METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

1933 NOVEMBER Part 11

I.—PROPERTIES OF METALS

(Continued from pp. 545–548.)

Beryllium. J. Laissus and P. Tyvaert (*Bull. Assoc. Tech. Fond.*, 1933, 7, 209–219).—A general discussion on the metal beryllium from the points of view of: historical development; occurrence in natural state; metallurgical extraction; principal properties; effect as an addition agent in foundry practice; and economical considerations.—W. A. C. N.

The Absolute [Magnetic] Saturation of Cubic Cobalt. Robert J. Allen and F. W. Constant (*Phys. Rev.*, 1933, [ii], **44**, 228–233).—The method of Weiss and Forrer (this *J.*, 1930, **43**, 439) for extracting an ellipsoid from the field of a powerful electromagnet has been used to determine the absolute saturation intensity of magnetization of cubic cobalt between 93° and 273° abs. The magnetization for infinite field (J_{ST}) was calculated by means of Weiss' formula, which agreed with the upper half of the experimental curve within 0·03%. A straight line was obtained by plotting the values of J_{ST} at different temperatures against the square of the absolute temperature; from this the saturation intensity at the absolute zero, J_{SO}, was determined as 1418. When the reduced saturation intensities (J_{ST}/J_{SO}) were plotted against $(T/\theta)^2$, where θ is the Curie point, a straight line was obtained which coincided with that for iron and nickel, but differed from the curves for hexagonal cobalt, and for the orthorhombic crystals magnetite, cementite, and Fe_2B, indicating that the crystal structure is an important factor. The cobalt used was 98% pure with nickel, iron, carbon, and aluminium as the chief impurities.—W. H.-R.

Thermal Expansion of Columbium [Niobium]. Peter Hidnert and H. S. Krider (*U.S. Bur. Stand. J. Research*, 1933, **11**, 279–284; *Research Paper* No. **590**).—The results are given of an investigation on the linear thermal expansion of a rod of niobium containing 0·93% tin and 0·26% iron. Data were obtained at various temperatures between − 135° and + 305° C. The following is given as the most probable second-degree equation for the expansion of this rod of niobium:

$$L_t = L_0[1 + (7{\cdot}06t + 0{\cdot}00144t^2)10^{-6}].$$

The coeff. of expansion increases regularly with temperature. From 0° to 100° C. the average coeff. of expansion is $7{\cdot}2 \times 10^{-6}$ per ° C. A table gives the coeff. of expansion for various temperature ranges.—S. G.

An Examination of Roman Copper from Wigtownshire and North Wales. G. Clement Whittick and J. A. Smythe (*Proc. Univ. Durham Phil. Soc.*, 1933, 9, 99–104).—Analysis of four circular cakes of copper found in North Wales and ascribed to the Romans gave the following results: (A) copper 98·90, arsenic 0·03, iron 0·11, nickel 0·02, insoluble 0·35, total 99·41%; (B) copper 99·08, iron 0·04, nickel 0·01, sulphur 0·04, insoluble 0·07, calcium carbonate 0·39, total 99·63%; (C) copper 99·00, silver 0·03, arsenic 0·06, iron 0·09, nickel 0·02, insoluble 0·18, calcium carbonate 0·73, total 100·11%; (D) copper 99·08, silver 0·03, iron 0·10, nickel 0·02, insoluble 0·13, calcium carbonate 0·41, total 99·77%. The density of the samples was respectively 8·56, 8·65, 8·73, and 8·52. The average composition of the samples calculated on a scale- and dirt-free basis is copper 99·91, silver 0·01, arsenic 0·02, nickel 0·02, sulphur 0·04%. A cake of "copper" from Carleton, Wigtownshire, was found to be a leaded bronze of the composition copper 93·04, silver 0·14, lead 4·87, tin 1·85, iron 0·13, nickel 0·10, sulphur 0·02%, apparently made by addition of lead and tin to a copper having about the average composition recorded above. —A. R. P.

Influence of the Degree of Cold-Working and Temperature on Mechanical Properties of Soft Steel, Copper, and Nickel.—I.-II. André Ancelle (*Rev. Mét.*, 1933, 30, 266–274, 309–318).—(I.—) The influence of progressive drawing through dies is studied by tensile tests. Wires which have been subjected to various degrees of cold-working by drawing are reheated to various temperatures, cooled in air, and then subjected to tensile tests. The effects of the re-heating on the microstructure of the mild steel wire are studied. (II.—) Copper wires drawn to give various degrees of cold-working, reheated to various temperatures, and afterwards tested show maximum elongation values after reheating to the temperature which gives complete annealing, whatever the degree of previous cold-working. The maximum stress and elastic limit of drawn copper remain practically constant after reheating to low temperatures, but commence to fall as the reheating temperature approaches that of annealing. In the case of nickel wires, the maximum stress and elastic limit values show an initial increase corresponding with reheating temperatures in the range 20°–350° C., and afterwards decrease rapidly. The results of measurements of the small contractions in length observed immediately after removal of the load from wires overstrained in tension are given. The contraction is rapid at first, but slows down to zero.—H. S.

Hafnium. Paul M. Tyler (*U.S. Bur. Mines Information Circ.* No. **6457**, 1931, 1–11).—An account of the occurrence, distribution, properties, known compounds, and analytical separation of hafnium from zirconium. Future industrial applications are predicted owing to the high melting point and electronic emissivity of the metal.—P. M. C. R.

Notes on Some Romano-British Pigs of Lead. G. Clement Whittick (*J. Roman Studies*, 1931, **21**, (2), 256–264).—A description is given, without analyses, of some Roman pigs of lead found in the Mendip Hills and in Shropshire. Dimensions, weight, and inscription are discussed in detail.—A. R. P.

The Shropshire Pigs of Roman Lead. G. Clement Whittick (*Trans. Shropshire Archæol. Soc.*, 1932, **46**, 129–135).—The history and authenticity of some pigs of Roman lead found in Shropshire are discussed.—A. R. P.

The Clean-Up of Hydrogen by Magnesium. A. L. Reimann (*Phil. Mag.*, 1933, [vii], **16**, 673–686).—The mechanism of the clean-up of hydrogen by magnesium in vacuum tubes is investigated.—J. S. G. T.

The Relation of Hydrogen to Nickel with Special Reference to the Catalytic Power of the Latter. Harry N. Huntzicker and Louis Kahlenberg (*Electrochem. Soc. Preprint*, **1933**, May, 333–353).—The alleged passivity of nickel in solutions of nickel, copper, silver, and mercury salts has been studied by measuring the cathode potential of the metal in the various solutions. The results indicate that nickel exists in a passive state under ordinary conditions, and that this state is in no way dependent on a surface phenomenon, since scratching or bending the metal or the various chemical ways of depassifying passive metals do not alter the potential. Immersion of nickel in copper sulphate solution renders it more noble, but subsequent exposure to air or nickel sulphate solution slowly restores the ordinary "air potential." Silver and mercury salts do not produce this ennobling effect. In dilute sulphuric acid solutions nickel cathodes slowly become covered with a film of nickel sulphide, but in dilute phosphoric acid solutions the metal is activated by adsorption of hydrogen. This active nickel will immediately deposit silver and copper from their solutions, and becomes coated with a thin deposit of black cobalt or nickel in the corresponding sulphate solutions; it decolorizes bromine, iodine, permanganate, and ferric chloride solutions and reduces *N*-potassium nitrate to nitrite. Nickel may also be activated by heating it in hydrogen. On subsequently expelling the hydrogen it is liberated in a highly active form, some reactions of which are described.—A. R. P.

Spectro-Analytical and Electrical Investigations with Very Pure Platinum. Walther Gerlach and Else Riedl (*Physikal. Z.*, 1933, **34**, 516–522).—A spectrographic method and apparatus for the detection of minute quantities of impurities in metals are described. The method is applied to the analysis of three commercial varieties of platinum. Physically pure platinum, containing less than 0·001% of impurities, is shown to contain, in addition to calcium and strontium, copper, silver, palladium, and lead. The residual resistance of the very purest sample of platinum is found to be independent of temperature between 4° abs. and 1·35° abs. and to amount to 0·3 part per 1000 of its resistance at 0° C.—J. S. G. T.

The Catalytic Properties and Structure of Metal Films. I.—Sputtered Platinum. G. I. Finch, C. A. Murison, N. Stuart, and G. P. Thomson (*Proc. Roy. Soc.*, 1933, [A], **141**, 414–434).—The effect of sputtering conditions on the catalytic and structural properties of platinum films is investigated.—J. T.

[Contribution] to the Knowledge of Fundamental Atomic Weights. XII.—Revision of the Atomic Weight of Potassium; Analysis of Potassium Chloride and Potassium Bromide. O. Hönigschmid and R. Sachtleben (*Z. anorg. Chem.*, 1933, **213**, 365–376).—A redetermination of the atomic weight of potassium gave 39·096.—M. H.

Conditions Affecting the Freezing Temperature of Silver. Wm. F. Roeser and A. I. Dahl (*U.S. Bur. Stand. J. Research*, 1933, **10**, 661–668; *Research Paper* No. **557**; and (abstract) *Met. Ind.* (*Lond.*), 1933, **43**, 197–200).—The International Temperature Scale is defined in the range 660°–1063° C. in terms of the indications of a platinum to platinum–10% rhodium couple calibrated at the freezing points of gold, silver, and antimony, which metals, of course, should be of high purity when used. The requirements have been met in the case of gold and antimony, according to results from the chief research stations in England, Germany, and America, but differences, up to 0·5° C., were found in the freezing temperature of silver when using the same couple in the respective bulk samples of silver from the three institutions. In Germany and America the silver was contained in covered graphite crucibles, with presumably an atmosphere consisting of nitrogen, carbon dioxide, and carbon monoxide above the surface. At the National Physical Laboratory the silver was melted and cooled *in vacuo*. The three gases named are not appreciably soluble in the metal, but molten silver absorbs oxygen, and but 0·007% of this gas is sufficient to lower the freezing point of silver by 0·5° C. This amount of oxygen would be absorbed by molten silver in equilibrium with oxygen at a pressure of 0·4 mm. mercury. This investigation sought to find the source of the discrepancies. It was found that they are due primarily, if not wholly, to metallic impurities. It has been calculated, incidentally, that the freezing point of silver is only 0·005° C. lower *in vacuo* than at a pressure of 1 atm., which is well within the limit of experimental error, and the effect of changing pressure may be neglected. It is stated that any of the methods now in use for protecting silver from oxygen is adequate, but in order to obtain an accuracy of 0·1° C. it is necessary to limit the amount of impurities to 0·01%. A sample of silver containing 0·068% copper had a freezing point 0·5° C. lower than one containing only 0·008% of impurities. The freezing point of silver saturated with air at 760 mm. mercury pressure is 11·2° C. lower than that of the same silver protected from access of oxygen. Silver saturated with oxygen at 760 mm. mercury pressure melts at a temperature 22·6° C. lower than that of the same sample out of contact with oxygen.—W. N.

Some Physical Properties of Commercial Thorium. J. G. Thompson (*Metals and Alloys*, 1933, **4**, 114).—The physical properties of (A) electrolytic thorium and of (B) 10 mm. rods of calcium-reduced thorium (carbon 0·055, silicon 0·02, iron 0·058, calcium 0·078%, aluminium trace) have been determined. Extraordinary difficulties were met with in determining the melting point, since the metal reacts with carbon, oxygen, nitrogen, and all refractories except beryllia, and all the available supplies of commercial metal evolve much fume at about the melting point. The best results obtained indicate a melting point of 1680° C. for (B) and 1730° C. for (A), *i.e.* well below the accepted value of 1845° C. The latter is probably high, since molten thorium readily dissolves thoria and the melting point is thereby raised. Micrographs of the commercial metal showing inclusions of oxide, carbide, and metal-carbide eutectic are shown. The lattice parameter of (B) is 5·091 ± 0·004 A., whence $d_{\text{calc.}} = 11{\cdot}61$; actual determinations of d gave 11·1–11·49. The scleroscope hardness of (B) is 28–25, the Brinell hardness 78–74, and the Rockwell B hardness 43–29, the high values being those obtained on 10 mm. wire and the low values those obtained after annealing for 15 minutes at 700°–800° C. The electrical resistivity (A) at 20° C. is $18{\cdot}6 \times 10^{-6}$ ohm/cm., temperature coeff. 0·0038, coeff. of thermal expansion (B) $11{\cdot}1 \times 10^{-6}$ (20°–60° C.) and $12{\cdot}1 \times 10^{-6}$ (20°–300° C.) and the thermal e.m.f. against platinum − 0·13 (100° C.), − 0·53 (500° C.), + 0·87 (900° C.), and + 5·42 (1300° C.) mv. —A. R. P.

The Emission of Electrons from Tungsten and Molybdenum Under the Action of Soft X-Rays from Copper. J. Bell (*Proc. Roy. Soc.*, 1933, [A], **141**, 641–651).—The photo-electric emission from molybdenum and tungsten under the action of soft X-rays from copper in the voltage range 1–20 kv. is investigated. The effect of heat-treatment is to cause either an increase or a decrease of the emission, depending on the previous treatment of the metal. The emission from molybdenum is about 70% of that from tungsten.—J. T.

The Effect of Temperature on the Emission of Electron Field Currents from Tungsten and Molybdenum. A. J. Ahearn (*Phys. Rev.*, 1933, [ii], **44**, 277–286).—The electron field currents from clean filaments of tungsten and molybdenum have been investigated between 300° and 2000° K. at field strengths from about 5×10^5 to 1×10^6 v./cm. Above about 1600° K. the thermionic emission completely masks the field currents. At low temperatures the thermionic emission was estimated by extrapolating Richardson emission curves, and the field current was determined by subtracting the thermionic emission from the total emission. The field currents thus obtained are independent of temperature to within 5% from 300° K. to 1400° K. Above 1400° K. the data are consistent with the assumption that the measured current consists of a thermionic current plus a field current which is independent of temperature, but the rapid increase in the thermionic emission with temperature makes it impossible to detect a small temperature effect on the field current above 1400° K. The theoretical bearing of the results is discussed.—W. H.-R.

The Effect on the Density of Zinc of Deformation by Cold- and Hot-Rolling. O. Bauer and P. Zunker (*Z. Metallkunde*, 1933, **25**, 149–153; and (abstract) *Met. Ind.* (*Lond.*), 1933, **43**, 246).—Cast ingots of (A) electrolytic zinc (99·98%) and (B) zinc (lead 1·12, cadmium 0·11%) had densities of 7·134 and 7·160, respectively. After hot-rolling at 175° C. to reductions of 22, 32, 42, 72, and 98% the density of A was 7·115, 7·087, 7·127, 7·134, and 7·116, respectively; the corresponding values for B were 7·159, 7·162, 7·163, 7·165, and 7·149. The large decrease in the density of electrolytic zinc on hot-rolling up to about 32% is due to cracking of the coarse-grained casting structure and to the absence of lead inclusions which can fill these cracks. With reductions of about 40% the casting structure disappears in both cases, and the density once more increases until cracking again occurs with more than 72% reduction. Cold-rolling is possible only after an initial hot-rolling to 50% reduction. With cold-reductions of more than 76% a decrease in density takes place which is considerably larger in the case of electrolytic zinc. The change in the density of electrolytic zinc sheet on annealing at 150°, 220°, and 300° C. and after subsequent cold-rolling has also been investigated.—M. H.

"Zinkan" as the Latest Material for Mining Machinery and Apparatus. J. F. Kesper (*Schlägel u. Eisen*, 1933, **31**, 78–79; *Chem. Zentr.*, 1933, **104**, II, 120).—"Zinkan" is zinc (containing a small amount of aluminium) plated on both sides with pure aluminium in a similar way to "Alclad." Sheets of the material have a density of 6–7, according to the thickness of the aluminium layers, and a tensile strength of 20–25 kg./mm.^{2} with an elongation of 40–65% in the annealed state, 25–32 kg./mm.^{2} with an elongation of 10–20% in the semi-hard state, and 32–42 kg./mm.^{2} with an elongation of 5–10% in the hardest-worked state. At 150°–300° C. some of the aluminium diffuses into the zinc and increases the hardness and strength, so that articles made from soft sheet can be hardened by subsequent annealing within this range. The metal melts at 450° C.—A. R. P.

The Preparation of Some Rare Metals by Thermal Dissociation [of Their Compounds]. A. E. von Arkel (*Rev. Univ. Mines*, 1932, [viii], **8**, 37–41; and (abstract) *Met. Ind.* (*Lond.*), 1932, **41**, 462).—The preparation of ductile zirconium, titanium, and thorium by thermal dissociation of their iodides *in vacuo* on an electrically-heated tungsten filament is briefly described. A similar method may be used to prepare ductile vanadium using the diiodide heated in an evacuated quartz tube at 1000° C. Boron has been prepared in the form of extremely hard and brittle rods by reduction of the bromide with mercury vapour. The thermal dissociation method may also be used for preparing pure platinum from platinum carbonyl dichloride. The theory of the method is briefly discussed.—A. R. P.

Theory of Metals. P. Peierls (*Z. Physik*, 1933, **81**, 697–699).—P. replies to N. H. Wilson's criticism (*J.*, this volume, p. 7) of P.'s theory of the metallic state (*Ann. Physik*, 1932, **12**, 154).—J. S. G. T.

The Nature of Metals. R. Seligman (*J. Inst. Brewing*, 1933, **39**, 445–448; and (abstract) *Brewers' J.*, 1933, **69**, 456–457).—The way in which the chemical, physical, and mechanical properties of metals depend on their structure is explained with particular reference to materials used in the brewing industry. —H. W. G. H.

The Physical Properties of Metals Used in Brewing. T. S. Pritchard (*J. Inst. Brewing*, 1933, **39**, 449–450).—Materials used for fermenting vessels are discussed with particular reference to the effect of surface on fermentation and to metallic contamination of the yeast. A discussion of the papers by Seligman (preceding abstract) and Pritchard follows, *ibid.*, 451–453.—H. H.

The Origin of the Plasticity of Single Crystals. (i) H. Schlechtweg. (ii) W. C. Burgers. (iii) H. Schlechtweg (*Physikal. Z.*, 1933, **34**, (i) 404–407; (ii) 623–624; (iii) 624).—(i) S. shows that the plasticity of single crystals can be explained in terms of a combination of Polanyi's theory of stresses in the crystals (this *J.*, 1928, **40**, 481) with Prandtl's model embodying his kinetic theory of solids (see this *J.*, 1928, **40**, 481). The postulation of a mosaic structure within the crystal is unnecessary. (ii) B. contends that the existence of microscopic heterogeneities within the crystal is necessary to explain the phenomenon of plasticity. (iii) S. replies.—J. S. G. T.

A Method for Obtaining Single Crystals With a Given Axis Orientation. P. A. Polibin and A. I. Froyman (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki* (*Journal of Experimental and Theoretical Physics*), 1933, **3**, (2), 162–164).—[In Russian.] The method, which depends on a special arrangement of the capillary in the lower portion of the tube, has been used with pure zinc, cadmium, and tin.—N. A.

Plastic Deformation. N. Seljakov (*Zhurnal Tehnicheskoi Fiziki* (*Journal of Technical Physics*), 1933, **3**, (1), 14–25).—[In Russian.] A review of the present position of the problem.—N. A.

The Mechanism of Plastic Deformation. A. W. Stepanow (*Z. Physik*, 1933, 81, 560–564).—Plastic deformation, it is suggested, is accompanied by a transformation of the energy of deformation into heat in a narrow zone in the neighbourhood of the slip bands, whereby a temporary dissociation of the crystal lattice in this region is produced. Experimental results supporting this hypothesis are referred to.—J. S. G. T.

The Path Followed by the Fatigue Fracture in Metal Parts. A. Thum and H. Oschatz (*Usine*, 1932, 41, (11), 33).—A summary of a paper published in *Z.V.d.I.*, 1932, 76, 132–134. See this *J.*, 1932, 50, 342, 725.—R. B. D.

The Tenacity of Polycrystalline Materials. W. Kuntze (*Z. Physik*, 1933, 81, 564).—A diagram in K.'s paper (*J.*, this volume, p. 229) is corrected.

—J. S. G. T.

Lattice Distortion in Nitrided Steels and Theory of Hardness. W. A. Wood (*Phil. Mag.*, 1933, [vii], 16, 719–727).—An X-ray investigation of the changes produced in the case-hardening of steels by the nitriding process indicates that the method produces a surface layer of nitrides and a case of steel having an abnormally diffused and weakened X-ray spectrum. Extreme hardness values are associated with this type of spectrum. The results necessitate the postulation of the existence of a distorted atomic lattice and a disturbance of the electron distribution affecting the hardness. The disturbed distribution tends to obliterate the electronic arrangement facilitating "slip."—J. T.

Gases in Solid Substances. S. W. Ptitzyn (*Zhurnal Tekhnicheskoi Fiziki* (*Journal of Technical Physics*), 1932, 2, (9–10), 953–971).—[In Russian.] The distribution of gases in metals and other solids and their diffusion in a high vacuum is reviewed.—N. A.

Crystallization of Metals is Not Caused by Vibration. Joseph A. Kendrick (*Power Plant Eng.*, 1933, 37, 402).—K. attacks the popular misconception that fatigue failures are due to the production by vibratory strains of a crystalline structure in the metals concerned.—P. M. C. R.

The Surface Tension of Molten Metals and Alloys. IV.—The Change of Surface Tension with Time and the Drop Method of Measurement at Elevated Temperature. F. Sauerwald and B. Schmidt (*Z. anorg. Chem.*, 1933, 213, 310–318).—Apparatus for the determination of the surface tension by the drop method is described. The surface tension of mercury in the highest vacuum lies between the initial and final values in air. Under a pressure of 5×10^{-5} mm. the surface tension of tin shows no change with time, whereas that of thallium increases. Hence it is concluded that when the surface tension of a metal changes with time the final value is the resultant of the influence of the atomic arrangement at the surface and the effect of the gas atoms adsorbed thereon. Experiments on the influence of concussions and irradiations on the surface tension are in accordance with this conception.

—M. H.

The Action of Metals at a Distance on Microorganisms. G. A. Nadson and E. A. Stern (*Doklady Akademii Nauk U.S.S.R.* (*Comptes rendus de l'Académie des Sciences de U.R.S.S.*), 1932, [A], (14), 352–367).—[In Russian.] The action of magnesium, aluminium, nickel, copper, silver, tin, and lead on yeast and bacteria has been investigated. The distance of the metals from the culture was 1 mm. The action at a distance is apparently due to the radioactivity of the surrounding medium, secondary radiation being emitted from the metal surface. Just as in the case of secondary X-rays, so with metals, the principal effect is caused by streams of electrons which bombard the bacteria, either killing them or weakening and altering their activity.

—N. A.

Theory of Thermal Conduction at Low Temperatures. Wolfgang Kroll (*Z. Physik*, 1933, 81, 425–427).—An expression for the thermal conductivity at low temperatures is deduced from Bloch's theory, and satisfactory agreement is found between theoretical and experimental results relating to lithium.—J. S. G. T.

The Contribution of Protons to Electrical Conduction in Metals. III.—The Photographic Plate as Indicator. Alfred Coehn and Kurt Sperling (*Z. Physik*, 1933, 83, 291–312).—The motion of hydrogen in palladium conducting a current can be recorded on a photographic plate. A method for achieving this is described and discussed.—J. S. G. T.

On the Meaning of the Origin of Superconductivity. U. Dehlinger (*Naturwiss.*, 1933, 21, 607).—The transition from superconductivity to finite resistance is considered to be a transition from the oriented to the unoriented state in the electronic configuration, and to be comparable to the transition from regular to irregular atomic distribution which occurs in certain transformations in alloys.—J. W.

Some Remarks on the Frequency Dependence of Superconductivity and Ferromagnetism. Raymund Sänger (*Phys. Rev.*, 1933, [ii], 44, 302–307).—Theoretical. Superconductivity and ferromagnetic properties are affected by high frequencies. S. investigates the extent to which this frequency dependence can be accounted for by assuming that a conducting wire consists of a normal metallic core surrounded by a surface layer or skin which shows neither superconductivity nor ferromagnetism. The treatment is preliminary only, but suggests that such an explanation is possible although the surface layer required is rather thick, being of the order 10^{-4} and 10^{-5} cm. as indicated by the calculations for the superconducting and ferromagnetic properties, respectively.—W. H.-R.

A Possible Explanation of Superconductivity. J. I. Frenkel (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki* (*Journal of Experimental and Theoretical Physics*), 1933, 3, (2), 101–108).—[In Russian.] See abstract from another source, *J.*, this volume, p. 489.—N. A.

Remarks on the Theory of Superconductivity. J. Dorfman (*Physikal. Z. Sowjetunion*, 1933, 3, (4), 366–380).—[In German.] It is shown that the various factors, such as temperature, magnetic fields, and high frequency, which prevent superconductivity can be considered as purely energy factors which supply sufficient energy to the superconductors to transform them into the non-superconducting state. The observed relations admit of the drawing of certain conclusions as to the nature of superconductivity.—N. A.

