aluminium which has been superheated to about 800° C. and covered with a cryolite flux.—R. G.

The Moulding of Aluminium-Bronze and Method of Control of the Quality. C. Meigh (*Bull. Assoc. Tech. Fonderie*, 1934, 8, 180-185; discussion, 185-186).—Casting in sand, metal, or mixed moulds is compared and contrasted. Methods of control of the quality of castings are discussed in detail. Control by micrography is strongly advocated and examples given of the estimation of the mechanical properties of a piece from its microstructure. The disadvantages of the separately and integrally cast test-pieces (for mechanical test) are discussed and the use of coupons suggested.—R. B. D.

Casting Under Pressure. M. F. Nielsen (*Bull. Assoc. Tech. Fonderie*, 1934, 8, 106-115).—The various types of machines, their design and construction are discussed together with the different types of nozzle. Gate design, running, and air removal methods are reviewed.—R. B. D.

Brass Die-Castings. Anon. (*Metal Progress*, 1934, 26, (5), 26-29).—Some developments in die-casting practice are summarized. The alloys most generally employed are a modified Muntz metal (copper 60, tin 1, lead 1, aluminium 0.1%, remainder zinc) and "Webert" alloy (copper 81.5, silicon 4.25, manganese 0.15%, remainder zinc), and the physical properties of both in the die-cast condition are described. The composition of die steels is discussed, a readily carbonizing type containing up to 7.5% of both tungsten and chromium being recommended.—P. M. C. R.

XV.—FURNACES AND FUELS

Fuel-Fired Furnace Temperature and Atmosphere Control. G. H. Barker (*Metallurgia*, 1934, 11, 29-32).—The performance of heat-treatment furnaces is determined by the method of control adopted as well as by their suitability, design, and construction. The method of control affects the furnace atmosphere, combustion efficiency, and consequently the fuel combustion, as well as determining a uniform temperature or pre-determined time-temperature cycle. Methods of control, including two-position, three-position, balancing, and floating control, are fully discussed in the light of modern developments and as applied to different designs of furnaces, and the future trend of furnace control is also considered.—J. W. D.

Theory of Regulation of Industrial Electric Furnaces. Max Lang (*Elektrowärme*, 1934, 4, 201-208; *C. Abs.*, 1934, 28, 7167).—Cf. *Met. Abs.*, 1934, 1, 314. Principles of calculation of temperature control as determined by the prevailing practical operative conditions are developed, and the application of the derived formulæ is illustrated by a few examples.—S. G.

Continuous Electric Furnace for Strip and Wire. R. Gränzer and L. Moennich (*Elektrowärme*, 1934, 4, 181-184; *C. Abs.*, 1934, 28, 6639).—Principles of calculation of annealing furnace capacity and curves of production for a given width of strip or diameter of wire, and for a given length of furnace are developed.—S. G.

***Temperature Distribution of a Gas Flowing Through a Furnace.** K. F. Herzfeld (*Physics*, 1933, 4, 362-365).—The temperature distribution in gases flowing through a cylindrical furnace at low pressure and high speed is investigated mathematically. The flow is laminar, and two cases are distinguished. Temperature equilibrium is attained throughout when the pressure gradient is less than 0.003 mm. of mercury per cm. For pressure gradients about 10 times as great only a thin layer of gas close to the furnace wall attains temperature equilibrium.—J. S. G. T.

XVI.—REFRACTORIES AND FURNACE MATERIALS

Suitable Packing of Refractories. C. Koeppel (*Tonind. Zeit.*, 1934, 58, 1110-1111).—Refractory bricks should be stacked in railway wagons in such a way that their broadest side is transverse to the direction of travel; bricks of unusual shape having no parallel sides and which can easily move diagonally in the truck should be stacked in trucks the sides of which can be well bolstered.—B. Bl.

XVII.—HEAT-TREATMENT

***Experiments in Wire-Drawing. Part IV.—Annealing of H.-C. Copper Wires of Varying Hardness—Elongation Values.** W. E. Alkins and W. Cartwright (*J. Inst. Metals*, 1934, 55, 189-197; discussion, 197-199).—The results of determinations of the elongation values of a series of wires of very pure high-conductivity copper, drawn with widely varying amounts of reduction and annealed at varying temperatures for varying periods of time, are recorded in full and briefly discussed.—W. E. A.

XVIII.—WORKING

***Tests on Deep-Drawing.** L. Herrmann and G. Sachs (*Metallwirtschaft*, 1934, 13, 687-692, 705-710).—The Wazau deep-drawing tester is described. The influence of the rounding of the tool and of the grip of the blank-holder on the deep-drawing value has been determined on 63 : 37 brass, and the factors which cause folds in the cup have been investigated.—v. G.

***Researches on the Detection of Copper Flecks on Rolled Aluminium Wire.** H. Röhrig (*Aluminium*, 1934, 17, 149).—Specks of copper which have been pressed into the surface of aluminium alloys during working can be detected by holding the metal first in the vapour of strong nitric acid, then in ammonia, a blue colour being produced around the copper specks. A quantitative determination may be made by immersing the metal for 5 minutes in nitric acid (*d* 1.41), whereby all the copper, but practically no aluminium, is dissolved, and then determining the copper in solution electrolytically or colorimetrically.—A. R. P.

†**Influence of Friction on the Flow of Metals in Rolling.** Erich Siebel (*Stahl u. Eisen*, 1934, 54, 1049-1056).—A discussion of the effect of the coeff. of friction on the deformation occurring during rolling of metals, including copper, lead, and aluminium. Cf. Siebel and Osenberg (*Met. Abs.*, 1934, 1, 459), Pomp and Lueg (*Mitt. K.-W. Inst. Eisenforsch.*, 1933, 15, 81), Lueg and Osenberg (*Mitt. K.-W. Inst. Eisenforsch.*, 1933, 15, 99).—W. H.-R.

†**Machinery in Rolling-Mill Construction and Its Maintenance.** Erich Howahr (*Stahl u. Eisen*, 1934, 54, 1101-1108).—A review of recent developments in rolling-mill plant in Germany with special reference to devices for

cooling and lubrication, and for the movement of the rolls relatively to one another. Detailed drawings are given, and H. discusses the effect of friction and lubrication on the maximum safe pitch of screws which must not move under pressure.—W. H. R.

The Effect of Some Mill Variables on the Gauge of Sheet Brass. C. K. Skinner (*Met. Ind. (Lond.)*, 1934, 45, 343-344).—The influences of the many variables in mill operation on the gauge of sheet brass as rolled on the ordinary 2-high mill are set out.—J. H. W.

Aluminium Working and Oils [Therefor]. Karl Krekeler (*Aluminium*, 1934, 17, 37-39).—Suitable lubricants are described for rolling, extruding, deep-drawing, wire-drawing, and turning aluminium and its alloys.—A. R. P.

Hard Metals in the Machining of Metals. U. Pirani (*Anz. Masch.*, 1934, 56, 4-5).—Examples of the best cutting speeds and size of chip are given for various hard metal tools cutting some of the common metals.—B. Bl.

***The Life of Turning Tools as Influenced by Shape.** O. W. Boston and W. W. Gilbert (*Trans. Amer. Soc. Metals*, 1934, 22, 547-567; discussion, 567-576).—S. G.

XIX.—CLEANING AND FINISHING

Treatment of Aluminium Ware in the Household. Research Dept. of the Vereinigte Aluminium-Werke A.-G. (*Aluminium*, 1934, 17, 34-36).—Methods of cleaning domestic aluminium ware are given; various German proprietary cleansers are recommended.—A. R. P.

†**Colouring and Surface Protection of Metals by Chemical Processes.** H. Krause (*Maschinenbau*, 1934, 13, 487-490).—Tables, references, and practical hints on modern methods of colouring metals, especially copper, zinc, and cadmium, are given.—K. S.

Colouring of Aluminium. Kurt Vollrath and Georg Lahr (*Aluminium*, 1934, 17, 91-92).—Aluminium and its alloys (free from copper) can be coloured with various dyes by immersion for $\frac{1}{2}$ hr. at 80°-90° C., in a 2-5% solution of potassium sulphide containing an appropriate dye; thus morin gives a yellow, alizarin a red, a mixture of morin and alizarin a bronze, and vanadyl sulphate a black to brown colour. Mixtures of these reagents with or without bichromate produce intermediate tints of brown to orange. A golden-yellow colour is obtained by immersing the metal in 2% permanganate solution; the colour may be darkened by addition of copper sulphate. Recipes are given for 11 colouring solutions.—A. R. P.