On the Influence of a Transverse Magnetic Field on the Resistance of Liquid Metals. Ibrahim Fakidow and J. Kikoin (*Physikal. Z. Sowjetunion*, 1933, 3, (4), 381–392; also (in Russian), *Zhurnal eksperimentalnoy i teoreticheskoy Fiziki* (*Journal of Experimental and Theoretical Physics*), 1933, 3, (1), 36–43).—[In English.] The influence of a magnetic field on liquid sodium–potassium alloy is to produce a change in the resistance $\Delta R/R$ which for fields of more than 1000 Gauss is linearly proportional to the intensity.—N. A.

Superconductivity and the Hall Effect. J. Kikoin and B. Lasarew (*Physikal. Z. Sowjetunion*, 1933, 3, 351–365; and (in Russian) *Zhurnal eksperimentalnoy i teoreticheskoy Fiziki* (*Journal of Experimental and Theoretical Physics*), 1933, 3, 44–52).—[In German.] The value of the Hall constant R and of the product of this constant and the sp. electrical conductivity σ have been compared for a series of metals. R is relatively small and $R \cdot \sigma$ exceptionally small for superconducting metals at room temperature compared with the corresponding values for ordinary conductors. The same remarks apply to superconducting alloys of lead–bismuth, bismuth–thallium, and antimony–thallium, as well as to superconducting compounds containing a non-metallic component, *e.g.* sulphides.—N. A.

The Influence of the Elastic Elongation of Ferromagnetic Material on the Magnetic Transformation Point. M. N. Michejew (*Physikal. Z. Sowjetunion*, 1933, 3, (4), 393–398; also (in Russian) *Zhurnal eksperimentalnoy i teoreti-*

cheskoy Fiziki (*Journal of Experimental and Theoretical Physics*), 1933, 3, (1), 72–75).—[In German.] Determinations of the magnetic transformation point of a loaded copper–nickel alloy wire have shown that this point is independent of the tensional stress within the limits of experimental error.
—N. A.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 548–553.)

X-Ray Study of the Equilibrium Diagram of the Iron–Aluminium System. Atomi Osawa (*Kinzoku no Kenkyu*, 1933, 10, (7), 277–289).—[In Japanese.] The equilibrium diagram of the iron–aluminium system has been studied by X-ray and microscopic examination, and from the results a new diagram is proposed. Four compounds exist; namely, $(FeAl)_n$, $FeAl_2$, Fe_2Al_5, and $FeAl_3$. The first three are formed by peritectic reactions :—

$$\text{melt} + \delta \text{ solid solution} \rightleftharpoons (FeAl)_n$$
$$\text{melt} + (FeAl)_n \rightleftharpoons FeAl_2$$
and
$$\text{melt} + FeAl_2 \rightleftharpoons Fe_2Al_5$$

$FeAl_3$ solidifies directly from the melt, having a maximum melting point on the liquidus line, and forms eutectics with pure aluminium on one side and with Fe_2Al_5 on the other.—S. G.

Solubility of the Chemical Compound $MgZn_2$ in Aluminium in the Solid State at Different Temperatures. P. Saldau and M. Zamotorin (*Z. anorg. Chem.*, 1933, 213, 377–382).—The solubility of $MgZn_2$ in aluminium in the quasi-binary system Al–$MgZn_2$ (determined by micrographical analysis) is about 30·0, 24·7, 14, 3·6, and 1·6% $MgZn_2$ at 475° (eutectic temperature), 460°, 400°, 300° C., and room temperature, respectively.—M. H.

The Sodium Content of Silumin. E. Scheuer (*Z. Metallkunde*, 1933, 25, 139–141, 157–160; and (abstract) *Met. Ind.* (*Lond.*), 1933, 43, 354).—The sodium content of Silumin can be determined by melting the alloy in air, cooling, washing with distilled water, and titrating the alkaline solution with standard acid. Grain-refinement takes place independently of the modifier used (metallic sodium or sodium salts) but is not produced by less than 0·003% sodium; normally modified Silumin contains about 0·010% sodium. The amount of sodium taken up by molten Silumin depends, under otherwise equal conditions, on the temperature at which the sodium is added; it is considerably smaller at the melting point of Silumin and at 1000° C. than at 700° and 900° C., and largest at about 800° C. The decrease in the sodium content of Silumin melts has been determined at temperatures between 600° and 1000° C. Between 15 seconds and 1 minute after the addition of the sodium the loss was 20–40%, the rate of oxidation being smallest at 600° C. and greatest at 800° C.—M. H.

Hydronalium, a New Light Metal Alloy with a High Resistance to Corrosion. Werner Schultze (*Forschungen u. Fortschritte*, 1933, 9, 386–387).—A short account of the properties and uses of Hydronalium.—J. W.

Notes on the Light Alloys of Aluminium, Especially Those which Require no Heat-Treatment. E. Herrmann (*Bull. tech. Suisse Romande*, 1933, 59, 193–195).—A survey of the development of light alloys leads to a discussion of the ageing alloys Duralumin, Avional, and Anticorodal. Uniformity of structure, high strength, and good elongation are secured by working in the soft condition, with subsequent heat-treatment, but the selection of suitable materials may obviate the expense and skilled labour entailed by these methods. Recently developed alloys of aluminium with magnesium and manganese are described, notably Peraluman (special Anticorodal), of the composition : man-

ganese 1·5, magnesium 2·0–2·5%, and remainder aluminium. The mechanical properties of pressed sections and of sheet in the annealed, half-hard and fully hardened conditions are tabulated. Other alloys considered are Aluman (aluminium with 1·5% manganese) the American " 4 S " alloy (magnesium 1; manganese 1%), Birmabright (magnesium 3·5; manganese 0·5%), Hydronalium, Duranalium, and " MG 7 " (low manganese, magnesium 5–15%).
—P. M. C. R.

The Influence of Small Quantities of Silicon on the Strength and Elasticity of Duralumin. J. G. Muzalevsky (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1933**, (1), 70–80).—[In Russian.] The influence of 0·04% to 0·66% of silicon on Duralumin containing copper 4·5, magnesium 0·80, manganese 0·40, and iron 0·20% has been investigated in tensile and bending tests on rolled and heat-treated specimens after ageing for 2, 24, and 144 hours. The strength of Duralumin during natural ageing is independent of the silicon content within the above limits. In bending sheet Duralumin the toughness falls sharply when the silicon exceeds about 0·5%, the fall being especially marked with annealed metal with a high silicon content. It is concluded that additional silicon should not be introduced into Duralumin.—N. A.

The Influence of Silicon on the Mechanical Properties of Duralumin. V. O. Krenig (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1933**, (1), 81–83).—[In Russian.] Criticisms of a paper by J. G. Muzalevsky. Krenig's researches demonstrate the beneficial influence of silicon on the properties of Duralumin. The decrease in strength in the annealed condition is without significance, since Duralumin sheets in practice are usually bent immediately after the quenching.—N. A.

Methods of Strengthening Duralumin by Means of Thermal Treatment. S. M. Voronov (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1929**, (8), 500–513; (9), 568–576).—[In Russian.] From a study of the mechanical properties during the process of ageing, it is concluded that the degree of strengthening is a function of the chemical composition of the alloy, degree of the preceding plastic deformation, temperature of quenching, and temperature of the quenching medium. The greater the prior mechanical deformation and the better the condition of the subsequent quenching, the more vigorous is the ageing process and the more intense the final strengthening effect. The existing theories of the ageing process are examined in the light of numerical data prepared by V. which confirm the important part played by the separation of Mg_2Si during the ageing process.—N. A.

An Investigation of the Influence of Air Quenching on the Mechanical Properties of Duralumin. I. G. Schoulgin (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1932**, (10), 933–949).—[In Russian.] The mechanical properties and hardness of air-quenched (normalized) Duralumin during the first 8 hrs. of ageing at room temperature are higher than those of the water-quenched alloy. During the next 7 days of ageing this relationship changes, until after 15 days the difference practically vanishes. The mechanical properties during the ageing process alter as shown below.

	Water-quenched, %.	Air-quenched, %.
Increase in tensile strength	31–41	16–29
,, limit of proportionality	105–119	39–81
,, Rockwell hardness	46–159	34–91
Decrease in elongation	0–16	0–15

Air quenching of tubes and complete structures is possible if the furnace is operated correctly and the heating period is sufficiently prolonged. The mechanical properties of air-quenched Duralumin fall more rapidly than those of water-quenched during corrosion. No difference between the two can be detected by metallographic methods.—N. A.

An Investigation of the Materials of Connecting Rod Forgings of Duralumin for Aircraft Motors. I. G. Schoulgin (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1933**, (2), 50–58).—[In Russian.] The condition of connecting rod forgings of Duralumin has been investigated at different points, to determine the effect of the thermal and mechanical treatment. The alloy tested contained copper 4·45, silicon 0·17, manganese 0·50, magnesium 0·75, and iron 0·46% and in the initial state had an average tensile strength of 25 kg./mm.^{2}, an elastic limit of 15·8 kg./mm.^{2}, a relative elongation 13·3%, and an impact strength of 3·55 kg./cm.^{2}; the corresponding values for the quenched alloy were 41·2, 31·5, 24, and 3·27. Results of a metallographical examination are given.—N. A.

Measurements of the [Thermal] Expansion of Aluminium Casting Alloys for Motor Cylinders. F. Bollenrath (*Metallwirtschaft*, 1933, **12**, 85–89).—Different heat-treatments considerably affect the shape of the thermal expansion curve of cast aluminium alloys. The conditions under which the best curve for practical use of the alloys is obtained have been investigated.

—v. G.

Aviol (Aviation Aluminium). J. G. Muzalevsky (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1930**, (1), 47–58).—[In Russian.] Aviol is a medium strength alloy to replace aluminium in aircraft construction; it contains 0·7% silicon and 0·6% magnesium, and has a coeff. of linear expansion $2 \cdot 3 \times 10^{-5}$. The yield point (kg./mm.^{2}) is 12–15 in the annealed, 17–23 in the quenched, and 25–36 in the aged (at 150° C.) state; the corresponding values for the elastic limit are 5–7, 8–10, and 17–24 kg./mm.^{2}, for the elongation 27–20, 28–25, and 18–8%, and for the Brinell hardness 40–50, 60–75, and 80–110. The thermal treatment of Aviol and its influence on the mechanical properties have been investigated in detail: the mechanical properties are improved by quenching from above 400° C., the optimum temperature being 530°–550° C. With natural ageing a progressive rise in mechanical properties occurs during 4 days. Ageing at 150°–170° C. improves the mechanical properties during 3 hrs. The resistance of Aviol to the action of the atmosphere, and to fresh and sea-water does not differ from that of the purest aluminium. Acids, especially hydrochloric, in any concentration dissolve Aviol. The production of semi-manufactured parts for the aircraft industry and the methods of working Aviol are described.—N. A.

Strength of [" 4 S "] Aluminium [Alloy] Corrugated Sheet. Anon. (*Eng. News-Record*, 1933, **110**, 705).—Safe uniformly-distributed loads are computed for standard sizes of corrugated sheet made from the aluminium alloy " 4 S." Load-deflection tests made on samples with ends freely supported on wooden horses 6 ft. apart and loaded with dry sand over an area 24 × 72 in. showed close agreement with calculated values. Crushing tests indicated a wide margin of safety against the end reactions likely to be encountered in practice.

—J. C. C.

Vacuum-Melted Beryllium Alloys. W. Hessenbruch (*Heraeus Vacuumschmelze* [*10th Anniv. Volume*], **1933**, 199–232).—In preparing hardenable alloys of beryllium with copper, nickel, and cobalt with or without other metals, vacuum-melting produces alloys with more reproducible properties than does melting under a salt layer, since the loss of beryllium in the first case is almost negligible. Alloys of copper with 2·5% beryllium develop a maximum hardness after quenching from 750° C. and tempering at 250° C. for 10 hrs., or, after 30% reduction by cold-rolling, for 1½ hrs. An alloy of nickel with 1·7% beryllium develops the maximum hardness after quenching from 1000° C. and tempering at 450° C. for 15 hrs. or, after 30% reduction by cold-rolling, tempering at 400° C. for 16 hrs. The cold-worked and hardened copper alloy has a yield-point of 107 kg./mm.^{2}, tensile strength of 123·3 kg./mm.^{2}, elongation of 5·7%, Brinell hardness of 350, and notched bar impact value of 0·81 m.-kg./cm.^{2}; the corresponding values for the nickel alloy after similar heat and mechanical treatments are 150, 182·5, 8·3, 460, and 4·47. The high tensile strength and toughness are characteristic of vacuum-melted alloys. Beryllium confers similar remarkable properties on cobalt, but the alloy with 2% beryllium can be worked hot only; after addition of 8% iron to convert the cobalt from the hexagonal to the face-centred cubic form, the alloys can readily be cold-worked. For the 2 : 8 : 90 beryllium–iron–cobalt alloy maximum hardness is induced by quenching from 1000° C. and tempering at 400°–450° C. for 4–8 hrs.; in this way Brinell hardness numbers of over 600 can be obtained. The solubility of beryllium in copper, nickel, cobalt, and iron is reduced by addition of other elements such as molybdenum, tungsten, chromium, and manganese, and hence smaller quantities of beryllium are sufficient to produce temper-hardening alloys. Thus addition of 0·6–1% beryllium to Contracid (nickel 61, chromium 15, iron 15, manganese 2, molybdenum 7%) produces the following changes in the properties after heat-treatment; (values in same order throughout) (*a*) quenched from 1050° C.: yield-point 41·7 kg./mm.^{2}, tensile strength 88 kg./mm.^{2}, elongation 29·15%, Brinell hardness 195, notched bar impact value 13·9 m.-kg./cm.^{2}, (*b*) subsequently annealed at 500° C. for 4 hrs.: 49·6, 93·2, 22·75, 320, 8·14, (*c*) quenched from 1050° C. and reduced 30% by cold-rolling: 105, 110·5, 1·35, 390, 3·34, (*d*) as (*c*) but tempered for 6 hrs. at 450° C.: 118, 129, 7·9, 430, 2·83. Ordinary 80 : 20 Nichrome and 65 : 15 : 20 nickel–chromium–iron alloys become hardenable after addition of 1–1·5% beryllium, hardness values of over 420 being obtainable by cold-working the quenched alloys and tempering at 400°–500° C. Addition of 8% molybdenum or of 8% chromium and 4% molybdenum to nickel containing 1–1·5% beryllium confers marked temper-hardening properties and a relatively great stability of the hardened state at temperatures up to 450° C. Addition of chromium or of tungsten to beryllium–cobalt alloys reduces the amount of beryllium required to produce temper-hardening, but makes the alloys much too hard for cold-working in the quenched state. The alloy with cobalt 34, iron 50, chromium 15, and beryllium 1%, which has a hardness of 225 (Brinell) in the quenched state, can be reduced by 30–50% by cold-rolling, whereby the hardness is raised to 470; subsequent tempering at 450° C. raises the hardness to a maximum of 680–700. Addition of 5% manganese or silver or 3% silicon with 1% beryllium to copper produces alloys which can be heat-treated to give Brinell hardness values of about 300; with 3% titanium and 1% beryllium hardnesses of about 370 can be obtained. Curves are given showing the creep limit of beryllium–Contracid and ordinary Contracid at high temperatures as well as tables showing the electrical resistance and coeff. of thermal expansion of many of the above alloys after various heat and mechanical treatments. The rates of corrosion of beryllium–nickel and beryllium–Contracid alloys in various acids are compared with those of stainless steels and some possible uses of heat-treated beryllium alloys are mentioned.—A. R. P.

The Action of Oxygen and Hydrogen Sulphide Upon Iron–Chromium Alloys at High Temperatures. R. L. Rickett and W. P. Wood (*Amer. Soc. Steel Treat. Preprint*, **1933**, Oct., 1–32).—Alloys containing up to 28% chromium were studied within the range 760°–1095° C. and for periods of exposure up to 150 hrs. Examination comprised the determination of gain of weight, and the chemical composition, microstructure, and general crystal structure of the scale produced under the varying conditions. Other factors being constant,

hydrogen sulphide produced a greater amount of scale than oxygen. Resistance to oxidation was increased by increasing the amount of chromium, but resistance to sulphurization only slightly thereby. The greater resistance to oxidation of the higher chromium alloys was accompanied by a large increase in the amount of chromium found in the scale. The rate of scaling decreased with increase in time of exposure, and increased rapidly as the temperature increased. It is surmised that in these operations there is diffusion of the reacting gas, or of higher products of reaction, inward, and of the metal, or of lower products of reaction, outwards, through the scale.
—W. A. C. N.

Ordinary and Special Bronzes. The Alloys of Aluminium and Copper. II.–III.—" Aluminium–Bronzes." L. Guillet (*Cuivre et Laiton*, 1933, 6, 237–238, 395–396).—(II.—) A general discussion of the properties and uses of "aluminium–bronze." (III.—) Deals with the alloy containing copper 90, and aluminium 10%—the so-called St. Claire–Deville alloy. G. gives details of the thermal diagram, the physical properties of the alloy, and the precautions which must be taken during casting.—W. A. C. N.

On the System Beryllium–Copper. H. Tanimura and G. Wassermann (*Z. Metallkunde*, 1933, **25**, 179–181).—The solid solubility of beryllium in copper as determined by X-ray analysis of well-annealed and quenched alloys decreases from 2·1% (extrapolated) at the peritectic temperature (864° C.) to 1·8% at 700° C., 0·4% at 400° C., and about 0·16% at 250° C. The decomposition of the quenched, supersaturated solid solution during ageing at 150°–350° C. can be followed by X-ray analysis.—M. H.

Tin-Free Leaded Bearing Bronze. H. K. Herschmann and J. L. Basil (*U.S. Bur. Stand. J. Research*, 1933, **10**, 591–608; *Research Paper* No. **551**; and (summary) *Met. Ind.* (*Lond.*), 1933, **43**, 219–222, 243–246, 325–326).—Bronzes containing 25–28% lead have to a great extent replaced tin-base alloys in connecting-rod bearings of aeroplane engines. They usually contain tin, which is added to prevent agglomeration of lead particles and to give strength to the alloy matrix. The aim of the work here described was to produce such bronzes without tin, and the paper is divided into two parts: (1) the effect of small amounts of various elements on the distribution of lead in leaded-bronzes containing more than 30% lead; and (2) the characteristic mechanical properties of leaded bronzes containing 30·5–40% lead together with small amounts of sulphur, silicon, and zirconium. Steel-backed bearings lined with one of the best alloys studied were subjected to service tests. Individual additions of barium, calcium, zirconium, and sulphur showed promise in preventing lead segregation. An alloy containing sulphur, silicon, and zirconium is suggested as showing but little segregation. The one used in the steel bearings above mentioned contained lead 35, sulphur 0·4, silicon–zirconium alloy 1·5%. The wear-resistance of this alloy was superior to that of many commercial alloys containing appreciable quantities of tin. Its compressive strength was equal to that of an alloy containing tin but only 10% less lead. Between 100° and 250° C. there was little change in the resistance to pounding. Under service conditions in an aeroplane this alloy gave very promising results.—W A. C. N.

Investigations Relating to Heusler Alloys. S. Valentiner and G. Becker (*Z. Physik*, 1933, **83**, 371–403).—The magnetic properties of Heusler alloys are attributable to the presence of crystals of composition $Mn–Al–Cu_2$. The Curie points of the alloys are all in the neighbourhood of 330° C., which is that characterizing the very strongly magnetizable alloy of atomic composition manganese 25, aluminium 25, copper 50%. This alloy, whether quenched from 800° C. or higher temperatures or aged at temperatures below 350° C., possesses a body-centred lattice with super-structure, the side of the crystal unit being of length 5·950 A. At temperatures between 350° C. and 700° C.

the alloys consist of $Al–Cu_3$ and $Mn–Al–Cu_2$ with embedded Mn atoms. Alloys quenched from, or aged within, this range of temperatures are less strongly magnetizable than the alloys previously referred to. The magnetic saturation value of alloys of other compositions is dependent on the percentage of manganese present which goes to form crystals of $Mn–Al–Cu_2$. On ageing these alloys the coercive force at first increases and then decreases. Excess manganese can, in part, enter the lattice of the $Mn–Al–Cu_2$ crystals without altering the length of the lattice edge or appreciably affecting the magnetic properties. Excess aluminium disturbs the formation of crystals of $Mn–Al–Cu_2$, and easily combines with the copper of such crystals to form $Al–Cu_3$. If the aluminium content is only slightly greater than 25%, the crystal lattice, during ageing of the alloy, changes from one having a length of edge 5·833–5·950 A. to one of length 8·7 A. These latter alloys are only feebly magnetic. Alloys of composition not very different from that represented by $Mn–Al–Cu_2$ are characterized by a very high coercivity for weak saturation values.—J. T.

Herculoy—A Copper–Silicon–Tin–Zinc Alloy. R. A. Wilkins (*Metals and Alloys*, 1933, 4, 123–126).—Herculoy is a copper alloy containing silicon 3·25, zinc 1·5, and tin 0·5%. The zinc increases the tensile strength and improves the casting and working properties, whilst the tin improves the resistance to corrosion and permits a low-temperature anneal to be carried out to remove internal stresses without affecting the mechanical properties produced by cold-work. The cast alloy has a tensile strength of 55,000 lb./in.^{2} with an elongation of 70%; by cold-working a strength of 100,000 lb./in.^{2} can be obtained, and the internal stress induced by the work can be relieved by annealing at 285°–315° C., during which operation the hardness and strength are increased by a precipitation-hardening effect. Cold-drawn rod after annealing at 290° C. for 30 minutes has a yield-point of 105,000 lb./in.^{2}, an ultimate strength of 135,000 lb./in.^{2}, and an elongation of 11%; in this state an outside fibre stress of 30,000 lb./in.^{2} does not cause failure after 6×10^7 reversals of load. The alloy has a density of 8·54, modulus of resiliency of 17·5 (soft) and 375 (hard) in.-lb./in.^{3}, coeff. of thermal expansion of 0·0000170 (0°–100° C.), resistivity (soft wire) of 21·75 microhms./c.c. at 22·5° C., max. induction 470 Maxwells/cm.^{2}, magnetizing force 200 Gilberts/cm.^{2}, normal coercive force 1·5 Gilberts/cm.^{2}, permeability 2·5, temperature coeff. of resistance 0·00046 at 20° C., and melting point 1023·5° C. The alloy resists corrosion by most neutral and alkaline solutions and by hydrochloric and sulphuric acids.—A. R. P.

On the Equilibrium Diagram of the Copper–Tin–Phosphorus Alloys. J. Verö (*Z. anorg. Chem.*, 1933, 213, 257–272).—The solidification and transformation of copper–tin–phosphorus alloys with 0–25% tin and 0–8% phosphorus have been studied by thermal analysis and micrographical examination of alloys with a constant tin content of 5·0, 10·0, 15·0, and 20·0% and of alloys with a constant phosphorus content of 1·0, 2·0, and 3·0%. The eutectic reaction in the copper–phosphorus system (melt $\rightleftharpoons \alpha + Cu_3P$ at 707° C.), which also takes place in ternary alloys poor in tin, and the peritectic reaction in the copper–tin system (α + melt $\rightleftharpoons \beta$ at 798° C.) merge into the 4-phase reaction α + melt $\rightleftharpoons Cu_3P + \beta$ at 637° C. The transformations in the solid state are similar to those in the copper–tin system. The solid solubility of phosphorus in the α- and β-tin–copper solid solutions has been determined in detail and the phase equilibria are shown in diagrams and photomicrographs. —M. H.

Ageing and Elastic Hysteresis in Instrument Springs. Paul MacGahan and Robert W. Carson (*Instruments*, 1932, 5, 89–90).—An extended abstract of a paper read before the American Institute of Electrical Engineers. Spiral instrument springs are made by winding hard-rolled phosphor-bronze tape tightly on a mandrel, holding the tape with a close-fitting barrel, and heating for several minutes to about 300° C. to fix the shape. In the course of time, such springs uncoil 5°–10° and increase in torque by 2–5%, depending on forming and ageing temperatures. This is due to the relief of residual stresses. By heating at 100°–150° C., however, relaxation is very rapid, and no further ageing then occurs at lower temperatures. Measurements were made of the elastic hysteresis of spring materials under low stresses, making use of a grid glow relay tube to indicate contact between the ribbon and the micrometer used to measure deflections.—J. C. C.

Relative Temperatures of Brass when Subjected to Reversed Direct Stresses in Vacuo and in Air. H. J. Gough and D. G. Sopwith (*Aeronaut. Res. Cttee. R. and M.* No. **1482**, 1932, 1–4).—Cf. this *J.*, 1932, **49**, 93. In continuation of earlier work three alternating direct stress tests have been made on 70 : 30 annealed brass: (*a*) in air at ± 7·1 tons/in.^{2} (*i.e.*, just below the air fatigue limit); (*b*) *in vacuo* at ± 9 tons/in.^{2} (*i.e.*, just below the *vacuo* fatigue limit), and (*c*) in air at ± 9 hrs./in.^{2}; the temperature difference between the holders and the specimens during the tests are shown graphically. Specimens (*a*) and (*b*) survived respectively, 26 and 35·2 × 10^6 reversals without fracture, whereas specimen (*c*) broke after 0·36 × 10^6 reversals. The actual temperatures of the specimens were identical over the same period, the maximum temperature after primary hysteresis reaching about 30° C. Hence the difference in the fatigue limits in air and *vacuo* is not due to temperature effects.—A. R. P.