Researches on the Production of Brown Colours on Copper and Copper Alloys. H. Krause (*Metallwaren-Ind. u. Galvano-Tech.*, 1934, 32, 453-454, 471-472).—A review of recent work on the use of permanganate and chlorate baths with the addition of various metal salts for producing brown tones on copper and its alloys.—A. R. P.

XX.—JOINING

Riveting Aluminium Structural Work. A. J. Field (*Light Metals Rev.*, 1934, 1, 101-103).—Brief review of current American practice.—R. B. D.

The Improvement of Light Metal Rivets. — von Zeerleder (*Aluminium*, 1934, 17, 138-140).—To obtain the best mechanical properties in rivets of Duralumin and similar alloys careful control of the annealing temperature is essential, the best results being obtained by quenching from 500° to 510° C. Several small electric furnaces for controlling this operation accurately are illustrated and briefly described. A salt-bath is recommended for obtaining even heating.—A. R. P.

†**Practice of Light-Metal Riveting.** Walther Zarges (*Aluminium*, 1934, 17, 127-135, 177-188).—Various types of light-metal rivets are illustrated and their properties and uses are described. Suggested standard specifications (dimensions and mechanical properties) are tabulated and directions are given for using the rivets in joining articles of aluminium and its alloys; 30 references are appended.—A. R. P.

***Hot Riveting of Hardenable Aluminium Alloys.** R. Irmann (*Aluminium*, 1934, 17, 189-190).—Experiments have been made to show that hot riveting of Duralumin and similar alloys is not to be recommended since, even with air- or water-cooling, the area round the rivets is softened by the heat and widening of the hole is liable to occur under conditions inducing stress. Where the rivets are so large that cold riveting is unsatisfactory it is recommended that a larger number of small rivets should be substituted rather than use hot riveting.—A. R. P.

***How Should Aluminium Vessels for the Transport and Storage of Nitric Acid be Welded?** G. Eckert (*Aluminium*, 1934, 17, 84-87).—A series of corrosion tests on autogenously-welded joints of 99.5% aluminium has been made to find the best procedure for preventing attack by nitric acid. Plain welds and hammered joints are very rapidly corroded but, after a thorough annealing by the flame of the welding torch, avoiding local overheating, a high degree of immunity from corrosion is obtained.—A. R. P.

The Arc-Welding of Copper. Wilmer E. Stine (*Machine moderne*, 1934, 23, 561-562).—The welding of copper, employing carbon electrodes, may be effected by the addition either of pure copper or of phosphor-bronze, and both methods are described, with modifications according to dimensions. For the welding of very thin sheet, a phosphor-bronze electrode is recommended, though temperature control presents some difficulty. Certain examples of arc-welded copper are illustrated and described.—P. M. C. R.

Fusion-Welding of Copper. Anon. (*Soudure et Oxy-Coupage*, 1933, 10, 206).—Recommendations in technique.—H. W. G. H.

The Key to the Problem of Fusion-Welding Copper: Cuprous Oxide and Its Eutectic. Anon. (*Soudeur-Coupeur*, 1933, 12, (11), 1-4).—The formation of cuprous oxide eutectic during the welding of tough-pitch copper is said to have been announced for the first time by Le Grix in 1922. An extract from an article published by him at that time is reproduced, in which the phenomenon is explained at length.—H. W. G. H.

The Progress of Electric-Resistance Welding. J.-E. Languépin (*Métallurgie et la Construction mécanique*, 1934, Special No. (Nov. 17), 44-45).—Modern developments in the design of machines are reviewed; the tendency is shown to be towards the use of high power and short time of application.—H. W. G. H.

Metallic Arc Welding. H. V. Stead (*Marine Eng.*, 1934, 57, 320-323).—Some of the factors involved in ensuring sound welding are critically discussed, and although referring essentially to structural steel welding are of wider interest. Correct welding technique and the provision of suitable electrodes are considered necessary for sound metallic arc welding. Heat-treatment, where necessary, should be considered in the light of the process used, the electrode, the form of join, and the shape and size of the structure. The chief causes of unsound welds are summarized and the variety of faults arising from any one cause or combination of these causes, are dealt with. Reference is also made to the shrinkage stresses that may exist in a weld and the adjacent metal and to the importance of eliminating such stresses. The inspection of welds and testing procedure to ensure sound and reliable welds is also dealt with.—J. W. D.