Alloys of Copper Combining High Mechanical Strength with Good Electrical Conductivity. Anon. (*Cuivre et Laiton*, 1933, **6**, 401–403).—Data are given concerning the physical and electrical properties of a large number of copper alloys, for which good qualities in both directions are required. Special attention is devoted to silicon–, cadmium–, and beryllium–" bronzes."

—W. A. C. N.

[Basaloy] Pasco Copper Co. Alloys. Anon. (*Automotive Ind.*, 1932, **67**, 497).—Basaloy, an alloy of unstated composition, has a sp. gr. of about 10, melts at about 257° F. (125° C.), is somewhat malleable and ductile, is harder than lead, takes a clean impression, and retains a constant composition in re-melting. It is recommended for proving forging dies and as a liquid seal for annealing furnaces of certain types.—P. M. C. R.

The Tensimetric Analysis of the Systems Gold–Phosphorus, Silver–Phosphorus, and Copper–Phosphorus. Haakon Haraldsen (*Skr. Norske Vidensk.-Akad. Oslo. Mat.-Naturv. Kl.*, 1932, (9), 1–63).—[In German.] Tensimetric analysis of these systems in a specially designed apparatus has shown that the following stable compounds exist: Au_2P_3, AgP_3, AgP_2, CuP_2, and Cu_3P; this has been confirmed by X-ray analysis. The densities of these compounds are respectively 8·123, 3·881. 4·653, 4·201, and 7·147, and their heats of formation 41·7 (630° C.), 35·5 (456° C.), 32·7 (478° C.), and 52·0 (697° C.), respectively, from phosphorus vapour and metal or lower phosphide. Cu_3P is the most stable phosphide and Au_2P_3 is more stable than either of the silver phosphides.

—A. R. P.

X-Ray Investigations on Antimony–Lead and Tin–Lead Alloys. I. Obinata and E. Schmid (*Metallwirtschaft*, 1933, **12**, 101–103).—The lattice parameter of pure lead (a = 4·9389 A.) is reduced by 0·1°/$_{oo}$ by the presence in solid solution of 1 atomic-% antimony and by 0·34°/$_{oo}$ by 1 atomic-% tin. The solubility of antimony in lead at 250°, 200°, and 100° C. is 2·9, 1·5, and 0·4 weight-% respectively, and that of tin in lead at room temperature is 3·4 atomic-%.—v. G.

New Bearing Alloy [Satco] Designed to Withstand High Temperature. Anon. (*Automotive Ind.*, 1933, **69**, 122).—The following are claimed for Satco: solidification point 295° C.; temperature of complete liquefaction 420° C.;

transverse strength 10 tons/in.² with a bend of 11°, that of railway Babbitt metal tested under identical conditions being about 9·5 tons/in.² with a bend of 7°; low shrinkage and retention of hardness at elevated temperatures. The alloy is said to be suitable for die-casting.—P. M. C. R.

Shape and Structure of Lead Shot. G. Tammann and K. L. Dreyer (*Met. Ind.* (*Lond.*), 1933, **42**, 618).—Short abstract of a paper published in *Z. Metallkunde*, 1933, **25**, 64. See *J.*, this volume, p. 299.—J. H. W.

Study of Magnesium–Aluminium–Copper Alloys Rich in Magnesium. Paul Bastien (*Publ. sci. et tech. Ministère de l'Air*, No. **20**, 1933, 1–9).—The equilibria in the system magnesium–aluminium–copper have been determined by thermal analysis of alloys containing more than 45% magnesium. The section Mg_2Cu–Mg_4Al_3 does not form a quasi-binary system, since complex changes take place within a certain composition range and the compound $Mg_2Cu_3Al_2$, which has *d* 6·5, separates in crystals at the bottom of the melt. The liquidus of the ternary system in this region consists of four surfaces sloping down to two eutectic valleys corresponding with the solidification of two ternary eutectics (A) containing magnesium 56·5, aluminium 26·5, copper 17%, melting point 412° C., and (B) containing magnesium 67·5, aluminium 0·5, copper 32%, melting point 484° C. Two ranges of solid solution occur, one extending from magnesium to the alloy with aluminium 8·8 and copper 6·2%, and the other from Mg_4Al_3 to the alloy with magnesium 58, aluminium 41·4, and copper 0·6%. The existence of the above phases has been confirmed by micrographic examination, 30 photographs of characteristic structures being given. The hardness of magnesium is increased more rapidly by addition of copper than by addition of aluminium, and chill-cast alloys are always harder than sand-cast. Forging and drawing reduce the hardness, particularly of alloys with a high copper content. The coeff. of thermal expansion (α) of aluminium–magnesium alloys increases slightly up to the limit of homogeneous solid solution, then decreases linearly with increasing proportion of eutectic; similar effects occur in the copper–magnesium system. In the ternary solid solution aluminium increases α, whilst copper tends to decrease it slightly. The density, and the electrical and thermal conductivities of numerous alloys containing up to 15% aluminium + copper have been determined, and the results are given in tables and graphs. Alloys with up to 12% copper or 6% aluminium (total not exceeding 15%) can be readily forged into pistons of good hardness and thermal conductivity for use in internal-combustion engines. Static bending tests are more satisfactory than the ordinary tensile tests for appraising the value of cast ternary alloys. Certain alloys in the drawn state have a fatigue limit which compares favourably with that of Duralumin, *e.g.* the 9 : 3, 9 : 6, and 6 : 9 aluminium–copper–magnesium alloys have fatigue limits of 12–13 kg./mm.² with tensile strengths of 26–28 kg./mm.². The presence of copper increases the corrosion of these alloys slightly in acid media and considerably in saline media. Addition of aluminium to copper–magnesium alloys rapidly decreases their rate of corrosion.—A. R. P.

Selection of Alloys of the Elektron Type for the Casting of Aeroplane Parts. A. S. Ball (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1932**, (11–12), 1062–1068).—[In Russian.] The methods of manufacture, mechanical, casting, and corrosion properties were investigated of magnesium alloys containing (*a*) aluminium 4, zinc 3, manganese 0·2–0·5%; (*b*) aluminium 2, cadmium 2, copper 4, manganese 0·2%; (*c*) aluminium 6, zinc 3, manganese 0·2–0·5%; (*d*) aluminium 6·5, zinc 0·3, manganese 1%; (*e*) aluminium 8%; (*f*) aluminium 6, manganese 0·3%. Alloys (*a*) and (*b*) are recommended for fittings cast in chill moulds, alloy (*a*) is best for casting small structural details in sand moulds, and alloy (*c*) for large castings in sand.—N. A.

Alloys of Iron Research. XI.—The Constitution of the Alloys of Iron and Manganese. Marie L. V. Gayler. **Appendix I.—X-Ray Analysis of Manganese-Rich Alloys Heat-Treated and Quenched from Different Temperatures.** C. Wainwright (*Iron Steel Inst. Advance Copy*, **1933**, 1–48).—The constitution of the iron–manganese alloys has been determined by means of thermal, microscopical, and X-ray examinations of alloys made from very pure materials. Compared with previous determinations, the position of the liquidus and solidus has been appreciably raised and the existence of a peritectic between γ-iron and liquid to form γ-manganese has been confirmed. The δ–γ iron transformation takes place at 1504° C. from 1 to 8% manganese; γ-iron then separates directly from the liquid state, until at 1270° C. it reacts with the manganese-rich liquid to form a phase containing approximately 68% γ-manganese. This peritectic reaction extends from 65 to 74% manganese, after which the γ-manganese phase separates directly from the liquid on cooling. The constitution in the solid state of iron-rich alloys has not yet been solved. The changes in the solid state of manganese-rich alloys have been similarly determined. In the solid state of the manganese-rich alloys, the γ-manganese phase is shown to decompose into γ-iron and β-manganese at 1028° C. from 64 to 72% manganese, and similarly the β-manganese phase is shown to decompose into γ-iron and α-manganese at 600° C. from about 59 to 63% manganese. In Appendix I, the conclusions reached from X-ray analysis of manganese-rich alloys quenched from various temperatures and values of the parameters are given.—J. H. W.

Alloys of Iron and Manganese. Transformations and Heterogeneity in the Binary Alloys of Iron and Manganese. Francis M. Walters, Jr. (*Amer. Soc. Steel Treat. Preprint*, **1933**, Oct., 1–12).—These alloys may be made to exhibit striking differences in composition in the solid state by holding them within the α to γ transformation range. The heterogeneity may be demonstrated dilatometrically owing to the pronounced volume changes which occur. Homogeneity may be restored by heating to 100° C.—W. A. C. N.

A Correlation of Some Thermoelectric and Thermomagnetic Data. L. F. Bates (*Phil. Mag.*, 1933, [vii], **16**, 657–672).—Rods of manganese arsenide which have not been heated since their preparation are ferromagnetic up to about 45° C. They exhibit changes of magnetic properties following each transition from the ferromagnetic to the paramagnetic state until a steady condition is reached. These changes comprise a progressive increase in the intrinsic magnetization and a progressive lowering of the ferromagnetic Curie point. They are intimately connected with corresponding changes in the thermoelectric power of the substance.—J. S. G. T.

Solid Cadmium Amalgams; An X-Ray Proof of the Compound Cd_3Hg. Nelson W. Taylor (*J. Amer. Chem. Soc.*, 1932, **54**, 2713–2720).—Previous work on the cadmium–mercury system is summarized. Microscopic and thermal analysis gave no evidence of the formation of cadmium–mercury compounds, such as would have been expected from vapour-pressure and e.m.f. phenomena. The X-ray examination of a series of solid cadmium amalgams, annealed *in vacuo* at 147° C. for 72 hrs., revealed the existence of a solid phase (Cd_3Hg). Approximate lattice-constants are given; the body-centred tetragonal structure is apparently derived from the ω type of solid solution characterizing alloys containing 12 atomic-% or more, cadmium.—P. M. C. R.

Structure Viscosity of Dilute Amalgams. R. Köhler (*Kolloid-Z.*, 1933, **64**, 200–205).—Measurements of viscosity indicate that amalgams containing, respectively, 0·37% of copper and 0·5 or 1% of silver consist of colloid systems in which mercury is the dispersion medium.—E. S. H.

High-Grade Chromium–Nickel Alloys and Life Tests Thereon. W. Hessenbruch and W. Rohn (*Heraeus Vacuumschmelze* [10*th Anniv. Volume*], **1933**, 247–289).—The various methods which have been proposed for determining the useful life of wires of the Nichrome type as electric resistance heaters are critically discussed and shown to give variable results according to the heating and cooling rates employed in the test. Much more consistent results are obtained by measuring the rate of increase in resistance with time of heating at constant temperature, *e.g.* 1050° C., under constant voltage. The life of Nichrome wires is increased by additions of silicon and molybdenum and reduced by addition of carbon; plating with chromium or copper has no effect on the life, whilst coating with aluminium or silicon by cementation definitely reduces the life. Prolonged heating of the wires in carbon monoxide or dioxide at above 1100° C. results in absorption of carbon and subsequent precipitation of carbides along the grain boundaries on cooling. The life of the wires is independent of the diameter when this exceeds 0·6 mm., and for all wires at 900° C. it is 15 times as great as at 1050° C.; it is less with intermittent, than with continuous, heating, and with coarsely crystalline wire than with fine-grained. The melting and casting conditions have considerable influence on the life of Nichrome alloys; melting in hydrogen is more satisfactory than melting in air, but melting *in vacuo* gives the best alloys. Casting into copper moulds produces a finer structure than furnace cooling. Vacuum-melted alloys are softer and more easily worked by forging and drawing than alloys melted in air or hydrogen, and test-pieces bend without fracture in the notched-bar impact test. The average life of a good air-melted Nichrome is about 80 hrs. at 1050° C., but the same alloy vacuum-melted has a life of about 250 hrs. Prolonged heating of Nichrome containing chromium 33, nickel 50, iron 13, manganese 2, and molybdenum 2% results in the slow precipitation of a new phase along the crystal boundaries. This behaviour is exhibited by all the usual Nichrome alloys, and is accelerated by the presence of foreign elements; hence it appears that the generally accepted equilibrium diagram of the nickel–chromium–iron system does not represent the stable equilibria.—A. R. P.

On Sulphur-Resistant Alloys. H. Ipavic (*Heraeus Vacuumschmelze* [*10th Anniv. Volume*], 1933, 290–302).—In wet and dry atmospheres containing hydrogen sulphide, nickel–chromium alloys containing more than 50% nickel are rapidly attacked at high temperatures, the readily-fusible nickel sulphide formed spreading quickly along the grain boundaries until the wire is completely destroyed. Under similar conditions a protective sulphide film having no tendency to pass along the grain boundaries is formed on chromium–iron alloys with more than 30% chromium; cementation with aluminium or silicon is of no advantage. The behaviour of both types of alloys in atmospheres containing sulphur dioxide, *e.g.* furnace gases produced from the burning of oil or coal with a high sulphur content, is similar to that in hydrogen sulphide except that the rate of attack is slower.—A. R. P.

New Screen Metal Resists Corrosion and Staining [Inconel]. Anon. (*Daily Metal Reporter*, 1933, 33, (82), 4).—Inconel, containing approximately nickel 80, chromium 12–14, and iron 6%, is stated to possess exceptional resistance to corrosion by air, brine, and lactic acid. The alloy was originally applied to dairy equipment, but its tensile strength in the form of wire has been found sufficient to warrant its use in the manufacture of wire cloth. Screens made of this material are said not to corrode or stain in use, and to require no painting.—P. M. C. R.

On Alloys for [Watch and Clock] Springs with a Small Temperature Coefficient of the Elastic Modulus. R. Straumann (*Heraeus Vacuumschmelze* [*10th Anniv. Volume*], 1933, 408–423).—An alloy for the hair-springs of watches and clocks made by adding to 100 parts of a 33 : 67 nickel–iron alloy tungsten 8 (or molybdenum 6), beryllium 1, manganese 0·8, and silicon 0·1 parts has a very small linear temperature coeff., a high elasticity, and a high resistance to rusting, and is insensitive to magnetic fields. In combination with an anisotropic balance-wheel (*e.g.*, nickel silver) the system provides accurate timing over a wide temperature range. A non-rusting driving spring for clocks and watches with a high elasticity can be made of an alloy of nickel 60, chromium 15, molybdenum 65, iron 15, beryllium 0·65, and manganese 2%; such springs can be hardened by heat-treatment without becoming brittle and give more satisfactory service than the usual steel springs.—A. R. P.

Magnetic Properties and Chemical Compounds in Alloys. J. Dorfman (*Physikal. Z. Sowjetunion*, 1933, **3**, 399–417).—[In German.] Forrer, Sadron, and Neel's empirical data on the saturation moments of nickel alloys, have been recalculated on new assumptions. The results obtained indicate that (1) the atomic moments are a multiple of the Bohr magneton and (2) the absolute values of the atomic moments bear a definite relation to the number of valency electrons. From this it is inferred that the conducting electrons play no part in producing ferromagnetism, that ferromagnetism is due to the " missing " electrons in the unenclosed levels of the atom, and that in alloys the " excess " valency electrons can fill up these " gaps " in the atoms of the ferromagnetic metal and thus reduce the number of elementary magnets. The number of electrons of iron and cobalt filling these gaps in nickel atoms has been determined. The data so obtained have been checked with pure materials, and identical values for the relationship between the number of ionized atoms and the number of neutral atoms have been obtained by saturation magnetization and by susceptibility measurements. The methods have been applied to certain alloys, and the results afford a new insight into the origin of martensite and an explanation of the ferromagnetism of Heusler alloys.—N. A.

Non-Corrosive Silver Alloy Perfected in Japan. Anon. (*Daily Metal Reporter*, 1933, **33**, (169), 5); **Stainless Silver Alloy.** Anon. (*Met. Ind.* (*Lond.*), 1933, **43**, 310).—A " stainless " silver alloy for ornamental work, patented by Tadashi Tanabe, is stated to possess a tensile strength of 20 kg./mm.^{2}, an elongation of 11%, and a Brinell hardness of 60, as against 14 kg./mm.^{2}, 40%, 23, respectively, for pure silver. Its composition varies within wide limits, those quoted being zinc 0·5–20, tin 10–40, and silver 50–89·5%.—P. M. C. R.

Bearing Metals and Seatings for Aero-Engines. Jaroslav Malkovský (*Stroj. Obzor*, 1932, **12**, 273–278).—The best compositions, structure, casting temperature, and rate of cooling for high-grade bearing metals for aero-engines are discussed. Photomicrographs of good and faulty structures and the plan of a works are included.—R. P.

Design of Heat-Resisting Castings. Ralf S. Cochran (*Metal Progress*, 1932, **22**, (4), 45–49).—Abstract of a paper read before the Buffalo Convention, American Society for Steel Treating, Oct., 1932. The use of heat-resisting alloys, especially in beam conveyors, makes the elimination of unnecessary material important; accordingly, the questions of creep, beam design, and the chief operating stresses are considered. Compositions of suitable alloys are indicated, and some coeff. of friction at various temperatures are given.—P. R.

The Researches of A. Westgren in the Realm of Metallic Alloy Chemistry. N. Ageew (*Zhurnal Prikladnoi Khimii* (*Journal of Applied Chemistry*), 1932, **5**, (8), 1127–1129).—[In Russian.] An introduction to the paper on " The Problem of Alloy Chemistry " by A. Westgren (*Angew. Chem.*, 1932, **45**, 33–40; see this *J.*, 1932, **50**, 352). The historical development of Westgren's theories of the nature of intermetallic compounds and solid solutions, as the result of his X-ray investigations of the structure of alloys, is described. Westgren's earliest theory was the division of alloys into " ideal " compounds in which the atoms had a regular geometrical distribution in a space-lattice and " ideal " solid solutions in which the atoms had a statistical distribution. Later researches, however, showed that a regular geometrical structure was obtained if the ratio of the number of valency electrons to the number of atoms was a constant, which was usually a characteristic of a particular phase type.—M. Z

Properties of Alloys. R. S. Pratt (*Metal Progress*, 1933, 24, (2), 39–40, 50).—The structure and mechanical properties of the α-brasses are discussed. Graphs show the effect of cold-working on reduction of area, elongation, and tensile strength; the influence of cold-working and of annealing temperature on the same properties and on grain-size; and the effect of cold-working on tensile strength and Rockwell and Scleroscope hardness, the inter-relation of these properties varying considerably according to the degree of cold-working. The effects of common impurities are described. Uses are enumerated. Limitations of the material with respect to corrosion are discussed, and the selection of material for specific purposes is considered in relation to the American Society for Testing Materials, Specification B 36–27.—P. M. C. R.

Solid Solutions. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 53).—A brief article, referring to the results of C. H. Barrett (*Metals and Alloys*, 1933, 4, 63), which showed that the discrepancy between X-ray and density measurements of the lattice of aluminium–silver alloys, observed by other investigators, was due to imperfect data. There is thus no basis for the suggested third type of solid solution (additional to the substitution and interstitial types) in which groups of atoms are supposed to replace a number of atoms on the parent lattice.—R. G.

Studies on Precipitation-Hardening. Anomalies in the Course of Hardening During the Hardening Process. G. Masing and L. Koch (*Z. Metallkunde*, 1933, 25, 137–139, 160–163).—When a copper alloy with 2·5% beryllium is quenched and partly aged at 150° or 200° C., then aged at a higher temperature, a decrease in hardness occurs followed by a further increase. This "anomaly" has been studied in more detail by measurements of the Brinell hardness and electrical conductivity of Duralumin during ageing (*a*) first at 0°, then at 50°, 100°, or 150° C.; (*b*) first at 50°, then at 100° or 150° C.; and (*c*) first at 100° or 150°, then at 230° C. The initial decrease in hardness in the second ageing is associated with a more or less pronounced increase in the electrical conductivity and is probably due to a partial re-solution of the extremely minute nuclei which become unstable on heating at a higher temperature if their dimensions lie below a critical value. Theoretical aspects of the process of precipitation-hardening are discussed.—M. H.

Alloys Hardening at Elevated Temperatures. A. Portevin, E. Pretet, and E. Jolivet (*Revue du Nickel*, 1933, 4, 78–79).—Precipitation-hardening effects in certain iron–nickel–tungsten alloys containing high percentages of nickel and tungsten are recorded. In a particular case quoted the alloy was heated to temperatures between 650° and 1100° C. Precipitation was appreciable between 850° and 950° C.—W. A. C. N.

The Age-Hardening of Alloys as a Dispersoid-Chemical Problem. K. Trettin (*Kolloid-Z.*, 1933, 61, 125–127; *Chem. Zentr.*, 1933, 104, II, 121; cf. *J.*, this volume, p. 439).—By suitable heat-treatment of beryllium–copper alloys the hardness, tensile strength, and resistance to corrosion can be made equal to those of hardened steel. Magnesium–copper alloys can also be considerably hardened by heat-treatment. Hardenable copper alloys containing aluminium can be produced by addition of iron, cobalt, or nickel or mixtures of these in an amount exceeding the percentage of aluminium. The working properties of silicon–copper alloys are considerably improved by quenching which also produces a great increase in the resistance to corrosion. The modifications which occur in the structure of the above alloys on heat-treatment to produce these remarkable changes in properties are discussed from the point of view of the colloid chemist.—A. R. P.

Notes on the Ageing of Metals and Alloys. Albert Sauveur (*Amer. Soc. Steel Treat. Preprint*. 1933, Oct., 1–17).—A general review of the evidence in connection with the ageing of alloys, of the theoretical explanations which have been advanced, and of the predictions which may be made as to the behaviour of certain classes of alloys when quenched and subsequently modified.

The later section of the paper deals with the ageing of iron carbon alloys, but the principles involved afford instructive comparisons with those generally accepted for non-ferrous alloys. The hardening and tempering of steel are satisfactorily explained by the precipitation theory. The influence of nitrogen and oxygen on the ageing of steel is discussed. An interesting piece of technique is the use of the Brinell ball hardness test to produce cold-work deformation and the measurement of the change of hardness at the bottom of the depression by the Rockwell machine.—W. A. C. N.

The Present Status of Age-Hardening. Richards H. Harrington (*Amer Soc. Steel Treat. Preprint*, **1933**, Oct., 1–17).—The three theories of age hardening that are considered are (1) precipitation; (2) simple lattice strain; and (3) allotropic complications. Typical examples, ferrous and non-ferrous, are discussed in each instance. Other causes of age-hardening that are mentioned are: (*a*) gas reactions within a metal lattice; (*b*) a single solid solution phase in a quenched alloy which may, on reheating, be transformed into two solution phases, of which one or each is harder than the original; (*c*) recrystallization to a fine grain-size or the complete precipitation of a new phase along the lattice planes of maximum slip or deformation. Considerations affecting the choice of age-hardening alloys for specific requirements—tensile properties, spring properties—are discussed: the methods of investigation are described. The addition of cobalt to several age-hardening alloys has resulted in a marked increase in age-hardening properties, and often increases the temperature of maximum age-hardness. It acts, generally, in two ways—as a "desolvent," reducing the solubility of the precipitating constituent, part of the cobalt going into solid solution in the solvent lattice, and also by entering into a ternary constituent with the precipitating agent, thus usually decreasing the solubility of the latter.—W. A. C. N.

The Functioning of Entirely Metallic Piles in Contradiction of the Law of Electric Tension in Metals (Volta's Second Law). O. Scarpa (*Bull. Soc. franç. Elect.*, 1933, [v], **3**, 891–901).—Anomalies in the behaviour of certain metallic systems in electrical contact at constant temperature lead S. to conclude that Volta's Second Law and its corollaries hold good only when no mobile metallic ions are present, and cannot apply with any accuracy to metals in the liquid state, many metals being capable of an appreciable degree of interaction at room temperature. The systems studied are: copper–cadmium–mercury–platinum–copper; copper–zinc–mercury–platinum–copper; and the alloys of mercury with silver, platinum, gold, nickel, lead, bismuth, iron, and aluminium, respectively.—P. M. C. R.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from p. 551.)

The Mechanism of Crystal Growth. Wheeler P. Davey (*Amer. Soc. Steel Treat. Preprint*, **1933**, Oct., 1–32).—The paper deals with the evidence leading up to a picture of the mechanism of crystal growth and with the consequences of that mechanism in determining certain of the properties of crystals. It is shown that imperfection, rather than perfection, is the normal state of all crystals, no matter whether they have been grown from the vapour, liquid, or solid or from less stable crystals in contact with the growing crystal in a continuous solid. The various instances are discussed and illustrated by examples, and it is stated as a general conclusion that the ordinary properties of materials —crystal growth, tensile properties, segregation of impurities, properties of the melt, etch figures, and segregate structures of the Widmanstätten type—all follow as natural corollaries to the theoretical picture which D. develops. A *bibliography* of 31 references is included.—W. A. C. N.

Some Characteristics of the Microstructure of Cold-Drawn Brass Tubes. James Fox (*Mech. World*, 1933, **94**, 722–723).—A series of photomicrographs is given illustrating the transverse sections of 70 : 30 brass tubes in various degrees of reduction. [*Note by abstractor:* F.'s interpretation of these structures is open to criticism.]—F. J.

Photomicrography. A. MacDougall (*J. West Scotland Iron Steel Inst.*, 1931–1932, **39**, (2), 13–23; and (abstract) *Heat.-Treat. and Forging*, 1932, **18**, 351–359, 366).—A review of the technique of photomicrography, with special emphasis on diffraction effects, the importance of critical illumination, and the use of filters.—P. M. C. R.

X-Ray Investigations in the System (Zn, Cd)–Sb.—II. F. Halla, H. Nowotny, and H. Tompa (*Z. anorg. Chem.*, 1933, **241**, 196–200).—Cf. this *J.*, 1930, **43**, 525. Crystal structure of the unstable compound Cd_3Sb_2: monoclinic, $a = 7{\cdot}20$, $b = 13{\cdot}51$, $c = 6{\cdot}16$ A. with 4 molecules in the elementary cell. Crystal structure of ZnSb: rhombic, $a = 6{\cdot}17$, $b = 8{\cdot}27$, $c = 3{\cdot}94$ A. with 4 molecules in the elementary cell. From X-ray investigations and density measurements after different heat-treatments of an alloy corresponding in composition with the formula Zn_3Sb_2 it is concluded that the compound Zn_3Sb_2 is stable only at elevated temperatures and decomposes on cooling into Zn and ZnSb.—M. H.

X-Ray Analysis of the Systems Iron–Boron, Cobalt–Boron, and Nickel–Boron. T. Bjurström (*Ark. Kem. Min. Geol.*, 1933, **A 11**, (5), 1–12; *Chem. Zentr.*, 1933, **104**, I, 3680).—The borides Fe_2B, Co_2B, and Ni_2B crystallize in the body-centred tetragonal system with 4 molecules in the elementary cell: for Fe_2B, $a = 5{\cdot}099$, $c = 4{\cdot}240$ A.; for Co_2B, $a = 5{\cdot}006$, $c = 4{\cdot}212$ A.; for Ni_2B, $a = 4{\cdot}980$, $c = 4{\cdot}236$ A. The borides FeB and CoB crystallize in the rhombic system V_h^{16}; for FeB, $a = 4{\cdot}053$, $b = 5{\cdot}495$, $c = 2{\cdot}946$ A.; for CoB, $a = 3{\cdot}948$, $b = 5{\cdot}243$, $c = 3{\cdot}037$ A. The atomic coordinates have been determined in all cases. NiB has not been prepared.—A. R. P.

In Which Binary Intermetallic Alloys Are β-, γ-, and ε-[Brass] Lattices to be Expected? H. Perlitz (*Metallwirtschaft*, 1933, **12**, 103–104).—From Hume-Rothery's and Westgren and Phragmén's rules on the occurrence of phases with the structure of β-, γ-, and ε-brass it is deduced that such phases can occur in an alloy system when one component has at the most one, and the other component at least two valency electrons. In the light of this rule manganese, iron, cobalt, nickel, rhodium, palladium, and platinum have no metallic valency electron, and copper, silver, and gold one; beryllium, magnesium, zinc, and cadmium have two, aluminium has three, and mercury, indium, germanium, and tin have five such electrons.—V. G.

The Structure of Liquid Mercury. O. Kratky (*Physikal. Z.*, 1933, **34**, 482–487).—Debye and Menke's results relating to the X-ray investigation of the structure of liquid mercury (*ibid.*, 1930, **31**, 797, and 1932, **33**, 593) are explained by assuming the existence of a closest-packed hexagonal atomic lattice within the liquid.—J. S. G. T.

X-Ray Analysis of the Alloys of Mercury with Silver, Gold, and Tin. Sten Stenbeck (*Z. anorg. Chem.*, 1933, **214**, 16–26).—Murphy and Preston's work (cf. this *J.*, 1933, **46**, 507–527) on the silver–mercury system has been confirmed. The phase with 60% mercury has a hexagonal close-packed lattice; after tempering at 100° C. $a_1 = 2{\cdot}964$ A., $a_3 = 4{\cdot}831$ A., $a_3/a_1 = 1{\cdot}631$ (saturated with silver) or $a_1 = 2{\cdot}987$ A., $a_3 = 4{\cdot}830$ A., $a_3/a_1 = 1{\cdot}617$ (saturated with mercury). The homogeneous phase with about 74% mercury (Ag_5Hg_8) has a cubic body-centred lattice similar to that of γ-brass with $a = 10{\cdot}013$ A. when saturated at 100° C. with silver and $a = 10{\cdot}031$ A. when saturated with mercury. In the gold–mercury system X-ray analysis of alloys tempered at 90° C. for several months has shown that the limit of the cubic face-centred gold-rich solid solution lies at 16·7% mercury (a = 4·098 A.) and that 5 intermediate phases exist: β (close-packed hexagonal) with 21·6 (a_1 = 2·900 A., a_3 = 4·770 A., a_3/a_1 = 1·648)—27·7% mercury (a_1 = 2·915 A., a_3 = 4·802 A., a_3/a_1 = 1·647), and γ, δ, ε, and μ with about 50%, 67%, 72%, and 80% mercury, respectively. The complex crystal structures of γ, δ, ε, and μ have not been elucidated. Mercury is not appreciably soluble in solid tin but between 6 and 10% mercury an intermediate phase exists with a simple hexagonal crystal lattice (b = 3·198 A., c = 2·980 A., c/b = 0·932 at 8% mercury). A somewhat "deformed" structure of the same nature has been found in an alloy with 14% mercury; it has a rhombic lattice: a = 5·548 A., b = 3·196 A., c = 2·981 A., a/b = 1·736, c/b = 0·933). The question whether these two lattices belong to the same phase or to two different phases could not be decided by X-ray analysis.—M. H.

The Crystalline Structures of Electrolytically Deposited Alloys. An X-Ray Study of Silver–Cadmium Deposits. Charles W. Stillwell and Lawrence E. Stout (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 457–459).—See *J.*, this volume, p. 361.—A. R. P.

Crystal Parameters of Four Metals When Under Reduced Pressure. E. A. Owen and E. L. Yates (*Phil. Mag.*, 1933, [vii], **16**, 606–610).—A precision X-ray camera suitable for the investigation of materials at high temperatures *in vacuo* is briefly described. The crystal parameters of four spectroscopically pure elements—*viz.* gold, platinum, palladium, and rhodium—have been determined. Each specimen was heated *in vacuo* to a high temperature and maintained thereat for a definite time. It was then allowed to cool to atmospheric temperature and exposed to X-rays *in vacuo*. The following values of the respective parameters (A.U.) were found: gold, 4·0699$_9$; platinum, 3·9158$_0$; palladium, 3·8823$_8$; rhodium, 3·7955$_9$.—J. S. G. T.

On the X-Ray Investigation of Molten Metals and Alloys.—I. F. Sauerwald and W. Teske (*Z. anorg. Chem.*, 1933, **210**, 247–256).—The question of the interpretation of the X-ray interferences of molten metals is discussed. The results of S. and T.'s work on mercury, thallium, tin, and lead and of earlier work on potassium, sodium, and gallium are not opposed to the general hypothesis that in a molten metal there are locally atomic arrangements which correspond with the structure in the solid state. Investigation of alloys (Hg_5Tl_2, KHg_2) which can very probably be regarded as intermetallic compounds showed that larger molecular complexes can be detected in them than in the structure of the components.—M. H.

Adsorption, Oriented Overgrowth and Mixed Crystal [Solid Solution] Formation. C. W. Bunn (*Proc. Roy. Soc.*, 1933, [A], **141**, 567–593).—The properties of crystals usually regarded as being built up by continual adsorption and inclusion of impurity during growth are compared with those of solid solutions, and it is concluded that the two types differ only in degree. The condition for strong adsorption is similarity of lattice structure and interatomic distances on specific planes only; the rest of the structures may be quite dissimilar. This condition is the same as that necessary for oriented overgrowth of different crystals on each other. Another consequence of the ideal is that modification of habit should be reciprocal. A simple explanation of modification of habit is suggested: on the affected faces a mixed crystal is formed and, being unstable, tends to redissolve, thereby reducing the rate of growth. Examples are given.—J. S. G. T.

A Rapid Method of Determining the Crystal Axes of Single Crystal Wires of Certain Metals. R. Roscoe and P. J. Hutchings (*Phil. Mag.*, 1933, [vii], **16**, 703–707).—Method and apparatus for the determination of the crystal axes of single-crystal wires from the elliptical slip bands which appear on the surface of the stretched wires are described. The method is applied more especially, to cadmium wires.—J. S. G. T.

On the Broadening of the Debye–Scherrer Lines in the Röntgenograms of Metals with Cold-Working and Annealing. S. Konobievsky and J. Selisskiy (*Trudi rentgengraficheskoy laboratorii Ginzvetmeta* (*Transactions of the X-Ray Laboratory of Ginzvetmet*), 1933, (2), 1–19).—[In Russian.] The broadening of the lines in röntgenograms of metals after cold-deformation has been investigated with especial reference to magnesium and Elektron (aluminium 4·2; zinc 0·8%). In contradistinction to pure metals, there is no separation of the K_α doublet in Elektron after annealing for many hours at 150° C., and the broad lines remain up to the temperature of recrystallization. Two specimens, A and B, of cold-worked Elektron were annealed for 5 minutes at 280° C. (*i.e.* above the recrystallization temperature), and B was further annealed for 8 hrs. at 150° C.; A showed a distinct separation of the K_α doublet, whereas B showed none. This result may be explained by the diffusion in the magnesium lattice at 150° C., of the dissolved aluminium and zinc. Owing to the asymmetric deformation of the lattice and the presence of unequal residual strains, this diffusion causes an irregular distribution of solute atoms. It has been shown theoretically that the recovery from elastic stress during heating of a deformed solid solution lattice through a certain temperature range must take place by means of a redistribution of the solute atoms. The connection between the observed phenomena and the change in recrystallization temperature of Elektron is shown, and the possibility of that factor influencing the course of phase changes in alloys is suggested.—N. A.

IV.—CORROSION

(Continued from pp. 555–556.)

Dissolution of Corrosion Products of Light and Ultra-Light Alloys. Paul Bastien (*Rev. Mét.*, 1933, 30, 284–286).—Attention is directed to the method which has been adopted as standard by the Aluminium Association for cleaning-off the corrosion product from corroded samples of light aluminium alloys. The samples are immersed for 30 minutes in concentrated nitric acid heated to 30° C., rinsed carefully, and dried in an oven at 120°–150° C. The method is unsuitable for observing the degree of corrosion when the latter is of the intercrystalline or other deep-seated type. B. refers to Whitby's method for removing corrosion product from magnesium-rich alloys. The formation of protective films often renders the interpretation of results of corrosion tests difficult. The influence of aluminium content in magnesium-rich magnesium–aluminium alloys on the rate of corrosion in hydrochloric acid, citric acid, and magnesium chloride solutions, and the influence of silicon content of magnesium-rich magnesium–silicon alloys on the rate of corrosion in 1% hydrochloric acid are illustrated by graphs as examples.—H. S.

A Review of the Behaviour of Aluminium and Its Alloys Towards Materials of the Chemical and Foodstuffs Industries. H. Bohner (*Korrosion u. Metallschutz*, 1933, 9, 86–92, 113–122).—An alphabetically arranged list of foodstuffs and pharmaceutical and other chemicals with recent information on their behaviour in contact with aluminium and its alloys.—A. R. P.

The Use of Aluminium Alloys for the Construction of Stills and Rectifying Apparatus for Alcohol. F. Bendix (*Z. Spiritusind.*, 1933, 56, 46–47; *Bur. Chem. Abs.*, 1933, [B], 431).—Silumin is recommended. It is much stronger than pure aluminium, forms good castings, can be repaired by welding, and is satisfactorily resistant to corrosion by spirit mashes. Strips having 133 cm.^{2} of area, fixed inside a mash column still of iron, and not insulated from the latter, lost in 170 days only 1·1 grm. in weight, equivalent to a layer of metal 0·03 mm. thick.—S. G.

Contribution to the Question of the Influence of Heat-Treatment of Age-Hardenable Aluminium Rolling Alloys on Their Resistance to Corrosion by Sea-Water. Helmut Mann (*Korrosion u. Metallschutz*, 1933, **9**, 141–150, 169–178; and (abstract) *Met. Ind.* (*Lond.*), 1933, **42**, 645–646).—The effect of annealing and ageing temperatures and duration of ageing on the rate of corrosion in 3% sodium chloride solution containing 0·1% hydrogen peroxide has been determined for the alloys (A) Duralumin 681 B (copper 4·07, magnesium 0·50, manganese 0·60, iron 0·31, and silicon 0·24%) and (B) Lautal VLW 14 (copper 4·27, manganese 0·45, iron 0·30, silicon 0·78%). In the first series of tests the alloys were annealed for 20 minutes in a salt bath at temperatures between 460° and 540° C., quenched in water at 10° C., and aged at room temperature for at least 150 hrs.; the best resistance to corrosion was obtained after annealing (A) at 510° C. and (B) at either 480° or 515°–520° C. In the second series of tests the annealing temperature was 505°–510° C. and the specimens were aged at 75°–180° C. for 16, 32, or 48 hrs. after ageing for 150 hrs. at room temperature; a well-defined maximum of corrosion of the intercrystalline type occurred with an ageing temperature of 125°–145° C. for (A) and 100°–145° C. for (B). The more prolonged the ageing in each case the lower was the ageing temperature which promoted corrosion. With ageing temperatures of 150°–175° C. a marked decrease occurred in corrosion. The causes of these variations in the corrodibility with the heat-treatment are discussed from the point of view of the precipitation theory of hardening.
—A. R. P.

An Investigation of Structural Corrosion of Aluminium Alloys. I.—Electrode Potentials of the Structural Constituents of Aluminium Alloys. G. W. Akimov and A. S. Oleshko (*Zhurnal Fizicheskoy Khimii* (*Journal of Physical Chemistry*), 1932, **3**, (4), 336–344).—[In Russian.] The following values have been obtained for the electrode potentials, E_h of single crystals of the constituents of aluminium alloys in a 3% sodium chloride solution at 17°–18° C.; aluminium — 0·55; silicon — 0·421 to — 0·508: $FeAl_3$ — 0·14 to — 0·333; $CuAl_2$ — 0·371; $MnAl_3$ — 0·26 to — 0·607; Mg_2Si — 1·275 to — 0·427: $NiAl_3$ — 0·49 to — 0·471. Duralumin single crystals had $E_h =$ — 0·44 to — 0·41. E_h is calculated from the expression $E_h = E_c + 0{\cdot}250$, where E_c is the potential against a calomel electrode.—N. A.

Intercrystalline Corrosion of Duralumin. A. J. Sidery, K. G. Lewis, and H. Sutton (*Aeronaut. Res. Cttee. R. and M.* No. **1523**, 1933, 1–3).—An abstract of a paper published in this *J.*, 1932, **48**, 165.—A. R. P.

Action of Acids on Iron and Copper [Corrosion of Sugar Factory Plant]. J. Zamaron (*Bull. Assoc. Chim. Sucr.*, 1933, **50**, 108–113; *Bur. Chem. Abs.* 1933, [B], 709).—Abnormal corrosion of diffusion-battery steel calorisator tubes in a beet-sugar factory, involving a loss of 44% of the metal in 4 campaigns, is attributed to the acids in the raw juice. No such corrosion occurred in the tubes of the carbonated juice heater. Pieces of ordinary steel immersed for 7 hrs. in 0·04–0·16% sulphuric acid at 90° C. lost 0·4–1·4% in weight; in acetic acid of the same range of concentration under similar conditions losses of 1·2–1·5% were observed. Similar experiments with copper showed losses only about $\frac{1}{10}$ as great in sulphuric acid and much less in acetic acid.—S. G.

A Peculiar Case of Corrosion of Copper Sheet. M. von Schwarz and G. Koch (*Korrosion u. Metallschutz*, 1933, **9**, 123–125).—A hot-water reservoir made of 0·7 mm. thick copper sheet and tinned internally was very severely corroded after short use with water containing a high content of calcium bicarbonate, and soon after became perforated in many places. Tests on tinned copper in the water showed that in very few specimens of the commercial product was the tin film entirely sound. The presence of cuprous oxide in the copper causes faulty adherence of the tin film.—A. R. P.

Corrosion of Iron, Chromium, and Nickel. Resistance Alloys of These and Other Metals. R. Müller, G. Hahn, and H. Krainer (*Berg. hüttenmänn. Jahrb.*, 1932, **80**, 74–78; *Chem. Zentr.*, 1932, **103**, II, 251; *Brit. Chem. Abs.*, **1933**, [B], 349).—With magnesium fluoride (melts at 950° C.), nickel was the most resistant, chromium–nickel steels moderately resistant, and heat-resistant silicon steels considerably attacked.—S. G.

Resistance to Intercrystalline Corrosion of Acid-Resistant and Hardenable Chromium–Nickel Alloys. W. Hessenbruch and E. Horst (*Heraeus Vacuumschmelze* [*10th Anniv. Volume*], **1933**, 233–246).—The rate of corrosion in 10% solutions of hydrochloric, sulphuric, and nitric acids of vacuum-melted Contracid (chromium 12·55, nickel 61·75, iron 13·37, manganese 2, silicon 0·4, cobalt 3, tungsten 3·41, molybdenum 3, carbon 0·05%) is practically unaffected by cold-work or by annealing at temperatures up to 1000° C. The ordinary 18 : 8 chromium–nickel steel shows a slightly greater rate of corrosion in sulphuric acid and a much greater rate in hydrochloric acid; in all three acids corrosion increases rapidly after annealing at 500°–800° C., due to intercrystalline penetration of the acid and to the effect of local elements formed by precipitation of constituents from solid solution. Tests have been made to determine the effect of heat-treatment on the corrosion-resistance of (*a*) nickel containing iron 0·2, manganese 1·0, and beryllium 1·8% and (*b*) Contracid containing nickel 60, chromium 15, iron 14·9, molybdenum 7, beryllium 0·61, manganese 1·8, silicon 0·6, and carbon 0·02%; neither quenching from high temperatures nor prolonged annealing produced any marked effect on the very slow rate of corrosion of these alloys in 10% mineral acids.—A. R. P.

The Influence of Corrosion on the Fatigue Limit of Chromium–Nickel Alloys. A. Thum (*Heraeus Vacuumschmelze* [*10th Anniv. Volume*], **1933**, 424–434).—The fatigue limit (8×10^7 alternations of stress) of Contracid B7M with 0·65% beryllium is 26–28 kg./mm.^{2} in the temper-hardened state, and is practically unaffected by corrosion in tap water. The results are compared with those obtained by other workers on non-rusting steels.—A. R. P.

Wire Rope Research. Anon. (*Colliery Guardian*, 1933, **147**, 336–338).—From an appendix to the 11th Annual Report of the Safety in Mines Research Board. An account is given of observations made on deteriorated zinc coatings on wires taken from winding ropes.—P. M. C. R.

General Observations on the Determination of Loss in Weight in Corrosion Tests. Albert Portevin (*Rev. Mét.*, 1933, **30**, 275–279).—The degree or intensity of corrosion may be studied by observation of loss in weight if the corrosion is of determined types (simple solution or superficial corrosion), and if the corrosion is sufficiently intense to render the loss in weight measurable with sufficient accuracy. There are 3 methods: (*a*) direct, by difference in weight of the metal before and after corrosion; (*b*) indirect, by determination of the products of the reaction; (*c*) mixed, by observing the general change in weight resulting from the reaction. The relative merits and limitations of these methods are discussed. Methods (*a*) and (*b*) imply ability to remove corrosion product from the metal, whilst methods (*b*) and (*c*) cannot be applied to marine exposure tests or immersion tests in rivers. Reference is made to Pomey's reagent for the removal of rust from iron, and the preparation and use of the reagent are described.—H. S.

Determination of Loss in Weight in Corrosion Tests of Metallurgical Products. Jean Cournot (*Rev. Mét.*, 1933, **30**, 280–283).—Methods for observing corrosion as employed in France are discussed, and those recommended by the Sous-Commission de Normalisation under the presidency of M. Legendre and the Commission de Corrosion under C. Grard are outlined. C. points out that brushing or scratch-brushing to remove corrosion product and to indicate loss of metal due to corrosion is objectionable and should be substituted by chemical methods of such a nature as not to result in any attack on the underlying sound metal. A method of removing corrosion product from iron and steel is described. The piece to be cleaned is immersed in a boiling 20% solution of caustic soda: 30 grm. of zinc dust are then added to each litre of solution. Most of the corrosion product falls off, the rest being left in a loose condition on the surface and easily removed by brushing with a soft hair brush. The results given indicate that the chemical method gives consistent values of loss in weight and indicates greater loss than the usual brushing method.—H. S.

Results of Corrosion Research and New Methods of Testing Metals for Resistance to Corrosion and Erosion. Walter Denecke (*Giesserei*, 1933. **20**, 89–93).—A review of recent work with illustrated descriptions of modern apparatus for testing the corrodibility of metals under standardized conditions. —A. R. P.

Preparation of Test-Pieces for Exposure Tests of Electrolytic Coatings on Steel. Anon. (*Galvano*, **1932**, (5), 27–28; (6), 17–20).—Translation of a report of a joint committee of the American Electroplaters' Society, American Society for Testing Materials, and U.S. Bureau of Standards; see this *J.*, 1932, **50**, 609.—E. S. H.

Corrosion of Metals by [Vegetable] Tan Liquors. IV.—Corrosion of Submerged Metals in Movement. M. P. Balfe and H. Phillips (*J. Soc. Leather Trades Chem.*, 1933. **17**, 448–459; *Bur. Chem. Abs.*, **1933**, [B], 791).—Cf. this *J.*, 1932, **50**, 547, and this volume, p. 22. Chromium–iron and nickel–iron–chromium alloys are not corroded and iron–silicon alloy is slightly corroded by vegetable tan liquors and bleaching extracts, respectively. Phosphor-bronze, nickel, Monel metal, and copper–aluminium–nickel alloy are equally resistant, but aluminium–brass is more resistant than are these to both vegetable tan liquors and bleaching extracts. Copper was equally resistant to chestnut extract but less resistant than these to bleaching extracts. An aluminium–magnesium–manganese alloy is corroded but the tan liquors are not contaminated. Brass is not superior to other copper alloys, nickel, or Monel metal. Metals are not markedly corroded by algarobilla liquors.—S. G.

Corrosion Effects of Lubricants on Bearing Surfaces. Christopher H. Bierbaum (*Iron Age*, 1933, **132**, 20–21, 58).—The corrosion effects of various lubricants on bronze were investigated by heating the oil, with and without additions, to 150° F. (65° C.), bubbling air through and introducing polished metallographic specimens into the oil, the resulting effects being examined microscopically. It was found from a purely chemical point of view that: (1) the oils may have no effect, an exceedingly rare condition, (2) they may have a slight selective corrosion effect on the softer formations, which may be beneficial, (3) they may have an excessive selective corrosion effect on the softer formations, causing pitting and reducing the bearing life, (4) they may have a selective effect on the harder formations, thereby destroying both the bearing value and the life of the alloy, (5) they may corrode all phases of the alloy, producing a general destructive effect.—J. H. W.

The Resistance to Oxidation of Lubricating Oils. Anon. (*Automobiltech. Z.*, 1933. **36**, 367).—The corrosive effects of lubricating oils are mainly due to their acid content. Inorganic acids occur only in oils of mineral origin; the less highly corrosive organic acids are present in almost all oils to a greater or less extent. If the content of such acids is too high there is danger not only of corrosion, but also of the formation of an obstructive slimy deposit. Improvements in acidity titrations are suggested. In use, the catalytic action of the metallic parts promotes oxidation; existing methods of estimating this effect are briefly reviewed, and an accelerated method is described, involving the use of "Perhydrol" (hydrogen peroxide).—P. M. C. R.

The Corrosion of Metals: Its Causes and Effects. G. Guzzoni (*Aerotecnica*, 1933, **13**, 714–744).—An account is given of the principles of the electrochemical theory of corrosion, the factors governing the corrosion of metals are discussed, and modern methods of protection are described.—G. G.

The Electrochemical Theory of Corrosion. Oliver P. Watts (*Electrochem. Soc. Preprint*, **1933**, Sept., 219–224).—The opinions of eleven leading exponents of the electrochemical theory of corrosion in England and the U.S.A. as to the fundamentals of the process are briefly summarized and discussed by W.
—A. R. P.

Season-Cracking Due to Corrosion (Corrosion-Fatigue as the Cause of Premature Wear on Cylinders). P. Nettmann (*Automobiltech. Z.*, 1933, **36**, 438–439).—Previous work on corrosion-fatigue is briefly reviewed, and is correlated with recent researches dealing with the influence of lubrication on cylinder wear. Faulty lubrication in itself seems to have no appreciable effect on wear, the main operative factor being the temperature of the cylinder walls. If this is sufficiently low, the condensation of water produced by combustion may set up corrosion, the necessary p_H value being given by the presence of alcohol or its combustion products.—P. M. C. R.

Dissolved Oxygen and Corrosion. F. J. Matthews (*Eng. Rev.*, 1933, **47**, 106–108).—The principle of differential aeration is discussed, and its application to local concentrations of oxygen is indicated. Certain common cases are quoted in illustration. Inhibitory methods are classified; other methods mentioned are de-aeration, agitation and spraying of water, and electrical protective devices.—P. M. C. R.

Electrolytic Corrosion of Heating Coils in Hot Plates Fitted with Unipolar Switches. W. Schmidt (*A.E.G. Mitt.*, **1933**, (4), 139–142).—Corrosion is traced to the electrolysis of moisture absorbed during periods of disuse by the porcelain insulators. The oxygen thus produced rapidly attacks the material (nickel–chromium alloy) of the coils. Tests on specimen coils in moist air with a.c. and d.c. showed that only d.c. produced any appreciable corrosive effect; this confirms observations made under ordinary service conditions.
—P. M. C. R.