XXI.—INDUSTRIAL USES AND APPLICATIONS

***The Hygienic Significance of Aluminium Cooking Vessels.** Joseph Wührer (*Arch. Hyg. Bakt.*, 1934, 112, 198–216; *C. Abs.*, 1934, 28, 7371).—Analysis of foods that have been cooked in aluminium vessels shows that the amount of aluminium transferred is far below concentrations which might have any harmful effect.—S. G.

Use of Aluminium in Bleaching Apparatus. H. Tatu (*Rev. gén. mat. col.*, 1933, 37, 427–436; *J. Textile Inst.*, 1934, 25, 132A).—Discusses the faults of the usual materials used in the construction of apparatus for the bleaching of textiles by the peroxide process and indicates the requirements of a suitable material for this purpose. These requirements are shown to be fulfilled by aluminium. Some practical applications of this metal in the construction of apparatus used in bleach works are described.—S. G.

A New Light Aluminium Alloy [Hiduminium R.R. 53B]. — (*Textile Expt.*, 1934, 11, (83), 10; *J. Textile Inst.*, 1934, 25, 202A).—Hiduminium R.R. 53B contains copper 2.5, nickel 1.5, magnesium 0.8, iron 1.2, and silicon 1.2%. Its physical properties in various conditions are given. It is stated that this alloy is proving of value for fast-moving parts, and is being applied in the textile industry to such components as levers, treadles, brackets, &c.—S. G.

Progress in the Production and Use of Light Alloys. C. C. Hodgson (*Metalurgia*, 1934, 11, 37–38).—The recently developed alloys of aluminium and magnesium are discussed and the properties which render them suitable for various applications are considered. The alloys dealt with are both casting and wrought alloys, and include the alloys of aluminium with silicon, magnesium, or cerium, the Y alloy, and the "R.R." series of alloys. Special attention is called to the advantages accruing from the heat-treatment of cast alloys, and to the importance of determining the fatigue-strength and the relative corrodibility of such alloys. The increasing application of these light alloys in transport, engineering, and marine work is also referred to.—J. W. D.

Aluminium for Roof Coverings. R. Haefner (*Metallwirtschaft*, 1934, 13, 786–789).—Laboratory and practical tests have shown that aluminium forms a satisfactory roof covering provided it is laid properly; a bitumen under-layer is recommended.—v. G.

Aluminium in Architecture and Building Construction. W. Zarges (*Light Metals Rev.*, 1934, 1, 25–28).—Translated from *Metallbörse*, 1934, 24, 683, 697–698, 729–730. See *Met. Abs.*, 1934, 1, 528.—R. B. D.

Aluminium Roof on the Radio Corporation of America Building. A. J. F. (*Light Metals Rev.*, 1934, 1, 29–30).—Brief description of the method of erection of the aluminium roofs of a portion of the building.—R. B. D.

Developments in the Uses of Light Metals in the Railway Field. — (*Light Metals Rev.*, 1934, 1, 150–191).—Detailed survey of developments during the last few years in the various branches of the railway field, with abstracts of all the more important papers and articles published and an extensive bibliography.—R. B. D.

A New Aluminium Train. Anon. (*Light Metals Rev.*, 1934, 1, 1–3).—A short description of a 5-car train for the Brooklyn and Manhattan overhead railway in which heat-treated aluminium-alloy sections and castings were extensively used.—R. B. D.

Aluminium in Electrotechnics. H. Schmitt and L. Lux (*Aluminium*, 1934, 17, 5–15).—A detailed account is given of the uses of aluminium in the electrical industry with especial reference to the manufacture of free transmission cables for long distance distribution of electricity. Details are given of the construction of these cables and their properties compared with those of copper.

—A. R. P.

***Aldrey for Electrical Transmission Lines.** — Irmann and W. Müller (*Aluminium*, 1934, 17, 142-147).—The possibility of substituting Aldrey for copper for overhead conductors for tramways, &c., has been investigated, especially with a view to finding a suitable contact material which does not wear the wire unduly or produce an excessive amount of sparking. Satisfactory results have been obtained with carbon and with a copper-aluminium alloy provided that adequate lubrication is used. Without lubrication only carbon gives satisfactory results.—A. R. P.

A New Clip for Free Transmission Lines [of Aluminium]. M. Preiswerk (*Aluminium*, 1934, 17, 147-148).—A clamp, made of Anticorodal, for holding aluminium or Aldrey wires to the supports is illustrated and briefly described.—A. R. P.

Heat-Losses in Sugar Mills; Insulation and Aluminium Applications. K. Šandera (*Listy Cukrovar.*, 1934, 52, 361-368; *C. Abs.*, 1934, 28, 7054).—Heat losses in sugar mills were computed for insulated and non-insulated surfaces; those from vacuum pans were 66 kg.-cal./m.²/hr., from evaporators 83.3, from piping carrying condensed steam 102, from piping carrying superheated steam 177. In a heat balance, the losses from the evaporator were 0.25% of the total; losses from all pipes were 2% of the total. After insulating about 95% of the piping with insulating material having a heat-flow of 0.08 kg.-cal./m.²/hr., the total heat-losses from pipes were decreased from 2 to 1%. After applying an aluminium film to an insulated surface, the heat-losses from that surface were decreased 10%; when the aluminium film was applied to an uninsulated surface, the decrease in heat-losses was 25%. The largest heat saving was effected by spraying aluminium on uninsulated surfaces. During a 6-hr. period the heat-loss from the evaporator surface ranged from 73.8 to 84.6 kg.-cal./m.²/hr.; after spraying the surface with aluminium, the heat-flow did not exceed 71.8 kg.-cal./m.²/hr. The atmosphere in the mill, however, makes it impossible to predict how long the new aluminium film will remain so effective.—S. G.

Aluminium Foil and Its Uses. E. Herrmann (*Aluminium*, 1934, 17, 15-19).—Besides its use as a packing material for foodstuffs, tobacco, tea, &c., aluminium finds extensive use as a heat insulator, for decorating the interiors of railway coaches, &c., for lining ship's refrigerators, for the manufacture of electric condensers, and for many radio purposes. Examples of these uses are illustrated.—A. R. P.

Wrapping of Apples in Aluminium Foil. E. Herrmann (*Aluminium*, 1934, 17, 190).—Aluminium foil has proved to be a satisfactory wrapping material for preserving apples, provided that the fruit is perfectly dry before wrapping. For a short period after gathering, apples exude a small amount of moisture by sweating and if wrapped before this has dried off the fruit rapidly rots; once this has dried, however, an aluminium wrapper will preserve the fruit until well after Christmas.—A. R. P.

Cadmium Poisoning in the Industry. H. Fühner and W. Blume (*Arch. Gewerbepath. Gewerbehyg.*, 1934, 5, 177-184; *C. Abs.*, 1934, 28, 6881).—Cadmium poisonings of recent times are discussed. They are due to the inhalation of cadmium, cadmium dust, and cadmium oxide fumes. Various symptoms are described. Whisky or milk are good antidotes.—S. G.

Poisoning by Wine Containing Cadmium [Derived from Plated Filters]. P. Fortner (*Pharm. Zentr.*, 1932, 73, 769-774; *Brit. Chem. Abs.*, 1933, [A], 91).—The wine contained cadmium, derived from the plating of filters through which it had passed.—S. G.

Poisoning by Cadmium in Coffee [from Galvanized Kettle]. C. Griebel and F. Weiss (*Pharm. Zentr.*, 1931, 72, 689-690; *Brit. Chem. Abs.*, 1932, [B], 46).—Eleven factory workers were seized with nausea and vomiting shortly after drinking coffee prepared with water boiled in a 50-litre kettle which had been treated with concentrated hydrochloric acid to remove scale.

Only the lower part of the inner surface had been cleaned. The coating of the galvanized iron contained zinc 91.5 and cadmium 8.5%. The coffee was faintly acid and contained cadmium 0.08, zinc 0.006, chlorine 0.129, and mineral matter 0.25%. Although the kettle had been rinsed with alkali followed by hot water, sufficient zinc, cadmium, and chlorine had been absorbed by the scale on the upper part of the inside to contaminate the coffee to the extent indicated.—S. G.

†**Estimation of the Toxicological and Hygienic Effects of Prolonged Absorption of Small Amounts of Copper in the Human Organism.** — Spitta (*Reichgesundheitsblatt*, 1932, 7, 862; *U.S. Public Health Eng. Abs.*, 1934, 14, W. 42, May, 26; *C. Abs.*, 1934, 28, 7388).—A critical study of the literature of the effect of copper on health. Large amounts of copper are poisonous and destroy the mucous membrane of the alimentary canal; smaller amounts, taken over a long period accumulate in the liver and may be related to certain liver diseases. Very small amounts of copper are necessary for normal biological processes. Approximately 4–5 mg. of copper is ingested in the food of a normal adult daily. The minimum amount of copper which affects taste in drinking water is 2 mg./litre. Ordinarily harmful amounts of copper are not dissolved by water from copper pipes, but pipes constructed from other materials are recommended.—S. G.