9th Report of the Corrosion Committee of the Association Suisse des Électriciens and Three Associated Societies. Anon. (*Bull. Assoc. Suisse Élect.*, 1933, **24**, 409–411).—Periodic inspection of electric tramways and railways, together with careful avoidance of supercharging of conductor rails, has resulted in a marked diminution of ground corrosion due to stray currents. An extension of such control is expected. Research on subterranean corrosion (see 8th Report, *ibid.*, 1932, **23**, 275–277, and this *J.*, 1933, **53**, 3, 131) has been continued and extended to aluminium and its alloys. The action of certain corrosive agents on metallic conductors has been observed, in order to elucidate the mechanism of the process. Corrosion under a.c. has also been studied.
—P. M. C. R.

Chemical Injection Retards Corrosive Action. Anon. (*Oil Weekly*, 1933, **70**, (3), 21–22).—In certain Kansas oil wells, corrosion of metallic parts (ferrous and non-ferrous) is severe on account of the action of hydrogen sulphide in the presence of brines of low sodium chloride concentration. Caustic [soda] was found to give the best protection against further action, and methods of injection are described.—P. M. C. R.

Reducing Metal Corrosion Rate by Use of an Inhibitor. A. R. Dunham (*Gas Age-Record*, 1933, **71**, 657–658).—Tests relating to the reduction of corrosion of iron by the use of tetrahydronaphthalene are described.—J. T.

Erosion in Steam Turbines. C. R. Soderburg (*Mech. World*, 1933, **93**, 212–213).—Abstract of a paper read before the Engineers' Society of Western Pennsylvania. The most favourable solution of this problem is to apply separate shielding strips of tungsten, tantalum, Stellite, &c., to the blades by welding or soldering to render them impervious to the bombardment of the water-drops.—F. J.

V.—PROTECTION

(Other than Electrodeposition.)

(Continued from pp. 556–557.)

The Protection of Metals against Corrosion. The Principles of the Protection of Metals. J. Glaymann (*Usine*, 1932, **41**, (1), 29–30).—Consideration of the protection of metal parts against corrosion is divided into: (1) chemical composition; (2) physical constants and treatment of the part; (3) medium in which the part will work; (4) nature and intensity of the work to be undertaken; (5) immediate neighbourhood of the part; (6) duration of protection required. These factors are briefly discussed in general terms.—R. B. D.

Penetration of Non-Metallic Protective Coatings on Aluminium by Halogen Ions. L. Tronstad and B. W. Bommen (*Kong. Norske Videnskab. Selskabs Forhandl.*, **1933**, 175–178; *Chem. Zentr.*, 1933, **104**, I, 3237).—The resistance of passive films on aluminium to penetration of chloride ions has been determined under various electrical and corrosive conditions. The results indicate that the film most resistant to chloride attack is obtained by anodic oxidation of the aluminium at 50° C. with 150 v. in 0·01N-potassium chromate solution. —A. R. P.

Electrolytic Oxidation of Aluminium by Means of a High-Frequency Alternating Current (Preliminary Results). A. F. Valter, S. S. Gutin, T. G. Lapunzova, and D. V. Stepanov (*Zhurnal Tehnicheskoy Fiziki* (*Journal of Technical Physics*), 1932, **2**, (9–10), 1090–1093).—[In Russian.] Preliminary data on the electrolytic oxidation of aluminium by high-frequency currents (500, 13,000, and 10^6 cycles/second).—N. A.

The Eloxal Process. Hans Schmitt (*Korrosion* (Suppt. to *Chem. Apparatur*), 1933, **20**, 13–14).—Cf. *J.*, this volume, pp. 84, 195, 245. The electrolyte of the Eloxal process for the anodic oxidation of aluminium is a solution of oxalic acid containing varying quantities of strong inorganic acids other than those of the halogens. The crystalline structure of the deposit can be modified at will by varying the concentration of the bath, the temperature, and the current conditions; thus porous films suitable for impregnation with fatty substances and colouring matter and dense, hard, water-resistant films of the nature of corundum are both readily obtainable. The thickness can vary from almost invisible films to about 0·8 mm. A recent modification of the process for large castings consists in spraying the reagents with an aerograph over the casting and, after allowing a suitable period of reaction, removing the excess with a water spray.—A. R. P.

The Protection of Aluminium and Its Alloys by the New "Protal" Process. J. Bary (*Aéronautique*, 1932, **14**, 151–152).—In the "Protal" process, the aluminium is immersed in a solution of an alkaline salt of a metal the higher oxide of which is soluble and lower oxide insoluble in the alkali. The hydrogen evolved reduces the soluble oxide to the insoluble form, which is deposited as an adherent layer on the surface.—J. C. C.

Alumilite. H. Bergston and R. E. Pettit (*Quarterly Rev. Amer. Electroplaters' Soc.*, 1933, **19**, (10), 47–61).—A long general account is given of the Alumilite process of anodically oxidizing aluminium in sulphuric acid solution and of colouring the deposits; no precise details of the baths used or of the operating conditions are given, but numerous claims are made for the corrosion resistance of the products of the process.—A. R. P.

Increase of Resistance of Mild Steel to Oxidation at High Temperatures by Means of Aluminium Coatings. L. P. Istomin (*Metallurg* (*The Metallurgist*), 1932, **7**, (12), 48–52).—[In Russian.] The properties of mild steel (carbon 0·12, manganese 0·3, phosphorus 0·034, silicon 0·037, chromium 0·14%) aluminium-coated by hot-dipping under varying conditions were investigated, and the nature of the coatings was metallographically examined. The results are compared with those obtained by the cementation process using a bath containing ferro-aluminium 49, aluminium oxide 49, and ammonium chloride 2%. It is concluded that the hot-dipping process effects a cheap and simple method of protecting mild steel, the resulting resistance to oxidation being equal to that obtained by cementation with ferro-aluminium. The best results are obtained at 800° C., and maintenance in the dipping bath for 20 minutes, followed by annealing for 4 hrs. at 900° C. The latter process may be regarded as causing a diffusion of the ferro-aluminium surface alloy into the body of the steel. The amount of aluminium used is very low—about 800 grm./m.^{2}—and the presence of some iron in it (above 1%) is an advantage, since it prevents the dissolution of more iron from the steel to be coated.—M. Z.

Anodic Treatment and Dyeing of Aluminium Castings. N. D. Pullen (*Mech. World*, 1933, **94**, 668–669).—An abstract of a paper read before the Institute of British Foundrymen, see *J.*, this volume, p. 444.—F. J.

Hot-Dip Cadmium. Wallace Imhoff (*Met. Ind.* (*N.Y.*), 1932, **30**, 269; and (abstract) *Galvano*, **1932**, (4), 20).—A method for cadmium coating is suggested, involving the use of zinc to give a coherent bond with the [iron] base. The proportions recommended are cadmium 95, zinc 5%, with modification as requisite; the addition of a little lead should eliminate brittleness, and the bad colour due to oxidation is prevented by adding aluminium. Details as to flux and operating temperature are given.—P. M. C. R.

The Influence of Temperature Regulation During Tinning on the Resistance of Tinned Copper Wire to Corrosion. M. O. Kornfeld (*Vestnick Elektropromishlennosti* (*Messenger of the Electrical Industry*), **1932**, (1), 21–24).—[In Russian.] Published data on the structure of the tin coating are reviewed, and an investigation made on a polished specimen of an oblique section of a tinned wire is described. The effect of rubber during vulcanization conditions has been studied with alloys of a composition corresponding with the layers formed in tinning. It is shown that the stability of the tin layer can be increased by maintaining a low copper content in the tinning bath, by keeping the temperature at the minimum and by suitably designing the buffing mechanism to avoid removing the outer stable tin layer.—N. A.

Testing the Tinning of Rubber-Insulated Copper Wire. A. R. Matthis (*Kautschuk*, 1933, **9**, 4–8; *Brit. Chem. Abs.*, **1933**, [B], 309).—A piece of wire 4 dm.^{2} surface is coiled and the exposed copper ends are waxed; it is then rotated with 50 c.c. of aqueous ammonia (*d* 0·91) in a horizontal, wide-necked bottle closed with a cork covered with tin foil, for 5 minutes. The dissolved copper is then determined. Judged by a comparison of the details and results with those of other methods, the new test has distinct advantages.—S. G.

Galvanizing Fluxes. W. H. Spowers, Jr. (*Wire and Wire Products*, 1933, **8**, 165–167, 184).—The use of muriatic flux causes heavy dross, and, in this respect, a neutral flux such as properly acidulated zinc chloride is a great improvement. Cleaning with sulphuric acid results in the formation of iron salts and causes a thickening of the interlining alloy which is brittle. Frothing with sawdust, bran, oatmeal, tallow, or glycerine is usually resorted to, and zinc ammonium chloride used as a flux. A new flux, known as No. 20 Flux, has been developed. This incorporates the frothing agent and is claimed to have many advantages over other fluxes for galvanizing work.—J. H. W.

On the Durability of Baths for Hot-Galvanizing, and on Preventing Their Corrosion. Heinrich Meyer auf der Heyde (*Stahl u. Eisen*, 1932, **52**, 999–1000; and (abstract) *Technique moderne*, 1933, **25**, 527).—The solubility of iron in zinc increases sharply between 475° and 495° C.; it is found that the life of the iron pans employed in hot-galvanizing is prolonged if the working temperature is kept below this range. Local attack may be avoided by careful erection; a suggested scheme for use with regenerative heating is illustrated, and directions are given for draught regulation and material and thickness of draught chamber. Excessive attack on bath material is attributed solely to local overheating, the nature of the iron appearing to have no appreciable effect on the rate of attack.—P. M. C. R.

Galvanization, a Means for Protecting Ferrous Metals from Atmospheric Corrosion. Marcel Lepingle (*Science et Industrie*, 1933, 17, 423–426).—Protective methods are summarized and briefly described. Galvanization is considered under three headings: (1) hot-galvanizing; (2) electrolytic processes, and (3) Sherardizing. A discussion of the hot galvanizing process is illustrated by reference to the iron–zinc constitutional diagram; a series of curves shows the solubility of iron in zinc between 440° and 600° C. for varying periods of contact. The time of contact, rate of cooling, surface condition of the iron, and impurities present in it are shown to affect the texture and other properties of the coating. The effects of cleaning and of galvanizing on the mechanical properties of the sheet are discussed.—P. M. C. R.

The Protection of the Cooling Systems of Internal Combustion Engines Against Corrosion. V. O. Krenig and S. E. Pavlov (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1933**, (3), 59–68).—[In Russian.] The addition of as little as 0·05% of potassium dichromate to tap water is sufficient to protect iron, brass, aluminium alloys, and zinc against corrosion at room temperature, but to afford protection to iron at 80°–90° C. at least 0·2% of dichromate is necessary. The dichromate materially increases the electrode potential of iron, but has little influence on those of aluminium alloys; so that iron under the above conditions is more electropositive than aluminium alloys. To obtain complete protection where the iron is in contact with a more electropositive metal, *e.g.* brass, an additional protection, *e.g.* zinc, must be present. In quadruple contacts, *e.g.* iron–brass–9% copper–aluminium alloy–zinc, the two last-named act as anodes and the corrosion they suffer (especially the aluminium alloy) is extremely slight.—N. A.

Protective Treatment of Ferrous Pipe. Thomas B. Downer (*J. Amer. Water Works Assoc.*, 1933, **25**, 605–632).—The corrosion of pipe-lines from water and from soil is considered and a general review given of protective methods and practices. The use of copper steels, or the application of zinc galvanizing or lead paints is considered to afford little protection underground. Tar dips are not permanent. Heavy centrifugal linings of bitumens or cement are most effective in preventing corrosion. Service pipes should be made of copper except for inactive waters and in well-drained soil.—J. C. C.

The Protection of [Steel and Iron] Pipes against Soil Action. K. H. Logan (*Electrochem. Soc. Preprint*, **1933**, Sept., 137–148).—Zinc coatings on iron and steel pipes buried in soil are more protective than lead coatings; after 8 years in various soils a 2-oz. zinc coating was relatively slightly attacked, although a few rust spots and pits were observed on the pipe. In highly acid or alkaline soil pitting of galvanized pipe may be expected in about 6 years. The value of concrete and bituminous coatings on bare steel pipes is also discussed.
—A. R. P.

The Effect of Composition and Pre-Treatment of Steels Upon the Life of Protective [Zinc and Paint] Coatings. Karl Daeves (*Electrochem. Soc. Preprint*, **1933**, Sept., 161–172).—Paint and zinc coatings show a considerably better adhesion to steels containing 0·2–0·5% copper than to ordinary steel. The effect of surface condition on the adhesion of paint coatings and the difficulties associated with effective removal of coatings of mill scale from steel are discussed.—A. R. P.

The Spray-Sherardizing Rust-Proofing Process. Anon. (*Engineering*, 1931, **131**, 750; and (abstract) *Science et Industrie*, 1931, **15**, 392).—The dry-vapour Sherardizing process is described. Its development, known as the Spray-Sherardizing process, consists in spraying zinc dust on to completed structures.

The surface to be protected is first cleaned with steel brushes, a bright green bitumen-base paint is applied with an ordinary sprayer, and zinc dust is sprayed on when the paint has become tacky, the colour contrast ensuring complete covering of the surface. The process is stated to be no more expensive than painting, with 2 to 3 times the durability; the electropositive character of zinc with regard to iron eliminates the formation of rust beneath the coating on exposure. The plant is described and illustrated.—P. M. C. R.

Metallization. Anon. (*Soudeur-Coupeur*, 1933, 12, (2), 1–5).—A description of the principles of, and equipment for, the process is followed by a comprehensive account of its applications.—H. W. G. H.

On the Heat-Resistance of Steel Sprayed with Aluminium. K. Stauffer (*Metallwirtschaft*, 1933, 12, 73–76).—The resistance of sprayed aluminium coatings on steel to heating in air at temperatures up to 1200° C. has been investigated.—v. G.

Paints for Aluminium and Its Alloys. H. Rabaté (*Peintures, Pigments, Vernis*, 1933, **10**, 64–65, 67–69; *Bur. Chem. Abs.*, **1933**, [B], 595).—A general account is given of the suitability of coatings made from oils, asphalt, tar, nitrocellulose, and synthetic resins, and of the preparation of the metal surfaces.—S. G.

VI.—ELECTRODEPOSITION

(Continued from pp. 557–559.)

Chromium Plating at Low Temperatures and With Weak Current Density. A. Guerillot and J. Pierson (*Bull. Soc. franç. Élect.*, 1933, [v], 3, 859–866).—A summary of previous work on the possibility of chromium-plating on a commercial basis at a lower current density than that recommended by Sargent and others is followed by an account of investigations by G. and P. on the effect of various additions to the plating bath on low-current density plating, and by a description of the working at various temperatures of 5 types of commercial plating plant.—P. M. C. R.

Chromium Plating in the Cold. Anon. (*Galvano*, **1932**, (7), 13–14).—Electrodeposition of chromium from a cold-bath has the advantages of reducing the need for excessive ventilation, reducing the current density, and giving a brilliant deposit.—E. S. H.

Chromium Plating in the Cold. O. Macchia (*Galvano*, **1933**, (14), 13–16).—A review of recent literature.—E. S. H.

Considerations on the Use of "Protective Layers" for Chromium Baths. Anon. (*Galvano*, **1933**, (5), 15–16).—The advantages and disadvantages of using a layer of kerosene or other oil over the surface of the bath are compared with those of the practice of an air draught for removing fumes.—E. S. H.

Chromium Plating of Tools and Mandrels. Anon. (*Galvano*, **1933**, (8), 11–14).—In order to obtain chromium deposits which are particularly resistant to abrasion, curves are given showing the limits of current density under which such a deposit is obtained as a function of the temperature and of the sulphate content of the bath.—E. S. H.

Note on the Electrodeposition of Copper. E. Vuigner (*Bull. Soc. franç. Elect.*, 1933, [v], 3, 822–835).—Reviews the conditions for obtaining satisfactory deposits with optimum current efficiency.—P. M. C. R.

Electroplating Copper on Manganin. C. R. Cousins (*J. Sci. Instruments*, 1933, **10**, 256–258).—Difficulties exist in obtaining an adherent deposit of copper, but the following method has been found successful. (1) The wire is made alternately anode and cathode for a few seconds each in a strong solution of caustic soda, the other electrode being of copper. This results in " demanganization" of the surface, and the chemistry of the process is discussed. (2) The wire is then made cathode for about 1 second in dilute sulphuric acid. The effect of this is unknown, but it gives the wire a golden colour, and may remove nickel. (3) The wire is then transferred to the copper sulphate plating bath, when a strongly adherent coating is obtained. Details are given of current densities, electrolyte concentrations, &c.—W. H.-R.

Free Cyanide in Brass Plating Baths. L. C. Pan (*Quarterly Rev. Amer. Electroplaters' Soc.*, 1933, **10**, (11), 33–38).—See abstract from another source, *J.*, this volume, p. 253.—A. R. P.

Electrodeposition of Iron–Copper–Nickel Alloys. III.—Deposition from Sulphate-Boro-Citrate Baths. Lawrence E. Stout and Charles L. Faust (*Electrochem. Soc. Preprint*, **1933**, Sept., 111–122).—A ternary alloy of copper, nickel, and iron can be deposited from alkaline sulphate solutions containing ammonium boro-citrate to prevent precipitation of iron and the reduction of the copper salt by the alkaline ferrous compounds. Better results are obtained if the solution consists solely of nickel and iron salts buffered with the boro-citrate and the copper is supplied by the use of a copper anode having the same area as the cathode. With increasing current density the iron content of the deposits increases rapidly to a maximum at which it remains constant, irrespective of further rise in current density; the increase in nickel content of the plates with increasing current density is not nearly so marked. The copper content decreases with increasing current density. Numerous examples of the effects of bath composition and current conditions on the composition of the deposits are tabulated.—A. R. P.

American and Continental Practice in Nickel Deposition. W. T. Griffiths (*Brit. Indust. Finishing*, 1932, **3**, 33–37, 57, 79–82).—See this *J.*, 1932, **50**, 315.—E. S. H.

On the Electrolysis of Metals. III.—Structure of Electrolytic Deposits of Silver from Its Molten Salts. K. M. Gorbunova (*Izvestia Akademii Nauk S.S.S.R.* (*Bulletin of the Academy of Sciences of U.S.S.R.*), 1933, **7**, (2), 255–266).—[In Russian.] The macro- and micro-structures of silver deposited electrolytically from a molten mixture of silver nitrate with alkali nitrates or chlorides have been studied with reference to the effect of silver concentration, temperature, and cathode current density, and the results are tabulated. In mixtures containing sodium and potassium nitrates the temperature was varied from 225° to 330° C., the current density from 0·005 to 1·0 amp./cm.^{2}, and the molecular ratio of the silver, potassium, and sodium nitrates from 1 : 1 : 1 to 1 : 5 : 5. In the series with the corresponding chlorides, the molecular ratio varied from 1 : 1 : 1 to 5 : 1 : 1 and 1 : 10 : 10, the temperature from 670° to 725° C. and the current density from 0·050 to 1·0 amp./cm.^{2}. The deposits obtained may consist of small, medium, or very large crystals extending into the body of the electrolyte and frequently short-circuiting the electrodes. The nature of the deposits varies somewhat according to whether the electrolyte consists of nitrates or chlorides, whilst the crystal size is governed by the concentration and current density. With nitrates, the deposit does not adhere firmly to the cathode, but with chlorides the converse is true, except at high current densities (0·5–1·0 amp./cm.^{2}). The microstructure of deposits obtained from chlorides during the initial stages of electrolysis indicates that the atoms of silver penetrate into the lattice of the growing crystals of the cathode. Owing to the low recrystallization temperature of silver it is impossible to obtain small-sized crystals by electrolysis at high temperatures. It is concluded that temperature is the basic factor which determines the process of electrocrystallization.—N. A.

Electrodeposition of Nickel and Chromium on Zinc Alloys. Anon. (*Galvano*, **1933**, (12), 13–15).—A bath recommended for nickel plating zinc-base alloys contains nickel sulphate 7·2 kg., ammonium chloride 3·25 kg., magnesium sulphate 0·3 kg. in 100 litres of cold water. No special precautions are required to apply subsequently a satisfactory coat of chromium.—E. S. H.

Purification of Nickel Baths Adulterated with Foreign Metals. Anon. (*Galvano*, 1933, (13), 14–15).—Simple analytical methods for the detection and elimination of copper, iron, zinc, and lead in nickel baths are described. —E. S. H.

Prevention of Injurious Effect of Antimony in Electrodeposition of Zinc and Copper. N. Kameyama and H. Iida (*Kōgyō Kwagaku Zasshi* (*J. Soc. Chem. Ind. Japan*), 1933, 36, (4); *Bur. Chem. Abs.*, 1933, [B], 631).—[In Japanese, with English abstract in supplemental binding, pp. 173–174B.] Addition of KH tartrate in large excess of the antimony present, to an acid copper sulphate bath reduced the deposition of antimony to a low figure. In the electrodeposition of zinc the effect of KH tartrate was only slight.—S. G.

Electrodeposition of Tungsten from Alkaline Solutions. Anon. (*Galvano*, 1933, (10), 14–15).—Bright deposits of tungsten can be obtained by electrolyzing a solution of sodium tungstate, sodium carbonate, and dextrose, using a nickel anode.—E. S. H.

Selection of Electroplate Coatings for Iron and Steel. E. E. Halls (*Synthetic and Applied Finishes*, 1933, 4, 45–50; *Brit. Chem. Abs.*, 1933, [B], 591).—Electrodeposited coatings of the "sacrificial protection" and the "blanket" types are discussed with special reference to the electromotive series of the metals. Metals prone to passivity cannot be used as "sacrificial" coverings. The relative behaviour of metals under mild corrosive conditions is often reversed under more rigorous attack. The outstanding features of zinc, cadmium, nickel, copper, and chromium electrodeposits are summarized.—S. G.

Barrel-Plating With Particular Reference to Optimum Loads and Costs. Gustaf Soderberg (*Quarterly Rev. Amer. Electroplaters' Soc.*, 1933, 19, (10), 8–20).—The method of calculating the load and plating time to obtain a definite thickness of cadmium coating on iron and steel articles in barrel-plating is described in detail and the question of costing the work is fully discussed. —A. R. P.

The Decomposition of Cyanide [Plating] Solutions. R. M. Wick (*Quarterly Rev. Amer. Electroplaters' Soc.*, 1933, 19, (10), 20–23).—In a plating solution containing 4·3 oz./gall. of free potassium cyanide (*i.e.* 0·5N) about 70% of the salt is decomposed after exposure to the air in a shallow vessel for 10 days at 25° C., potassium carbonate being formed by hydrolysis. Rise in temperature and the presence of carbon dioxide accelerate hydrolysis; above 45° C. formation of ammonia is one of the principal causes of loss of cyanide. Hence, to avoid undue loss of cyanide in plating baths the temperature should be kept as low as possible, agitation should be avoided, and alkali hydroxide should be added occasionally.—A. R. P.

Barrel-Plating with Duozinc Solution. F. F. Oplinger (*Quarterly Rev. Amer. Electroplaters' Soc.*, 1933, 19, (10), 23–37).—For barrel-plating small steel parts by the Duozinc process the following recommendations are made: *electrolyte*—zinc cyanide 6, sodium cyanide 3, sodium hydroxide 6 oz./gall.; *anodes*—an alloy of zinc with 1% mercury with as large a surface as possible; *cathode current density*—8–10 amp./lb. for nuts and bolts, 5–10 amp./lb. for light stampings, 15 amp./lb. for screws; total amperage for 36-in. barrels, 400 amp.; *e.m.f.*—8–12 v.; *temperature*—90°–110° F. (32°–43° C.) for a volume of 150–250 gall.; *plating time*—20–30 minutes; *speed of barrel*—4–6 r.p.m., higher speeds reduce the cathode efficiency; *construction of barrel*—rubber-coated steel with perforated panels. The above recommendations are discussed at some length.—A. R. P.

The Theoretical Aspects of the Electrolytic Formation of Metallic Deposits. J. Salauze (*Bull. Soc. franç. Élect.*, 1933, [v], 3, 836–858).—Reviews the work of Nernst and Blum and Rawdon and others as applied to electrodeposition. Some fields for further investigation are indicated.—P. M. C. R.

The Protective Value of Electroplated Coatings. —— (*Quarterly Rev. Amer. Electroplaters' Soc.*, 1933, **19**, (10), 37–40).—A progress report of the Joint Inspection Committee of the American Electroplaters' Society, the American Society for Testing Materials, and the Bureau of Standards. Cf. *J.*, this volume, p. 255.—A. R. P.

Experiences in the Plating of Samples for Exposure Tests. P. W. Strausser (*Quarterly Rev. Amer. Electroplaters' Soc.*, 1933, **19**, (10), 40–46).—Some difficulties met with in preparing standard plates of nickel, chromium, copper, zinc, cadmium, and zinc–cadmium alloys for exposure tests are described, together with the means adopted to overcome them.—A. R. P.

p_H and Its Electrometric Determination. Edward B. Sanigar (*Quarterly Rev. Amer. Electroplaters' Soc.*, 1933, **10**, (11), 23–32).—An educational article. —A. R. P.