Properties and Uses of Lead-Base Bearing Metals. E. T. Richards (*Met. Ind. (Lond.)*, 1934, 45, 533–535).—The disadvantages of lead-base bearing alloys are largely due to their being handled according to the technique of tin-base alloys. The brittleness of the harder lead-antimony alloys (more than 13% antimony) can be overcome by adding a little tin. The alloys are greatly affected by the pouring temperature, which should be 400° C., and the preheating temperature of the moulds, which should be 200° C. Details of pouring and the precautions to be observed during cooling are set out and the compositions of several of these alloys are tabulated.—J. H. W.

***The Clean-Up of Various Gases by Magnesium, Calcium, and Barium.** A. L. Reimann (*Phil. Mag.*, 1934, [vii], 18, 1117–1132).—Characteristics of the gettering (clean-up) of residual gases, oxygen, nitrogen, hydrogen, carbon monoxide, and carbon dioxide, in evacuated vessels by magnesium, calcium, and barium are investigated experimentally and the results are discussed.—J. S. G. T.

Some Notes and Observations on Petrol and Diesel Engines [The Cracking of White Metal in Diesel Engine Big-Ends]. H. R. Ricardo (*Proc. Inst. Automobile Eng.*, 1932–1933, 27, 434–451; discussion, 452–477; *J. Roy. Aeronautical Soc.*, 1933, 37, 509–522; discussion, 523–546; *Diesel Engine Users Assoc.* 1933; and (abstract) *Mech. World*, 1933, 93, 283–285).—From a review of the experience of numerous British and Continental manufacturers of Diesel engines for heavy road cars it is concluded that the design of the engine is of relatively little importance in determining the life of the white-metal big-end bearings. Engine speed and lubrication also seem to be without effect. It does, however, appear to be preferable to employ very thin white-metal linings of the order of 0.01–0.02 in. thick carried in separate steel shells. Where the design and cost permit of the use of a hardened crankshaft, lead-bronze, gun-metal, or Duralumin bearings are much more satisfactory from the cracking point of view but may cause difficulties by seizing when the oil supply fails. Several theories to explain the cracking of white-metal bearings are put forward and briefly discussed. In the discussion, D. R. Pye stated that cracking could be reduced by stiffening the shell to make it less flexible, and G. S. Wilkinson said that by providing efficient oil-cooling so that the temperature of the bearing did not rise above a critical value cracking is almost entirely prevented.—A. R. P.

Metallurgy and Uses of Zinc.—I. Stanley Robson (*School Sci. Rev.*, 1934, 16, 21–31).—Adapted from an address to the London Local Section of the Institute of Metals.—S. G.

A Brief Discussion of Practical Application of Metals in Naval Machinery Design. C. S. Gillette (*J. Amer. Soc. Naval Eng.*, 1934, 46, 480-495).—A survey of the properties of metals as they affect the engineer deals with their selection for naval design with special reference to their resistance to corrosion and erosion, their maximum resistance to failure by shock or impact, their minimum cost, and their maximum availability within the industrial organizations of their own country. The non-ferrous metals referred to are the white metals and the leaded bronzes for bearings, and the various aluminium alloys for lightly stressed or unstressed parts, where lightness and a fair resistance to corrosion are required.—J. W. D.

Types of Tube Joints. G. Ehlers (*Z.V.d.I.*, 1934, 78, 460-465).—Various types of joint are described and their application to steel, copper, aluminium, and lead tubes is discussed.—v. G.

German Technique and Raw Material Economy. Anon. (*Z.V.d.I.*, 1934, 78, 1285-1290).—The substitution of aluminium and zinc alloys and artificial materials for copper and its alloys is discussed.—K. S.

XXII.—MISCELLANEOUS

The Work of Walter Rosenhain. J. L. Haughton (*J. Inst. Metals*, 1934, 55, 17-32).—Autumn Lecture. A very full *bibliography* is given of R.'s scientific publications.—S. G.