Simple Degreasing or Degreasing [with Simultaneous] Coppering? Anon. (*Galvano*, **1932**, (5), 11–12).—Degreasing by cathodic polarization in alkaline solutions is recommended for iron prior to coating with zinc or cadmium, and for certain aluminium alloys, and for nickel prior to chromium plating, whilst a bath containing copper is recommended for iron, copper, brass, zinc, lead, tin, and white alloys containing no aluminium.—E. S. H.

Degreasing Before Electrodeposition of Metal. Anon. (*Galvano*, **1933**, (11), 22–24; (12), 21–23).—A review of existing practice.—E. S. H.

Organization of Work in an Electrolysis Workshop. Henri Hervé (*Galvano*, **1932**, (5), 13–15).—E. S. H.

VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition and Electro-Refining.)

(Continued from pp. 560–561.)

Linear Rate of Crystallization of Cathodic Lead Deposits. Alexander Glazunov and E. Bartunĕk (*Chem. Obzor*, 1932, **7**, 172–175).—In continuation of earlier work (see this *J.*, 1932, **50**, 636) the rate of crystallization of electrolytic lead deposited from nitrate, chloride, and acetate solutions has been measured under the microscope.—R. P.

Studies on Overvoltage. VI.—The Mechanism of the Transfer of Electrolytic Hydrogen and Oxygen Through Thin Sheets of Platinum and Palladium. A. L. Ferguson and George Dubpernell (*Electrochem. Soc. Preprint*, **1933**, Sept., 253–279).—Evidence is adduced to show that electromotively-active hydrogen and oxygen do not diffuse through solid metals. Previous observations to the contrary are shown to have been due to porosity of the electrodes. The bearing of these facts on the theory of polarization and overvoltage is discussed and a theory is propounded to account for the blistering of metals used as cathodes.—A. R. P.

Metallized Glass–Hydrogen Electrodes. E. Newbery (*Electrochem. Soc. Preprint*, **1933**, Sept., 99–110).—Good bright adherent deposits of platinum or palladium on glass are obtained by dipping the glass in a 2% alcoholic solution of the chloride of the metal, burning off the alcohol, and heating over a Bunsen flame. Six treatments are necessary for a good coating opaque to sunlight. Similar deposits of silver may be obtained from an alcoholic solution of ammonio-silver oxide. Palladium-coated glass may be used as a bright hydrogen electrode in solutions where platinum or palladium black produces an undesirable catalytic action, but platinized platinum–glass electrodes are best for general use as hydrogen electrodes. The properties and uses of various types of metallized glass–hydrogen electrodes are described.—A. R. P.

VIII.—REFINING

(Including Electro-Refining.)

(Continued from p. 562.)

Modern Metallurgical Methods for Increasing the Purity of Aluminium; Their Technical Significance and Operation. Hans Bohner (*Metall u. Erz*, 1933, 30, 334–339).—Modern methods of preparing pure alumina for use in the electrolytic production of aluminium are described and a brief account is given of the Frary process of electrolytically refining aluminium. The economics of the processes described are briefly discussed.—A. R. P.

On the Course of the Oxidation of Liquid Copper Containing Small Quantities of Nickel, Arsenic, Tin, and Antimony. P. Siebe and C. Busse (*Metall u. Erz*, 1933, 30, 273–280).—During the refining of copper the impurities are oxidized in the following order: tin, antimony, nickel, arsenic, but the tin and antimony oxides formed are soluble in molten copper and therefore difficult to remove. Nickel oxide is also soluble in copper and very little enters the slag; that dissolved in the copper is reduced to metal again during the poling. Arsenic is removed chiefly by volatilization, and this is comparatively slow at the usual refining temperatures.—A. R. P.

Evaluation of the Process of Desulphurization and Dearsenification of Copper in Reverberatory Furnaces According to the Laws of Physical Chemistry. Em. Lubojatzky (*Metall u. Erz*, 1933, 30, 311–313).—The concentration of sulphides and arsenides in molten copper is inversely proportional to their vapour pressure. By the application of the law of mass action to the decomposition of sulphides and arsenides during the refining of copper, equations can be derived to represent the processes of desulphurization and dearsenification as a function of the temperature.—A. R. P.

On the Removal of Selenium and Tellurium from Copper Electrolysis Slimes. Max Heberlein (*Metall u. Erz*, 1933, 30, 363–366).—The slimes produced in an American electrolytic copper refinery contain an average of copper 46·5, silver 4·1, gold 0·4, lead 1·2, selenium 23·5, tellurium 2·5, arsenic 0·6, and antimony 0·5%. Roasting with sodium hydroxide followed by leaching with water removes most of the selenium, but very little tellurium. Roasting the slime alone converts all the selenium and tellurium into dioxides, and a subsequent leach with potassium hydroxide solution removes all the selenium and about 70% of the tellurium; dead-roasting is essential, *i.e.* not more than 0·1% copper must remain insoluble in sulphuric acid. The leach liquor is acidified with sulphuric acid, whereby tellurium dioxide is precipitated, and the filtrate is treated with more sulphuric acid and with sulphur dioxide to recover the selenium. The selenium may also be recovered from the alkaline selenite solution by electrolysis, or this solution may be treated with lime to recover the potassium hydroxide and the calcium selenite worked up by one of the above methods. The copper oxide residue from the leaching of the roast is extracted with spent electrolyte from the copper cells and the solution crystallized for copper sulphate or returned to the cells for the recovery of electrolytic copper.—A. R. P.

Electrolytic Refining of Copper by Use of the Complex Salt of Cuprous Chloride. XI.—Behaviour of Bismuth. Naoto Kameyama and Shoji Makishima (*Kōgyō Kwagaku Zasshi* (*J. Soc. Chem. Ind. Japan*), 1933, 36, (6); *C. Abs.*, 1933, 27, 4484).—[In Japanese, with English summary in supplemental binding, pp. 365–367.] See *J.*, this volume, p. 93. When more than 1 grm./l. of bismuth accumulates in the bath, it may reach 0·001% in the cathode deposit. It may also deposit on the anode. Under these conditions the cathode deposit becomes highly crystalline. Avoidance is possible by increase of copper and gelatin in the bath.—S. G.

The Technique of Electrolytic Copper. M. Altmayer (*Cuivre et Laiton*, 1933, 6, 135–143).—A review.—W. A. C. N.

IX.—ANALYSIS

(Continued from pp. 563–566.)

The Spectroscopic Examination of Thin Metallic Films. A. Hervey and E. S. Dreblow (*J. Sci. Instruments*, 1933, **10**, 224–225).—A note. For the spectroscopic analysis of very thin films of metals deposited on glass, *e.g.* deposits on the interior of valves, the glass is held in one copper electrode, and a discharge made to take place along the glass by holding the second electrode very near to its surface. As little as 10^{-6} grm. of metal can thus be detected.—W. H.-R.

New Method for the Rapid Analysis of Alloys Without Destruction of the Samples. A. Glazunov (*Chim. et Ind.*, **1930**, Special No. (March), 247–250; *C. Abs.*, 1930, **26**, 5666).—The previously described method (see this *J.*, 1929, **42**, 508) has been extended to the qualitative analysis of metals and alloys. If a single metal is present, its nature will be revealed by the coloured precipitate obtained on the paper. If the metals present merely form a mechanical mixture, by using a sufficiently low voltage only the metal having the highest potential will dissolve and react, and by raising the voltage the others may be successively dissolved. When the metals form solid solutions or true chemical compounds, the reagents must be selected so that each reacts with only one of the metals. It is hoped that by working under definite current density and time conditions, approximately quantitative analysis may be obtained from the intensity of the colours produced.—S. G.

Macro-Electrolytic Analysis of Co, Zn, Cd, Ag, and Hg. J. Guzmán and A. Rancaño (*Anal. Soc. españ. Fis. Quim.*, 1933, **31**, 348–355).—Details are given for the deposition of quantities of the order of 1–1·5 grm. of Co, Zn, Cd, Ag, and Hg in 1 hr. using a passive Fe anode (Pt anode for Hg) and a Cu cathode, previously silvered for Ag and Hg, and Cd-plated for Cd. For Co the electrolyte contains 40 grm. of $(NH_4)_2SO_4$, 20 grm. of Na_2SO_3, and 75 c.c. of NH_4OH (*d* 0·91); a constant voltage of 2·5 v. is maintained while the current falls slowly from 2·5 to 1·5 amp. For Zn the electrolyte contains 1 grm. of KCN, 20 grm. of $(NH_4)_2SO_4$, and sufficient NH_4OH to redissolve the precipitate; a current of 4 amp. at 4·2 v. is required. For Cd the solution contains 25 grm. of $(NH_4)_2SO_4$ and sufficient NH_4OH to redissolve the precipitate; current is supplied at 2·7 v. and falls slowly from 2·5 to 1 amp. For Ag the sulphate solution is treated with 20 grm. of $(NH_4)_2SO_4$ and 5 grm. of NaOH and electrolyzed at 1·2 v. Hg is deposited from a feebly acid $Hg(NO_3)_2$ solution with a constant current of 1·5 amp., the voltage being slowly raised from 1·7 to 2·9 v. The technique of the electrolysis has already been described for Ni and Cu (see *J.*, this volume, p. 141).—A. R. P.

Methods Used in the Analysis of Certain Lead Alloys. B. S. Evans (*Analyst*, 1933, **58**, 450–461).—*Determination of thallium:* The Pb (10 grm.) is dissolved in a mixture of 50 c.c. of 1 : 1 HNO_3 and 120 c.c. of citric acid (100 grm. in 200 c.c. H_2O), the solution is made alkaline with NH_4OH, cooled, and treated with 10 c.c. of 0·5% $AgNO_3$ and 20 c.c. of 4% KI, and the precipitate of AgI and TlI is collected next day and washed with 2% NH_4OH containing 0·1% KI. The AgI is removed by washing with KCN solution, the TlI dissolved in hot HCl, the Tl precipitated with NaOH and Na_2S, the TlS dissolved in HCl and Br, the solution boiled with SO_2, and the Tl titrated with 0·05*N*-$NaBrO_3$ at 55° C. A blank titration is necessary. *Determination of tellurium:* The metal is dissolved in 60 c.c. of 1 : 1 HNO_3 and 50 c.c. of tartaric acid (50 grm. in 200 c.c. H_2O), NH_4OH is added until the precipitate first formed redissolves, then tartaric acid until the solution is strongly acid to litmus, and, after cooling, the acid Pb tartrate is removed and the filtrate treated with 10 c.c. of 4% KI and 40 c.c. of 1 : 3 H_2SO_4. After 15 minutes the solution is filtered and the filtrate treated with 20 c.c. of 20% NH_4Cl and 2–3 grm. of

NaH_2PO_2, boiled to precipitate Te, and filtered. The Te is dissolved in 10 c.c. of HCl saturated with Br and the solution diluted to 300 c.c. with H_2O and 20 c.c. of HCl. The Te is reprecipitated as before and after washing is rinsed into the beaker, treated with 2–3 c.c. of 1 : 3 H_2SO_4 and 10 c.c. of 4% KI, and dissolved with an excess of 0·01*N*-I. After neutralizing with $NaHCO_3$ the excess I is titrated with 0·01*N*-$Na_2S_2O_3$ using C_6H_6 as indicator; starch is then added followed by 0·01*N*-I until the blue colour appears. 1 c.c. I = 0·000319 grm. Te. *Determination of cerium:* The Pb (10 grm.) is dissolved in 50 c.c. of 1 : 1 HNO_3, NH_4OH is added in slight excess followed by $CH_3{\cdot}COOH$ until acid, and the Ce is precipitated by shaking the solution at 90° C. with $NaBO_3$. Reprecipitation is necessary to remove all the Pb; the Ce is finally determined by oxidation with Na bismuthate followed by reduction with $FeSO_4$ and titration of the excess of the latter with $KMnO_4$. *Determination of antimony* in Pb alloys containing Tl is made by precipitating the Sb from the chloride solution with metallic Fe and conversion into Sb_2S_3 followed by dissolution in HCl and titration with $NaBrO_3$. Methods are also given for the determination of Ca and Ba in Pb-base bearing metals.—A. R. P.

On a Method of Increasing the Sensitivity of a Microchemical Reaction for Chromium. I. M. Korenmann (*Z. anal. Chem.*, 1933, **93**, 265–271).—In testing for traces of CrO_3 by precipitation as Ag_2CrO_4 addition of a little Na_2SO_4 gives a crystalline precipitate of Ag_2SO_4 which is coloured yellow with Ag_2CrO_4 if Cr is present. The sensitivity of the test is much enhanced in this way. —A. R. P.

New Colour Reaction for Cobalt. A. Chiarottino (*Industria Chimica*, 1933, **8**, 32–33; and (abstract) *Chim. et Ind.*, 1933, **30**, 53).—The Group III precipitate which is insoluble in HCl is dissolved in *aqua regia*, evaporated to dryness, neutralized if necessary, and warmed with 5–10 c.c. of dilute alcohol. The Ni is precipitated by a 1% dimethylglyoxime solution and filtered off. To the filtrate a solution of 0·5 grm. benzidine and 0·25 grm. dimethylglyoxime in 100 c.c. alcohol is added. If Co is present a characteristic orange colour is obtained. The reaction is sensitive for 0·01 mg. of Co.—W. A. C. N.

1 : 2-Diaminoanthraquinone-3-Sulphonic Acid as a Reagent for the Detection of Copper, Cobalt, and Nickel. J. V. Dubsky and V. Bencko (*Z. anal. Chem.*, 1933, **94**, 19–20).—In alkaline solutions the reagent gives a blue-black precipitate of an adsorption compound with Cu, Ni, and Co salts. With Cu a violet coloration is produced in 1 × 10^{-6} *N*-solutions.—A. R. P.

β-Naphthol Reaction for Copper. Charles C. Fulton (*Amer. J. Pharm.*, 1933, **105**, 62–63; *Chem. Zentr.*, 1933, **104**, I, 3601).—As little as 1 part of Cu in 3 × 10^6 parts of solution can be detected by the greenish-yellow colour produced by adding 0·5 c.c. of 1 : 2 NH_4OH and 2 c.c. of C_2H_5OH containing 0·04 grm. of β-naphthol to the neutral solution under test.—A. R. P.

Use of Triethanolamine for the Detection of Traces of Gold and Silver and as a Characteristic Reagent for Manganese, Nickel, and Cobalt. E. Jaffe (*Ann. Chim. appl.*, 1932, **22**, 737–743; *Chem. Zentr.*, 1933, **104**, I, 3221–3222).—A 20% solution of triethanolamine gives the following reactions with solutions containing the metals: $Hg^{\cdot}$, grey precipitate of metal; $Ag^{\cdot}$, yellowish-brown flocculent precipitate soluble in excess giving a solution from which a Ag mirror is deposited on boiling; $Cu^{\cdot\cdot}$, reaction the same as that of NH_4OH; $Cd^{\cdot\cdot}$, white powdery precipitate insoluble in excess; $Hg^{\cdot\cdot}$, heavy white powder which becomes greyish on boiling with excess; $Pb^{\cdot\cdot}$, $Bi^{\cdot\cdot\cdot}$, $Sn^{\cdot\cdot}$, $Sb^{\cdot\cdot\cdot}$, heavy white precipitates insoluble in excess; $Al^{\cdot\cdot\cdot}$, $Cr^{\cdot\cdot\cdot}$, $Fe^{\cdot\cdot\cdot}$, gelatinous precipitates similar to those given by NH_4OH, but much more soluble in excess of the precipitant; $Mg^{\cdot\cdot}$, white amorphous precipitate insoluble in excess. $Au^{\cdot\cdot\cdot}$ in concentrated solution gives a reddish-yellow precipitate which dissolves to a yellow solution in excess or to a blood-red solution with 10–15 vols. of reagent to 1 vol. of solution; both solutions yield black precipitates of Au and some-gives a Au mirror on warming. Very dilute Au solutions yield red colloidal solutions of Au; the red colour is visible with 10^{-6} grm. of Au in 1 c.c. Mn gives first a white precipitate which becomes reddish-yellow on exposure to air and on addition of NaOH turns brown, then dark green, and the solution becomes emerald-green. Ni gives a blue solution which becomes emerald-green on addition of NaOH, and Co gives a carmine-violet solution which gives a precipitate with tartaric acid soluble in excess to a carmine-red solution becoming violet with an excess of NaOH.—A. R. P.

On Some Separations of Metals of the Ammonium Sulphide and Alkaline Earth Groups. Albert Krüger (*Z. anal. Chem.*, 1933, **93**, 422–429).—Zn can be separated completely from Fe, Al, Ni, Co, Cr, and the alkaline earths by saturating with H_2S at 70° C. the solution of the metals containing 0·7–1·5 c.c. of N-H_2SO_4 per 100 c.c., adding 2–3 drops of saturated $Na_2S_2O_3$ solution, again passing H_2S, adding 1–2 grm. of solid $Na_2S_2O_3$, cooling and filtering off the ZnS. If the filtrate is saturated with H_2S, and then heated under pressure in a hot-water bath, NiS, CoS, FeS, $Al(OH)_3$, and $Cr(OH)_3$ are precipitated in a granular readily filtrable form, leaving a solution containing only alkalis and alkaline earths.—A. R. P.

The Quantitative Separation of Aluminium from Iron. J. Haslam (*Analyst*, 1933, **58**, 270–272).—The Fe is removed by H_2S in ammoniacal tartrate solution and the Al then precipitated with 8-hydroxyquinoline.—A. R. P.

Electrolytic Separation of Copper from Arsenic and Selenium. M. G. Raeder and B. Holfors (*Kong. Norske Videnskab. Selsk. Forhandl.*, 1933, **5**, 171–174; *Chem. Zentr.*, 1933, **104**, I, 3602).—The HNO_3 solution of the elements is neutralised with NH_4OH, treated with KCN until the CuCN precipitate redissolves, then with a further 0·03–0·05 grm., made strongly ammoniacal (15 c.c. of NH_4OH, *d* 0·88), and electrolysed at 70°–75° C. with 2–4 amp. at 4 v. using a rotating (600 r.p.m.) gauze cathode. All the Cu is deposited in 20 minutes free from As and Se.—A. R. P.

A New Reagent for Lithium in the Presence of Other Alkalis: Separation of Lithium from Magnesium: Quantitative Determination of Lithium: Separation of Arsenates from Arsenite. T. Gaspar y Arnal (*Ann. chim. analyt.*, 1933, [ii], **15**, 193–194).—Li is completely precipitated in 60–70% C_2H_5OH solutions by addition of Na_3AsO_4. If Mg is present it is first separated by addition of Na_3AsO_4.—A. R. P.

On the Use of the Mercury Cathode. W. Böttger [with Natalie Block and M. Micheel] (*Z. anal. Chem.*, 1933, **93**, 401–422).—Electrolyses of various metal solutions have been made under different conditions to determine which cathode gives the best results, (A) the amalgamated brass gauze cathode of Paweck (*Ibid.*, 1924, **64**, 89) or (B) a liquid Hg cathode. For Zn in acid or alkaline solutions A gives the best results, but is not so good for Cd deposition. B is much the more satisfactory for Ni and Fe deposition. The purification of the Hg cathode is discussed and means for avoiding various sources of error are indicated.—A. R. P.

Working Technique with Hydrogen Sulphide in Qualitative Analysis. J. V. Dubský and V. Dostál (*Z. anal. Chem.*, 1933, **94**, 21–23).—A technique is described for gassing several solutions with H_2S simultaneously from one Kipp apparatus at constant pressure.—A. R. P.

The Polarographic Determination of the Alkali Metals. Vladimir Majer (*Z. anal. Chem.*, 1933, **92**, 321–351).—Heyrovský's polarographic method with the dropping Hg cathode has been applied to the quantitative determination of K and Na; the original must be consulted for details of the apparatus and procedure.—A. R. P.

New Method of Determining Aluminium in Aluminium Alloys. W. Ehrenberg (*Chim. et Ind.*, 1933, **29**, 1352).—Abstracted from *Z. anal. Chem.*, 1932, **91**, 1–5; see *J.*, this volume, p. 258.—W. A. C. N.

An Apparatus and Procedure for the Electrolytic Estimation of Arsenic. Frank N. Moerk (*Electrochem. Soc. Preprint*, **1933**, Sept., 173–186).—The method described is a variation of the Gutzeit process for determining minute quantities of As. The AsH_3 is evolved by electrolysis under standard conditions in a specially designed apparatus and the action on the test-papers is controlled to give consistent stains under standard conditions. The original should be consulted for details.—A. R. P.

A Gravimetric Method for the Determination of Arsenic as $MgNH_4AsO_4,6H_2O$. J. Dick (*Z. anal. Chem.*, 1933, **93**, 429–433).—The solution containing the As as $(NH_4)_3AsO_4$ is treated with 3–5 grm. of NH_4Cl and 10–15 c.c. of magnesia mixture in excess of that required to precipitate the As. HCl is added dropwise until the precipitate just redissolves, and the solution is then neutralized with 2·5% NH_4OH and treated with one-third its volume of this reagent. After cooling to 0°–5° C. for 1–2 hrs. the crystalline precipitate is collected, washed in succession with 2·5% NH_4OH, C_2H_5OH, and $(C_2H_5)_2O$, dried in a vacuum desiccator at room temperature, and weighed as $MgNH_4AsO_4,6H_2O$, which contains 24·02% As.—A. R. P.

On the Determination of Beryllium. L. Fresenius and M. Frommes (*Z. anal. Chem.*, 1933, **93**, 275–279).—Ignition of $Be(OH)_2$ precipitates containing volatile chlorides or basic Be chloride leads to no loss of Be by volatilization; $BeCl_2$ is quantitatively converted into BeO on ignition. Mo is best separated from Be by means of tannin in acetate solution; an excess of tannin must be avoided, since it tends to dissolve the Mo. If Fe is present, both Fe and Mo are quantitatively precipitated by the tannin. Al is best separated from Be and P by 8-hydroxyquinoline; the Be is then recovered as $BeNH_4PO_4$.
—A. R. P.

A Volumetric Method for the Determination of Bismuth. C. Mahr (*Z. anal. Chem.*, 1933, **93**, 433–437).—The Bi solution is treated with 30% KBr until the BiOBr first formed redissolves, and is then neutralized with NaOH, warmed to 40°–50° C., and treated with a warm solution of $[Cr(NH_3)_6](NO_3)_3$. The crystalline precipitate of $[Cr(NH_3)_6]BiBr_6$ is collected in a porous glass crucible, washed with 20–25% KBr solution, and then distilled with NaOH to liberate the NH_3, which is collected in standard H_2SO_4 and determined acidimetrically. In the presence of other metals, the first precipitate should be boiled with H_2O to obtain BiOBr, which is redissolved in KBr solution and the process continued as above.—A. R. P.

Simplification of the Methods of Treadwell and Mayr. Bromometric Determination of Bismuth. P. Montequi and J. González Carreró (*Anal. Soc. españ. Fís. Quím.*, 1933, **31**, 242–254).—The $Bi(NO_3)_3$ solution (0·5–1*N* in HNO_3) containing not more than 25 mg. of Bi is treated with an excess of $K_3Cr(SCN)_6$ solution and shaken with 5–10 drops of toluene. The precipitate is collected, washed, and boiled with dilute KBr solution; after cooling, HCl is added followed by 0·1*N*-$KBrO_3$ until the liquid is coloured yellow with Br. KI is then added and the liberated I titrated with $Na_2S_2O_3$. The difference between the two titrations multiplied by 0·58 gives the amount of Bi present.
—A. R. P.

A New Rapid Method for the Macro- and Micro-Determination of Bismuth. G. Spacu and P. Spacu (*Z. anal. Chem.*, 1933, **93**, 260–265).—The cold $Bi(NO_3)_3$ solution is treated with KI to give $KBiI_4$ and then boiled with an excess of a concentrated solution of *trans*-$[Co\ en_2\ (SCN)_2]SCN$, whereby a crystalline orange-yellow precipitate of $[Co\ en_2\ (SCN)_2]BiI_4$ is obtained. On cooling, the precipitate is collected, washed with a dilute solution of the precipitant containing KI, then with C_2H_5OH and $(C_2H_5)_2O$, dried in a vacuum desiccator, and weighed; it contains 20·65% Bi. (*Note*: en = ethylenediamine.)
—A. R. P.

Gravimetric Determination of Calcium and Its Separation from Magnesium. O. Brunck (*Z. anal. Chem.*, 1933, **94**, 81–86).—The technique of the oxalate separation is discussed in detail.—A. R. P.

Solubility of Calcium Oxalate in Some Salt Solutions. K. L. Maljaroff and A. J. Gluschakoff (*Z. anal. Chem.*, 1933, **93**, 265–268).—The solubility of CaC_2O_4 in 2% $(NH_4)_2SO_4$, NH_4NO_3, and NH_4Cl solutions is respectively 10, 12, and 27 mg./litre; in H_2O the solubility is 6 mg./litre. The presence of Mg salts increases the solubility in all cases.—A. R. P.

Detection and Determination of Cobalt with 1 : 2-Nitronaphthol. Hans Herfeld and Otto Gerngross (*Z. anal. Chem.*, 1933, **94**, 7–12).—The Co solution is treated with 3 c.c. of 10% H_2SO_4 and with a warm 3% solution of the reagent in 50% $CH_3{\cdot}COOH$. The precipitate is collected, washed with warm water, and evaporated with HNO_3 and H_2SO_4 to destroy organic matter. Eventually the excess acid is expelled by further heating and the $CoSO_4$ residue weighed. A colorimetric method for traces of Co is based on the red colour produced by addition of the reagent and excess of NaOH to the Co solution; a distinct pink colour is produced with 1 part of Co in 2×10^7 parts of solution.—A. R. P.

On the Quantitative Determination of Some Metals by Means of Anthranilic Acid. II.—A Simple Method for the Quantitative Determination of Cobalt, Nickel, and Copper. H. Funk and M. Ditt (*Z. anal. Chem.*, 1933, **93**, 241–247).—Anthranilic acid precipitates Co, Ni, and Cu from acetate solutions under the same conditions as previously described for Zn and Cd (see *J.*, this volume, p. 453). The precipitates can be dried at 105°–110° C. and weighed (factor for Co 0·1780, for Ni 0·1774, and for Cu 0·1894) or dissolved in HCl and the anthranilic acid determined bromometrically.—A. R. P.

Potentiometric Determinations in Alkaline Solution. Determination of Gold with Vanadyl Sulphate. Carlos del Fresno and Edmundo Mairlot (*Z. anorg. Chem.*, 1933, **214**, 73–76).—The $AuCl_3$ solution is made strongly alkaline with NaOH (7·5–30%) and titrated at 30°–70° C. with 0·1*N*-$VOSO_4$ solution; the reaction is $NaAuO_2 + 3VOSO_4 + 8NaOH = Au + 3NaVO_3 + 3Na_2SO_4 + 4H_2O$.—M. H.

Volumetric Determination of Lead by the Nickel Dioxide-Arsenite Method. R. Lang and J. Zweřina (*Z. anal. Chem.*, 1933, **93**, 248–260).—The $Pb(NO_3)_2$ solution or the $PbSO_4$ precipitate obtained in the usual separation methods is treated with 25 c.c. of 2·5*N*-NaOH, then with 20 c.c. of $Ni(NO_3)_2$ solution (135 grm. of crystals per litre) and 2 grm. of $K_2S_2O_8$ (Co and NH_4 salts must be absent). After shaking for 1 minute, 60–80 c.c. of 1 : 1 HNO_3 are added to dissolve the NiO_2 excess, and leave a residue of PbO_2, which is then dissolved by addition of 0·1*N*-Na_3AsO_3, the excess of which is titrated with $KMnO_4$ after addition of 10 c.c. of 1 : 1 HCl and 1 drop of 0·005*M*-KIO_3. For the determination of Pb in alloys containing Sb 0·3–0·5 grm. is dissolved by heating with 5 c.c. of concentrated H_2SO_4, and the cold solution is treated with 5–10 c.c. of HCl (*d* 1·19) and 1 grm. of KBr and boiled until fumes of H_2SO_4 are evolved; the treatment is repeated to remove all the Sb, and the $PbSO_4$ is collected and treated as described above.—A. R. P.

A New Semi-Micro- and Micro-Determination of Magnesium. A. Blanchetière and M. Arnoux (*J. Pharm. Chim.*, 1933, [viii], **17**, 97–107; *Chem. Zentr.*, 1933, **104**, I, 3747).—The method depends on the precipitation of $MgI_2{\cdot}10H_2O$, $2(CH_2)_6N_4$ by addition of KI and $(CH_2)_6N_4$ to the neutral Mg solution free from heavy metals. The precipitate may be determined volumetrically by titration of the I_2 content by the Volhard method or by addition of excess H_2SO_4 and titration of the excess with standard alkali.—A. R. P.

The Determination of Metals by Means of 8-Hydroxyquinoline. I.—The Effect of p_H **on the Precipitation of Magnesium, Zinc, Cobalt, Nickel, Copper, and Molybdenum from Acetate Solution.** H. Ronald Fleck and A. M. Ward

(*Analyst*, 1933, **58**, 388–395).—The p_H range within which precipitation by 8-hydroxyquinoline is complete in acetate solution is as follows: Mg 9·5–12·6, Zn 4·7–13·3, Co 4·3–14·5, Ni 4·5–14·5, Cu 5·4–14·5, Mo 3·7–7·4. No precipitation occurs when the p_H is less than 7·2 (Mg), 4·0 (Zn), 4·1 (Ni), 3·35 (Cu), 3·1 (Mo), or greater than 13·2 (Mg), 14 (Zn), 7·7 (Mo). Thus in acetate solutions, by adjustment of the p_H, separation of Mo and Mg from all the other metals is possible, but Co, Ni, Zn, and Cu cannot be separated from one another. —A. R. P.

Estimation of Manganese by Procter Smith's Method. A. Pinkus and L. Ramakers (*Chim. et Ind.*, 1933, **30**, 46).—Abstracted from *Bull. Soc. chim. Belge*, 1932, **41**, 529–548, 549–564; see *J.*, this volume, p. 369.—W. A. C. N.

Potentiometric Titration of Molybdenum. Blahoslav Stehlik (*Chem. Listy*, 1932, **26**, 533–537).—See abstract from another source, *J.*, this volume, p. 369. —R. P.

On the Determination of Potassium and Sodium in the Form of Sulphates. H. Remy and R. Siegmund (*Z. anal. Chem.*, 1933, **93**, 321–331).—The alkali sulphates become completely anhydrous only after heating at 400° C. (K_2SO_4) or 900° C. (Na_2SO_4). Addition of H_2SO_4 assists in expulsion of the H_2O; a further addition of $(NH_4)_2CO_3$ promotes expulsion of the excess SO_3. K_2SO_4 begins to volatilize above 800° C.—A. R. P.

Contribution to the Analytical Determination of the State of Silicon in Aluminium and in Aluminium–Silicon Alloys. P. Urech (*Z. anorg. Chem.*, 1933, **214**, 111–112).—SiH_4 is always evolved when Al or its alloys containing Si are dissolved in H_2SO_4 or HCl without addition of HNO_3. In the dissolution of such materials in H_2SO_4 (*d* 1·6) or 2*N*-HCl a loss of 0·033–0·040% Si or of 0·045–0·047% Si, occurs; this loss is independent of the Si content of the alloy. —M. H.

Application of Mercurimetry to the Determination of Silver. J. V. Dubský and J. Trtílek (*Z. anal. Chem.*, 1933, **93**, 345–348).—For the determination of Ag in alloys the HNO_3 solution is diluted to 0·2*N*-HNO_3 and the Ag precipitated with excess of standard NaCl solution, the excess being titrated with $Hg(NO_3)_2$ solution using diphenylcarbazide or, better, diphenylcarbazone as internal indicator.—A. R. P.

Determination of Tungsten with 8-Hydroxyquinoline in Complex Oxalate Solution. A. Jílek and A. Rysánek (*Coll. Trav. chim. Tchécoslov.*, 1933, **5**, 136–138).—W can be separated from Sn by treating the neutral oxalate solution of the metals containing $(NH_4)_2C_2O_4$ with 8-hydroxyquinoline. The precipitate is ignited to WO_3 for weighing.—A. R. P.

X.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

(Continued from pp. 566–567.)

A Precision, High-Power Metallographic Apparatus. Francis F. Lucas (*Metal Progress*, 1933, **24**, (4), 21–25).—Abbreviated from a paper read before the American Society for Steel Treating. The apparatus is intended for high-power photography with monochromatic light, the character of which can be controlled by rotating the mounting until the desired line in the spectrum produced by a spark gap or mercury lamp bears on the vertical illuminator of the microscope assembly. This is mounted separately from the illuminating apparatus, to increase the stability demanded by long-exposure work. The objectives may be of standard type or corrected for infinity tube length, the latter giving superior results.—P. M. C. R.

A New Optical Dilatometer.—I. Fr. Bollenrath (*Z. Metallkunde*, 1933, **25**, 163–165).—The instrument which is provided with a device for optically recording the extension–temperature curve is described in detail; it has several advantages over the Chevenard differential dilatometer, especially for the dilatometric investigation of materials with a low strength at high temperatures.—M. H.

A Useful Magnifier. Anon. (*J. Sci. Instruments*, 1933, **10**, 255).—Describes the Beck "Luminex" magnifier. This is a combination of a magnifying glass and electric torch arranged so that light is reflected on the object under examination. An adaptation as a microscope for examining Brinell impressions is also made.—W. H.-R.

New Profilograph Measures Roughness of Finely Finished and Ground Surfaces. E. J. Abbott and F. A. Firestone (*Automotive Ind.*, 1933, **69**, 204–207).—A description of recent improvements in the Profilograph. See *Metal Progress*, 1932, **21**, (4), 57, and this *J.*, 1932, **50**, 367.—P. M. C. R.

A Universal Automatic Filtration Apparatus. Jaroslav Chloupek and Vladislav Z. Daneš (*Chem. Obzor*, 1932, **7**, 237–240).—A simple inexpensive, self-contained, and safe automatic filtration apparatus is described for use with almost every form of filtering device, such as sintered glass crucibles, porous porcelain crucibles, ordinary or Büchner funnels, in the ordinary, or an inert atmosphere, with or without suction. The relative efficiencies of continuous and intermittent filtration procedures are compared.—R. P.

A Recording Photodensitometer for X-Ray Powder Photographs. W. O. Milligan (*Rev. Sci. Instruments*, 1933, **4**, 496).—A cheap and robust form of photodensitometer enabling intensities of spectra to be determined with an accuracy within 4–5% of accepted values is described.—J. S. G. T.

An Improved Apparatus for the Measurement of Poisson's Ratio. A Correction. W. A. Zisman (*Rev. Sci. Instruments*, 1933, **4**, 507).—Corrections necessary in Z.'s paper (*J.*, this volume, p. 454) are noted.—J. S. G. T.

A High-Temperature X-Ray Camera for Precision Measurements. A. H. Jay (*Proc. Phys. Soc.*, 1933, **45**, 635–642).—A precision X-ray camera designed for taking X-ray spectra by the powder method at temperatures up to about 600° C. is described.—J. S. G. T.

An Integrating Photometer for X-Ray Crystal Analysis. B. Wheeler Robinson (*J. Sci. Instruments*, 1933, **10**, 233–242).—Describes the construction of a photo-electric photometer for the measurement of integrated X-ray intensities in crystal analysis photographs. The general principle is that, on the same emulsion as that used for the photograph, a calibration wedge is imprinted by exposure behind a slit covered by a rotating cam, so that, along the length of the slit, exposure is proportional to distance. This calibration wedge is developed with the photograph, and is then cut away and placed under one exploring beam of the photometer, whilst the other beam travels over the area of the spot to be measured. The position of the wedge is altered until the two beams give an exact balance of density as measured by two photo-electric cells. The position of the wedge, which is mounted in a sliding carrier, is thus a linear measure of the X-ray density at the point under the exploring beam, and a simple integrating device gives a very good estimation of the total density of the whole X-ray spot. The instrument is simple and inexpensive to construct, and gives results in good agreement with those of the ionization spectrometer.—W. H.-R.

Gas-Tight Welding [of Metal Wires] to Fused Silica. E. Podszus (*Sprechsaal*, 1933, **66**, 215).—In order to weld metal wires to fused silica a special ceramic joining piece is prepared. It has at one end a composition which can be readily welded to fused silica, and at the other end merges into a glass.—J. W.

XI.—PHYSICAL AND MECHANICAL TESTING AND RADIOLOGY

(Continued from pp. 567–569.)

The Relationship Between Static and Dynamic Loading. B. Garre (*Z. Metallkunde*, 1933, 25, 206).—The relationship between the phenomena of fracture under static and dynamic loading postulated by Ljungberg (see this *J.*, 1931, 47, 103) holds good only for hard materials with an accuracy of about 10%. With medium hard and soft materials, however, considerable deviations exist. This is due to the fact that a number of assumptions on which that postulation is based do not prove to be absolutely correct.—M. H.

Supplementary Methods of Stress Analysis. Herbert J. Gilkey and Elmer O. Bergman (*Civil Eng.*, 1932, 2, 97–101; correspondence, M. M. Frocht, 377).—A general review, with selected bibliographies, is given of experimental methods of studying complex stress distributions in intricate structures. The plaster model or "brittle-material" method, the membrane analogy method, methods involving yield lines, and photo-elastic methods are among those briefly described. The inherent limitations of all methods based on the similarity of action of model and prototype are pointed out, and the need for the exercise of engineering judgment in interpreting results is emphasized. —J. C. C.

The Determination with Models of Internal Stresses in Arbitrarily Loaded Supporting Structures by the Deformation Gauge. K. Schaechterle (*Beton u. Eisen*, 1933, [D], 32, 174–176).—The adjustments and limitations of the gauging apparatus are described, and the theoretical basis of its working is explained. A short description is given of the construction of the celluloid models employed. Necessary approximations are indicated, and a formula is given for calculating actual moments from the results obtained on models of any given scale.—P. M. C. R.

Technique of Using Extensometers in Aeronautical Structures. Georges Ivanow (*Aéronautique*, 1932, 14, 187–191).—Measurement of the local deformation in a loaded structure gives information regarding the distribution of stresses which is obtainable in no other way. The Huggenberger extensometer is recommended for this work. Different methods of mounting it are described in detail, and the precautions necessary for accurate results enumerated. For observations on structures in motion, the Ritz extensometer, in which no magnifying devices are employed, is recommended. In this instrument, a record of deformation is obtained by the trace of a fine diamond on a glass or "cellon" tablet. A photographic enlargement of the record is subsequently made for examination.—J. C. C.

Comparison of Single-Step Long-Time Creep Results with Hatfield's Time-Yield Stress. A. E. White and C. L. Clark (*Amer. Soc. Steel Treat. Preprint*, 1933, Oct., 1–14).—The experiments have been conducted on samples of steel. It is stated that although there is a trend towards a relationship between the values obtained by the two methods mentioned, the variations are so great that no regular law is discoverable. The outstanding merit of Hatfield's proposal is the saving of time over the creep testing methods at present in vogue. Results for 3 steels at 455° C. and for 11 at 537° C. are given. It is concluded from these that the time-yield method may be used qualitatively in order to classify a series of steels of given type at a given temperature.—W. A. C. N.

Amsler 3000-Kg. Testing Machine, with Electric Furnace, for Determining the Creep Point of Four Test-Pieces Simultaneously. Anon. (*Bull. tech. Suisse Romande*, 1932, 58, 138–142).—The results of ordinary static tensile testing cannot be accepted as criteria for the selection of materials which will, in practice, be exposed to prolonged stress at high temperatures. The phenomena of creep are briefly summarized, and a description is given of a testing machine, installed by the Swiss Federal Laboratory for Testing Materials, for the investigation of creep in metallic samples. Four test-pieces can be tested simultaneously. Each is contained in a separate compartment of an electric furnace, which admits of testing-temperatures up to 800° C. Independent loading is secured for each piece (load varies from 50 to 3000 kg.), and the respective elongations are observed on a micrometer scale reading to 0·001 mm. They are, further, automatically recorded. Test-pieces are 10 mm. in diam. and 100 mm. gauge-length. The structure and adjustments of the machine are described and illustrated, with devices for neutralizing variations of current and ensuring a steady testing temperature.—P. M. C. R.

A Machine for Determining the Fatigue Limit of Metals. Walther Saran (*Engineering*, 1932, **133**, 731–734; and (abstract) *Technique moderne*, 1932, **24**, 384).—An autographically recording machine is described for short-time fatigue testing, primarily of light-alloy sand-castings. In the correlation of static and dynamic tests, unavoidable experimental errors may be eliminated if both types of test can be performed on the same machine. The present apparatus provides for this, and, further, for the superposition of static on dynamic stress, and for high-temperature testing; pure sinusoidal stresses can be applied, and the stress, strain-energy and temperature of the test-piece can be independently measured as the load increases. Provision is also made for keeping the test-piece cool, if necessary. The construction and manipulation of the machine and the interpretation of results are fully described, and the effect of the form of the test-piece is discussed.—P. M. C. R.

A New Device for Creep Testing. F. H. Norton and J. A. Fellows (*Metal Progress*, 1933, **24**, (4), 41–43).—A furnace is described for determining "creep" in specimens of 10-in. gauge-length. The expansion of the austenitic steel furnace tube automatically operates a current-breaking device and thus ensures close temperature control. The method of winding the furnace, the setting of the apparatus for a specific working temperature, and the routine of observation are described, and sample observations are recorded.

—P. M. C. R.

Static Principles of Vibration Fracture. W. Kuntze (*Mitt. Material., Sonderheft* 14, 1930, 17–22).—The characteristic features of vibration fracture are summarized and distinguished from those of tensile and of compressive fractures. The behaviour of materials under repeated tensile loading, and the influence of previous deformation, are graphically illustrated, and certain conclusions are applied to a consideration of vibratory fractures, with a view to elucidate their peculiar localized deformation. Investigations on the elastic properties of copper (W. Kuntze, *ibid.*, pp. 3–7) establish a maximum value of load permitting complete elasticity without proportionality. It is suggested that slip first appears when this limit is exceeded, and hence that the methods indicated might be employed for other materials, and to the establishment of values for their resistance to vibration stresses.—P. R.

An "Over-Night" Endurance Limit Test. H. F. Moore and H. R. Wishart (*Automotive Ind.*, 1933, **68**, 211).—An abstract of a paper read before the American Society for Testing Materials. See *J.*, this volume, p. 317.—P. R.

The Torsion Impact Test. G. V. Luerssen and O. V. Greene (*Amer. Soc. Test. Mat. Preprint*, **1933**, June, 1–15).—An impact machine is described which has been used to determine quantitatively the impact resistance of hard materials, so that this property may be controlled during the manufacture and use of the latter. Previous work is reviewed. It is believed that this method of subjecting standard specimens to impact under torsion provides a means of making an accurate comparison of impact values, similar to that which is possible by the use of standardized methods on softer materials.

—W. A. C. N.

On an Improved Apparatus for the Static Determination of the Torsion Modulus of Crystal Rods and Its Application to Single Crystals of Zinc. E. Goens (*Ann. Physik*, 1933, [v], **16**, 793–809).—The torsion modulus of zinc single crystals has been determined with a new apparatus (described) which obviates any bending of the rod during the test.—v. G.

Elastic Measurements on Copper by Means of the Martens Mirror. W. Kuntze (*Mitt. Material.*, *Sonderheft* **14**, 1930, 3–7).—In copper, where the elongation becomes progressively greater for equal increments of load, the measurement of elastic stretching is complicated by such factors as: (1) previous loading; (2) lag; (3) time of loading, and (4) the regulation of testing conditions. K. investigates (1) and (2) by a series of autographically recorded load-extension tests. Experimental conditions and method of loading are explained with reference to a specimen stress–strain diagram, which is used for the evaluation of the effects under consideration. The elongation (x_0) under an infinitely small initial load was determined for annealed material by extrapolation, thus facilitating comparative tests to establish the influence of the applied loads. Residual hysteresis effects were eliminated by artificial ageing: their influence is shown graphically, as is the effect of straining and subsequent heat-treatment on the elongation values.—P. M. C. R.

Interpretation of High-Temperature Tensile Tests. M. Sauvageot (*Rev. Mét.*, 1933, **30**, 319–322).—S. emphasizes the importance of giving full and precise details of the condition of material and of the testing when results are published. Reference is made to specific examples.—H. S.

New Bend Testing Machine. A. C. Blackall (*Wire and Wire Drawing*, 1933, **8**, 270, 284).—A description is given of the new Johnson bend testing machine, in which both the jaws gripping the wire slide simultaneously towards the centre line of the bending arm with a screw motion. In another machine, the wire is gripped in a vertical position by plates attached to the sides, and both the bending arm and the gripping device are fitted with guides, so that the wire is in a vertical position before bending begins.—J. H. W.

Critical Evaluation of the Bend Test for Welded Test-Pieces. K. Jurczyk (*Elektroschweissung*, 1932, **3**, 154–155).—In the bend test as usually performed, the angle of bend is not a true indication of weld ductility, since deformation does not take place equally in weld and parent metal. J. describes an apparatus in which the welded test-piece is bent round a pin in such a way that the deformation must be the same for weld, transition, and parent metal. The apparatus may be adapted to measure the bending moment applied to the specimen. It is suggested that the quality of a specimen should not be measured by its bend angle, but by its freedom from cracking after bending through 180° in the above apparatus, round a pin of given diameter for a given thickness.—H. W. G. H.

Hardness [of Metals] and Stress. Hans Kostron (*Mitt. staatl. tech. Versuchsamtes*, 1932, **21**, 17–31; *Chem. Zentr.*, 1933, **104**, II, 121–122).—The hardness of the stretched side of hard-drawn copper and normalized steel rods under a bending load has been measured with various testing machines. The scleroscope and impression hardness-testing machines all showed qualitatively a reduction in hardness due to the tensile stresses produced by bending. The degree of deformation of circular impressions varies with the induced stresses, being at a maximum when these are equivalent to about half the yield point; this deformation is attributed to the unevenness of the surface produced by the irregular flow induced by the stress. The change in hardness is the resultant of (*a*) the softening effect of the tensile stress; (*b*) the disturbance of the stress distribution caused by the permanent deformation round the impression, and (*c*) the increase in hardness produced by cold-work during the stretching caused by the bending. The reduction in hardness in the elastic range is less than that expected by theory owing to the effect of (*b*), whilst (*c*) opposes the decrease in hardness at the yield point. The hardness and irregularity of the impression are strongly influenced by the depth of the impression.—A. R. P.

On the Hardness of Metallic Elements. Masakatu Tokunaga (*Kinzoku no Kenkyu*, 1933, **10**, (9), 393–408).—[In Japanese.] The Rockwell, as well as the Shore, hardness have been measured for 27 metallic elements, and a conversion curve for these two hardness scales has been made. The relation between the hardness and atomic number has also been obtained.—S. G.

A Contribution to the Determination of the Initial Hardness in the Ball Hardness Test. E. Franke (*Z. Metallkunde*, 1933, **25**, 217–219).—The ball hardness test gives relative hardness values which allow only a conditional comparison of the hardness of different materials. These relative hardness values are higher than the initial hardness values, owing to the strengthening (cold-hardening) which takes place by the impression of the ball. The initial hardness is obtained if the value of the additional hardness (being due to the strengthening) is deducted from the normally determined hardness value. The experimental determination of the approximate initial hardness is possible by means of the scleroscope or the Herbert pendulum hardness tester. The initial hardness is: $H_I = \frac{H \times P_0}{P}$, where H is the normally determined ball hardness, P_0 the pendulum or scleroscope hardness of the material, and P the pendulum or scleroscope hardness of the cold-hardened zone of the impression of the ball.—M. H.

Hardness Testing with Preliminary Load (Rockwell Method) in Its Application to Standard Brinell Values. A. Wallichs and H. Schallbroch (*Stahl u. Eisen*, 1931, **51**, 366–368; and (summary) *Metallurgist* (Suppt. to *Engineer*), 1931, **7**, 110–111).—The ball-hardness and indentation-hardness values as obtained by the original Rockwell machine are correlated with Brinell values. Conversion curves are given for a variety of ferrous and non-ferrous materials; their interpretation is explained, and the effect of variations in ball-diameter is discussed.—P. M. C. R.

Determination of Hardness by the Method of Scratching as Applied to Metals. K. M. Juriew and V. A. Novopavlovskiy (*Sobshenia Leningradskogo Instituta Metallov* (*Communications of the Leningrad Institute of Metals*), **1933, (14)**, 116–156).—[In Russian.] In order to obtain satisfactory results by the scratching method, the diamond must be carefully selected and checked against a standard; the setting of its point must be permanent during scratching and illumination during measurement must be constant. Furthermore, a study of the structure of the metal must simultaneously be made, since the scratching method gives the hardness of individual structural constituents and calculation of the average value may give incorrect results. The diamond must be set at the greatest possible angle towards the surface of the specimen to obtain a scratch with even edges. The hardness number is best calculated by the expression: $H = \frac{P}{\lambda^2}$kg./mm.², which gives the same result with all loads on the point. Comparison with a ball test can be made by introducing a coefficient determined experimentally for a given metal and apparatus (the hardness number must be expressed on Mayer's scale).—N. A.

Diamond Hardness-Testing Machine. R. Guillery (*Rev. Mét.*, 1933, **30**, 287–291).—The machine described is of the type which observes the difference in penetration of a ball or point applied to the metal under examination under two different loads applied successively. Hydraulic pressure is used for accuracy and cheapness.—H. S.

Bowen Impressor Hardness-Testing Machine. Anon. (*Machinery* (*Lond.*), 1933, **42**, 651).—A brief description of the "Impressor" machine. See *J.*, this volume, p. 568.—J. C. C.

New Type Herbert Pendulum Hardness Tester. Anon. (*Machinery* (*Lond.*), 1933, 42, 744). **Herbert Pendulum Hardness Tester. A Simplified Model.** Anon. (*Found. Trade J.*, 1933, 49, 123).—See *J.*, this volume, pp. 568, 569.—J. H. W.

The Firth Hardometer. Anon. (*Machinery* (*Lond.*), 1932, **40**, 311, 694–695).—Illustrated descriptions. See this *J.*, 1928, **40**, 616; 1929, **42**, 565.
—J. C. C.