Research on Metals and Alloys. F. C. Frary (*Indust. and Eng. Chem.*, 1934, 26, 281-284).—Read before the American Chemical Society. A very able review of the two fundamental objectives in research on metals and alloys—the academic and the practical—and of the fields which have to be covered by the research-workers in order to make progress in the development of new and useful processes and products in the metal industry. The problems discussed are grouped under the heads: effect of impurities, workability, melting problems, customers' problems, casting processes, corrosion problems.—F. J.

The Story of Early Metallurgy. XI.—Copper and Bronze: The Question of Priority and the Mineral Sources. R. T. Rolfe (*Met. Ind. (Lond.)*, 1934, 45, 485-488).—The claims of Sumeria and Egypt to be the first smelters of copper and users of bronze, and the sources whence these countries derived their supplies of copper, tin, and nickel are discussed. See *J. Inst. Metals*, 1933, 53, 474.—J. H. W.

Adhesives for Metal Foil and the Technique of Glueing It. Fritz Ohl (*Gelatine, Leim, Klebstoffe*, 1934, 2, 195-199; *C. Abs.*, 1934, 28, 7437).—The adhesives used are discussed. The results depend as much on the technique of glueing as on the variety of glue.—S. G.

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XXIV.—BOOK REVIEWS

Pattern-Making. By James Ritchey. Revised by Walter W. Monroe, Charles Wm. Beese, and Philip Ray Hall. Med. 8vo. Pp. vi + 237, with 359 illustrations. 1933. Chicago, Ill.: American Technical Society. (\$1.75.)

The art of pattern-making has developed greatly in recent years, just as other branches of the mechanical industries have expanded, and the work of the pattern-maker is one of the first steps towards the production of the complete machine. The complexity of the patterns has increased in proportion as modern machines have become more complicated, calling for even greater skill on the part of the pattern-maker and the wider acquaintance with the various foundry methods which have their effect on pattern-construction. Duplication and mass production have led to the wider use of metal master patterns, and moulding machines for repetition work have still further enlarged the field of pattern-making.

The aim of this book is to cover fully the subject of pattern-making, giving the tools and equipment necessary, the design details of simple and complicated patterns for typical cases, use of green- and dry-sand cores, and finally the construction and design of a typical moulding machine with details as to the manner in which the castings are designed to suit this machine.

The authors achieve their aim and cover the subject adequately in a concise manner. The book is well written, being characterized by simplicity of language and clarity of expression. Not only will it prove of direct value to practical pattern-makers, but it contains much that is of interest to all connected with foundries who seek to enlarge their knowledge of this important branch of foundry work. It is particularly recommended for foundry students and apprentices.

The book is well printed and profusely illustrated with useful diagrams and photographs.

—J. E. NEWSON.

Text-Book of Mechanical Engineering. [Notified in Army Orders for August, 1934.] Demy 8vo. Pp. xv + 690, with 135 illustrations. 1934. London: H.M. Stationery Office. (12s. net.)

In view of the development of mechanization in the Army the issue of this manual by the Army Council is of special interest. Whilst it is intended specifically to serve as an instructional text-book for Army use, it presents such a comprehensive survey of the subject that it should prove to be a valuable reference book for many young engineers outside the service.

It is divided into three main parts—workshop practice, heat engines, and applications. In a work of this scope it is obviously impossible to devote much space to metallurgical considerations, but a brief *resumé* is given of the commoner ferrous and non-ferrous materials used in the branches of mechanical engineering covered by the book. Very useful chapters include the principles and practice of heat-treatment, pattern-making, foundry work, and joining of metals. A broad outline of workshop practice in these subjects is given, and similar treatment of fitting shop, machine shop, and wood-working shop follows. This part is concluded by an excellent chapter on workshop economics.

The second part forms a very complete treatise on heat engines and deals very fully with the theory, care, and maintenance of internal combustion engines—gas, petrol, oil, and heavy-oil Diesel types. The overhaul, repair, and testing of these engines receive naturally considerable detailed attention. Eight chapters are devoted to steam boilers and engines, their construction, auxiliaries, and working. The final part on transmission of power, lubrication, compressors, and pneumatic tools and refrigeration is equally thorough.

The whole volume is profusely illustrated with line drawings, photographs, and diagrams, and is well indexed. Following the index is a bibliography arranged under the chapter numbers, and the only criticism that one may offer in this respect is that the references given to metallurgical text-books could have been rather more comprehensive.

Considering the amount of information gathered together in this book the price is remarkably low, but the quality of the paper may account in part for the lower cost of production.

—J. E. NEWSON.