125 Kilogrammes Hardness-Testing Machine. Anon. (*Mech. World*, 1933, **93**, 452).—See *J.*, this volume, p. 375.—F. J.

Magnetic Testing of Welded Joints and Pieces. J. Pfaffenberger (*A.E.G. Mitt.*, **1933**, (4), 133–135).—The method depends on the deflection of magnetic lines of force by discontinuities, blow-holes, cracks, &c. Such deflections induce varying intensities of current in a coil contained in a testing handle, with which the entire joint, even in parts which are normally difficult of access, is easily explored: an amplifier transmits correspondingly varying sounds through head-phones worn by the operator. The apparatus is claimed to be cheaper, more easily operated, and more generally applicable than an X-ray testing plant.—P. M. C. R.

RADIOLOGY

Relative Merits of Film and Paper for Industrial X-Ray Work. Ancel St. John and H. R. Isenburger (*Amer. Soc. Test. Mat. Preprint*, **1933**, June, 1–9).—An acceptable X-ray negative should show perceptible shadows through the most opaque portion under examination, sufficient contrast to disclose a marker of 2% of the relative plate thickness through the thinnest portion under examination, and lead to unmistakable identification of the region examined. In the tests described the characteristics of good-quality film and paper as regards sensitivity, contrast, convenience in use, and cost are considered. The technique of the experiments is fully described. In respect of speed and contrast there is little to choose between film and paper. The balance is in favour of the paper with regard to general convenience. Paper is considerably less costly than film.—W. A. C. N.

Lattice Distortions and the Detection of Internal Stress [in Metals] with X-Rays. H. Mark and G. von Susich (*Z.V.d.I.*, 1932, 76, 1049–1052).—A brief review of recent work on the detection of deformations in the crystal lattice by the deterioration of the sharpness of the X-ray lines, and of various methods which have been proposed for their qualitative and quantitative evaluation.—v. G.

The Use of X-Rays for the Investigation of Elastic Stresses in Crystalline Substances for the Determination of Elastic Changes of Orientation. A. P. Komar (*Zhurnal Tehnicheskoi Fiziki* (*Journal of Technical Physics*), 1932, **2**, (7–8), 671–681).—See *J.*, this volume, p. 292. A review.—N. A.

Material Testing with X-Rays. E. Brandenberger (*Schweiz. Bauzeit.*, 1933, **102**, (4), 39–42).—A review of the principles of absorption and interference of X-rays and their application to the technical testing of materials.—J. W.

The X-Ray Inspection of Aluminium Alloy Welds. N. C. Hypher (*Metallurgia*, 1933, 8, 145–146, 148).—The application of aluminium alloys to aircraft and automobile construction is increasing the need for reliable welds, and the X-ray inspection of such welds is of importance. The uses and limitations of direct X-ray inspection of certain high-duty alloys of the "R.R." series welded either by the oxy-acetylene or the electrical "spot" method are discussed. The welds inspected did not exceed 3 in. in thickness, but welds up to 6 in. can be examined. Consideration is given to radiographs showing such defects as lack of fusion and union, gas pockets, seams and cracks, and inclusions of oxide and slags, produced by oxy-acetylene welding, and it is stated that radiography is of no value in detecting such faults in the case of electrical "spot" welds due to their construction. Reference is also made to the examination of structures and welds by the X-ray diffraction picture obtained by reflecting a pin-hole beam of X-rays at the surface of the point to be inspected. This is a new non-destructive method of inspection, at present in the research stage, which promises to be of value in determining the state of stress in metal parts and welds.—J. W. D.

The Capacity and Economy of the X-Ray Method for Testing Welds. R. Berthold (*Elektroschweissung*, 1932, 3, 201–205).—The technique of X-ray examination for welds is described in order to explain how the type of weld influences the number of exposures and the depth of penetration necessary for a satisfactory test. It is pointed out that the exposure required increases with the thickness of material and decreases with increased tube voltage, whereas the sensitivity of the method, *i.e.* the capacity for detecting very small defects, decreases with increasing tube voltage and thickness. Consequently a compromise must be sought for the most economical working. The method of doing so is fully explained and is illustrated by a table giving the essential data for testing typical types of weld.—H. W. G. H.

Sensitivity of the Gamma-Ray Method of Radiography. John T. Norton and Alfred Ziegler (*Amer. Soc. Steel Treat. Preprint*, 1933, Oct., 1–9).—Using a capsule of radon as the source of γ-rays, various thicknesses of iron, changing by definite measured steps, were radiographed and the optical density of the film so produced was measured by the densitometer. Hence the sensitivity was determined. It is defined as the change in thickness necessary to produce a 2% change in film density under certain specified conditions. The sensitivity is found to be nearly constant in value—1·3% of the thickness of the object—within the region of 2¼–6 inches of iron. The use of radon for γ-ray radiography is said to offer a very practical solution to the problem of the radioactive source.—W. A. C. N.

XII.—PYROMETRY

(Continued from pp. 569–570.)

New Micropyrometer for Determining Melting Points of Alloys. Anon. (*Electric J.*, 1932, 29, 152).—The material is heated on a resistance element consisting of a platinum strip 0·5 in. wide and 0·005 in. thick in a chamber which can be evacuated or filled with any gas desired. Observations of the first signs of fusion are made through a quartz window with the help of a microscope. The special feature of this equipment is that the temperature is automatically recorded by a total radiation pyrometer in conjunction with a recording potentiometer.—J. C. C.

Apparatus for Temperature Measurement and Temperature Regulation. Alfred Grunwald (*Siemens Z.*, 1933, 13, 141–146).—An illustrated description of some modern apparatus.—M. H.

Pyrometric Economies. W. Bowen (*Eng. Rev.*, 1933, 47, 102).—See *J.*, this volume, p. 457.—P. M. C. R.

Pyrometric Economies. H. Pickard. W. Bowen (*Eng. Rev.*, 1933, 47, 274–276).—Correspondence on "Pyrometric Economies," by W. Bowen (see preceding abstract). H. P. states that the low e.m.f. of the Pyrofer couple is likely to diminish accuracy as well as to necessitate a less robust indicator than is required by Chrome–Alumel or iron–Constantan couples. B. considers that a similarly designed indicator can combine high sensitivity and considerable robustness, and considers in some detail the importance of errors due to resistance and millivolt changes.—P. M. C. R.

XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 570–574.)

The Relationship Between the Engineering and the Foundry Trades. L. H. Pomeroy (*Proc. Inst. Brit. Found.*, 1930–1931, 24, 65–77; discussion, 77–93; and (abstract) *Mech. World*, 1931, 90, 200–201, 221–222).—P. advocates closer collaboration between foundry and designer; certain practical problems are indicated which could profitably be investigated under such conditions. The interpretation of mechanical tests is discussed, especially with regard to the relative reliability of castings and forgings. In the subsequent discussion, the different conditions in Great Britain and in the U.S.A. were considered in relation to efficiency, and certain research developments were reviewed.—P. R.

Contribution to the Study of the Casting Properties of Metals and Alloys. Paul Bastien (*Publ. sci. tech. Ministère de l'Air*, No. 20, 1933, 95–143).—Experiments on the ease with which pure metals fill the mould during casting ("castability") show that this is the resultant of numerous factors, among which the specific heat, latent heat of solidification, and melting point play a part as important as that played by the viscosity. The castability (C) increases linearly with increasing difference between the casting temperature and the melting point. For any given type of mould the castability of an alloy depends on the casting temperature, the mould temperature, the fluidity, the heat content, the solidification range (R), and the type of crystallization. Tests on lead–antimony, antimony–cadmium, and tin–antimony alloys show that C is inversely proportional to R and reaches a relative maximum when the material melts congruently (pure metals, eutectics, compounds) and a minimum with saturated solid solutions. C is better when the crystals which separate from the liquid have convex faces than when dendritic crystals separate. These two points are particularly emphasized by the good castability of the compound SbCd. Commercial magnesium has a low castability due to the presence of impurities in solid solution and possibly to the effects of oxide skins; addition of copper or aluminium improves considerably the castability. The effect of additions to the sand on the castability of magnesium alloys and the shrinkage and piping of castings of aluminium–copper–magnesium alloys have also been studied.—A. R. P.

Considerations on the Solidification of Metal Ingots. W. Roth (*Z. Metallkunde*, 1933, 25, 134–137; and (abstract) *Met. Ind.* (*Lond.*), 1933, 43, 448).—The temperature distribution during the period of solidification of an ingot of a pure metal has been calculated and the results are shown in diagrams and discussed. The formation of a zone of acicular crystals is explained by the existence of a temperature gradient in the liquid portion of the ingot. The theoretical considerations are in accordance with results of temperature measurements made at different places within an ingot of 70 : 30 brass in a cast-iron mould.—M. H.

On the Cooling of Ingots in Chill Moulds, Especially Brass Ingots in Water-Cooled Moulds. Walter Roth (*Giesserei*, 1933, 20, 413–419).—Equations have been deduced for calculating the temperature changes during the cooling of ingots in water-cooled moulds. From these equations the temperature gradient inside the ingot, the rate of cooling, and the time of solidification can be determined. The various methods by which the cooling conditions can be altered are discussed, and it is shown that the effects of the mould dressing, which opposes by far the greatest resistance to heat transfer, cannot be appreciably modified. By suitable selection of the mould material the time of solidification of brass ingots can be varied by about 50%, and, by changing the rate of flow of the water through the mould, by about 15%. Numerous tests have shown that ingots of 70 : 30 brass with a rapid rate of cooling solidify at a constant temperature and not through a temperature range as indicated by the equilibrium diagram of the copper–zinc system; it is therefore concluded that this brass has very little tendency to segregation. The grain-size and transcrystallization of the ingots depend chiefly on the casting temperature and rate of cooling, and, since only relatively small changes can be made in the latter factor in chill casting, it follows that the casting temperature is of primary importance for obtaining a desired casting structure.—A. R. P.

Efficient Casting Design. F. C. Edwards (*Foundry Trade J.*, 1932, **47**, 161–162, 363, 364; and *Canad. Mach.*, 1933, **44**, (2), 32–34).—Correct design should anticipate probable shrinkage stresses, and should not be influenced by previous association with other types of work: a consideration of faulty and improved flat-top designs illustrates the requisite adaptation of design to working conditions. Bracket and flanged castings are also considered. Suitable modifications of ribs, lightening cores, and lugs are suggested, and shown diagrammatically.—P. M. C. R.

Melting Aluminium in Crucible Furnaces. Anon. (*Metallbörse*, 1931, **21**, 915–916; and (abstract) *Light Metals Research*, 1931, **1**, (22), 21).—Serious attack on crucibles used for melting aluminium is caused by the affinity of the metal for iron and silicon at temperatures within the operating range, by the prolonged heating necessitated by the high specific heat of aluminium, and by the corrosive effects of aluminium oxide and of certain fluxes. Mechanical erosion generally follows chemical attack, and temperature variations and furnace gases cause further damage. Attack can be minimized by the use of high-carbon steel crucibles, by preserving the crucible surface without scraping between heats, and by coating the interior with a paste made of alumina and graphite. If a tilting furnace can be used, large heats are preferable. Graphite crucibles are recommended, and their preparation is described, with directions for their economical use.—P. M. C. R.

Gas Content of Aluminium Casting Alloys. H. Nipper (*Light Metals Research*, 1933, **2**, (32), 8–14).—Translated from *Z. Metallkunde*, 1933, **25**, 65–67; see *J.*, this volume, p. 326.—J. C. C.

Aluminium–Bronze Cog-Wheels Manufactured at the Marty Works at Nikolaev for Internal Combustion Engines. —— Klimow (*Liteinoe Delo* (*Foundry Practice*), **1933**, (3), 21–24).—[In Russian.] Detailed description of the experiments on the manufacture of cog-wheels in the State Marty Works at Nikolaev.—N. A.

Development of a Technical Casting Process for Beryllium–Copper Alloys. G. Masing and W. Pocher (*Heraeus Vacuumschmelze* [10*th Anniv. Volume*], **1933**, 339–348).—Casting of "beryllium–bronze" is attended with the same difficulties as are met with in casting "aluminium-bronzes," namely, the inclusion of oxide skins and the formation of long, thread-like, and often branched pipes within the ingot. Sound castings of rods may, however, be obtained by using moulds slightly tapering towards the bottom inside and towards the top outside, so that the wall thickness is much greater at the bottom than at the top; the moulds should be bolted to a heavy cast-iron bottom plate and should have a sand casting-head tapering outwards from bottom to top. With this arrangement the casting solidifies from the bottom upwards and piping is thus avoided.—A. R. P.

Copper–Nickel Alloys. Anon. (*Modern Eng.*, 1933, **7**, 12–15).—The properties, melting, casting, and working of cupro–nickels are discussed.—H. W. G. H.

Bells, Hand Bells, and Carillons. V. Cheilly (*Cuivre et Laiton*, 1933, **6**, 243–245).—A discussion of the factors which have to be borne in mind when adjusting the tone of bells.—W. A. C. N.

The Manufacture of Tin–Bronzes. A. P. Smiriagin (*Liteinoe Delo* (*Foundry Practice*), **1932**, (11), 23–24).—[In Russian.] Hints are given on the following points: melting of new metal charges, melting of charges containing scrap, amount and composition and method of using fluxes, rate of pouring, mould temperature, lubrication of chill-moulds, and the characteristic properties of moulding sands.—N. A.

The Filling of Bearings with Lead-Base Babbitts. A. N. Alimov (*Vestnik Metallopromishlennosti* (*Messenger of the Metal Industry*), **1930**, (5), 130–137).—[In Russian.] Non-porous homogeneous castings of lead-base Babbits containing more tin than antimony can be obtained by preheating the moulds to 150°. When the tin content does not exceed the antimony, good castings can be obtained by stirring the molten metal in the mould with an iron rod.—D. N. S.

"Rapidor" Gate Saw. Anon. (*Mech. World*, 1933, **94**, 789).—This new model gate-sawing machine is arranged so that the blade can cut the gate as nearly as possible flush with the casting.—F. J.

Position and Results of the Pressure Casting Method. W. Brunnckow (*Z. Metallkunde*, 1933, **25**, 190–194).—In pressure casting the melt is cast in permanent moulds under a high pressure. It shows the following three characteristics as compared with die-casting: (*a*) the molten metal is in a crucible outside the casting machine and the necessary quantity is added each time to the machine by means of a ladle; (*b*) the compressed air does not act directly on the melt, but by means of a press stamp; (*c*) at the moment of casting the melt is not fully liquid, but somewhat pasty, *i.e.* below the liquidus temperature. Pressure casting machines constructed by Eckert and Polàk are described. The mechanical properties of pressure castings of 60 : 40 brass, lead brass (58% copper, 2% lead), red-brass, and tin–lead bronze are compared with those of sand-castings and pressed bodies. The technical and economical limitations of pressure casting and pressing are discussed.—M. H.

Modern Casting Machines. Anon. (*Giesserei*, 1933, **20**, 94–96).—Illustrations with brief descriptions are given of new types of machines for making small pressure castings (chiefly for cast iron).—A. R. P.

The Dust Problem in the Foundry Industry. E. G. Meiter (*Amer. Found. Assoc. Preprint*, **1933**).—The importance of reducing the dust nuisance, particularly in regard to particles with largest dimension less than 10^{-3} mm. (which are liable to promote occupational diseases), is receiving serious study in the U.S.A., more especially on account of its legal aspect. Since, according to Stoke's law, such particles fall only 20·3 ft. in 24 hrs., a large amount of particles of this order of size is found in the ordinary foundry atmosphere. Samples for test are collected by causing a measured volume of air to impinge on a wet plate, which is revolved with its lower half in a water-bath. The collected dust is filtered through a 280-mesh sieve, and a microscopic count on a suitably ruled square is made of all particles of less than 10 microns largest dimension contained in an aliquot portion of the original sample. The reduction of silicosis should be brought about by reduction to within safe limits of air-borne dust and subsequent maintenance to ensure that this limit is not exceeded. Methods for removing light accumulated dust are discussed, such as: (1) washing off; (2) blowing off; (3) brushing, or (4) removal by vacuum, and the reduction of the formation and spreading of dust are discussed. Particular attention should be paid to (1) prevention of dust flying when floor-sweeping; (2) maintenance of dust-tightness of sand-blast and exhausting systems; (3) isolation, so far as practicable, of dusty processes; (4) suitable ventilation wherever possible, and (5) insistence on operators of equipment causing dust wearing respirators, helmets, &c. In a short discussion, various systems were discussed and vacuum-cleaning was advocated.
—R. B. D.

Keeping a Clean and Orderly Foundry. A. D. Lynch (*Amer. Found. Assoc. Preprint*, **1933**).—A brief review of practical details of the methods of carrying out the principles outlined in a paper by Meiter (preceding abstract).
—R. B. D.

Green-Sand Cores. Frank Whitehouse (*Iron and Steel Ind.*, 1933, 6, 399–401).—The relative advantages of dry-sand and green-sand cores are considered from the three essential aspects of reliability, quality, and cost. Green-sand cores, if properly made can be relied on, and are effective substitutes for dry-sand cores in green-sand moulds, but not in dry-sand moulds, and green-sand cores are also stated to be cheaper both to mould and fettle. The manufacture of green-sand cores is also considered in detail.—J. W. D.

Testing Foundry Sand. Anon. (*Mech. World*, 1933, 94, 819).—A brief note on the report on routine methods for testing green sands, issued by the Sands and Refractories Sub-Committee of the Institute of British Foundrymen. —F. J.

Modern Furnaces for Drying Cores and Moulds. H. Kalpers (*Maschinenkonstrukteur*, 1933, 66, 132–134).—The importance of drying conditions has increased with the prevalent use of oil in core-preparation: if a critical temperature, depending on the nature and amount of the binding material, is exceeded, the core is likely to crumble. Types of furnace for small and for larger work are described, with details as to fuel (gas, oil, coal, or coke), approximate dimensions and working temperatures.—P. M. C. R.

The Suitability of Certain Canadian Sands for Use in Sand-Blasting. L. Heber Cole, R. K. Carnochan, and W. E. Brissenden (*Canad. Dept. Mines, Mines Branch*, No. **727**, 1932, 1–41; and (abstract) *Canad. Mach.*, 1932, 43, (7), 46–50).—A series of tests in a commercial sand-blasting machine was made on certain Canadian sands, which were used on weighed steel plates of standard dimensions. Photomicrographs show the nature of the surface developed in each case, and also the character of all the original sands, as well as of certain sands after using. Testing conditions are described in detail, and results are tabulated together with shape, composition, lustre, and condition of sand after treatment. Granulometric analyses are also given. Angular grains appear to cut more quickly than rounded granules, and to give a more satisfactory surface for subsequent enamelling or painting. Within certain limits, fine sands are more efficient than coarse, and a slow feed increases cutting power.—P. M. C. R.

Determination of the Degree of Dispersion of Clay-Containing Moulding Sands. P. P. Berg (*Liteinoe Delo* (*Foundry Practice*), 1933, (1), 21–24).—[In Russian.] Of the two indirect methods used, determination of the degree of adsorption is preferable to determination of sp. gr. of the aqueous suspension. In the first method a procedure has been elaborated differing somewhat from those already known. A graph showing the relation between the clay content and the amount of moisture adsorbed for clay-containing sands from various deposits is given.—N. A.

The Determination of Clay Content in Moulding Sand According to A.F.A. Method (Theoretical Basis). K. Karlov (*Niimash Izvestia Nauchno-issledovatelskogo Instituta mashinostroenia i metalloobrabotki* (*Bulletin of the Scientific Research Institute of Machine Building and Metal Treatment*), 1933, (1), 41).—[In Russian.] The theories of precipitation, determination of the size of clay particles, importance of adding caustic soda, and estimation of clay content by Aulich's method are examined.—N. A.

Pattern Shop and Foundry Practice. Anon. (*Machinery* (*Lond.*), 1933, 42, 661–666).—A brief account is given of the equipment of the pattern shop and foundry of the works of G. and J. Weir, Ltd., Glasgow, and their production methods are outlined. Single castings up to 7 tons weight in cast iron and 6 tons weight in brass or bronze can be made—J. C. C.

Handling Materials in the Small Brass Foundry. D. G. Anderson and B. F. McAuley (*Mech. Handling and Works Transport*, 1932, 19, 237–239, 403–405).—A paper read before the American Foundrymen's Association, 1932; see *J.*, this volume, p. 42.—J. C. C.

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

(Continued from p. 571.)

Secondary Metal Output Lower in 1932 than in 1931. Anon. (*Daily Metal Reporter*, 1933, 33, (158), 6).—A decrease of 40% in the total production of secondary metal in the U.S.A. on the value for 1931 is recorded by the U.S. Bureau of Mines for 1932. The figures for copper, lead, zinc, tin, aluminium, antimony, and nickel and their principal alloys are analyzed for both years in a table.—P. M. C. R.

Scrap and the Lead Market. Samuel Tzach (*Eng. and Min. J.*, 1933, 134, 371–373).—An economic survey.—R. Gr.

Treatment of Platinum-Iridium Scrap. C. Campbell (*Sands, Clays, and Minerals*, 1933, 1, (4), 29–31).—Dry and wet methods for recovering platinum and iridium from scrap containing them alone or in admixture with other precious metals are briefly described. [*Note by abstractor*:—The methods described do not represent modern practice and the descriptions given are very poor.]—A. R. P.

The De-Tinning of Tinplate. Herbert Kurrein (*Chem.-Zeit.*, 1932, 56, 849–851; and (abstract) *Technique moderne*, 1933, 25, 491).—The reduction of tinned scrap to manageable proportions often renders parts of the material inaccessible to the solvent, with consequent loss of tin and poor quality in the recovered base material. This difficulty is eliminated by simultaneous rolling and perforation of the compacted scrap. Careful cleaning removes such adherent substances as paper, lacquer, paint, and previous contents of tins. The development of methods of preferentially attacking tin is traced. Chlorination, a highly favoured process, develops so much heat that product and residue may both suffer, and hence special methods of cooling are necessary. Other methods are: electrolysis in alkaline solution; the displacement of lead by tin in certain compounds, leading to the formation of a solution of sodium stannate for subsequent treatment; and the solution of the tin by direct contact with a more highly electro-negative metal, *e.g.* copper, and the separation of the dissolved tin by electrolytic or chemical precipitation.—P. R.

Baling Scrap Metal for Re-Use. Anon. (*Compressed Air Mag.*, 1933, 38, (7), 4177).—An electrically operated press is described for the baling of tinplate, round or flat wire, and other sheet- or thin-metal scrap. Details of working, capacity, and output are given.—P. M. C. R.

XV.—FURNACES AND FUELS

(Continued from pp. 575–577.)

FURNACES.

A Brief Review of Modern Applications of Heat to Various Non-Ferrous Furnaces. Gilbert Evans (*Met. Ind.* (*Lond.*), 1933, 43, 215–218, 239–241).—Describes and illustrates various types of reverberatory and reheating furnaces for non-ferrous metals, and discusses the selection of the fuel or the method of heating and the chief points to be considered in the design of the furnaces. —J. H. W.

Industrial Furnaces. J. S. Atkinson (*Fuel Economy Rev.*, 1933, 12, 24–30).—Recent developments in industrial furnaces are briefly reviewed. Amongst the subjects discussed are: continuous billet, ingot, and slab furnaces; soaking pits for ingots; normalizing furnaces, and rotary melting furnaces. —J. S. G. T.

Some Problems of Furnace Heating Practice. (Sir) Robert A. Hadfield and R. J. Sarjant (*Fuel Economy Rev.*, 1933, 12, 72–78).—Problems of furnace heating are reviewed, more especially from the points of view of the latest developments and the scope for improvement of current practice. Amongst the subjects discussed are: the economic position of competitive fuels, heat transmission, and control instruments.—J. S. G. T.

Fuel Comparison for Billet Reheating Furnaces. G. W. Akerlow (*Gas Age-Record*, 1933, **72**, 103–106).—The respective costs (dollars) per ton of reheating billets by furnaces fired with coal, oil, and gas are: coal, 3·13; oil 5·65; gas 5·13.—J. S. G. T.

Continuous-Type Furnaces Employed in Forging Aluminium Alloys. J. B. Nealey (*Iron Age*, 1933, **132**, 22, 23, 58).—The furnaces used in forging aluminium alloys are described and illustrated. The work is forged at 840° F. (450° C.), and the furnaces are gas-fired and automatic and continuous in both heat control and operation.—J. H. W.

Continuously Working Electric Furnaces. U. Aschmann (*Siemens Z.*, 1933, **13**, 135–141).—An illustrated description of modern continuous annealing furnaces, *e.g.* for strip, wires, ingots, lacquered articles, &c.—M. H.

Forced Air Circulation Electric Furnaces. Anon. (*Nickel Bull.*, 1933, **6**, 114–116).—The construction and operation of electric furnaces for low-temperature annealing using forced air circulation are described. Centrifugal fans are said to be superior to propeller fans for the air circulation. These types of furnace result in rapid heat transfer and enable the progress of the heat-treatment to be recorded by noting the temperature of the air entering and leaving the charge.—J. H. W.

Note on the Possibilities of the Electric Furnace in the Foundry. B. R. Bryne (*J. Inst. Locomotive Eng.*, 1933, **23**, 227–262; discussion, 262–269; and (abstract) *Locomotive*, 1933, **39**, 67).—A survey of the principal types of arc and induction melting furnaces is contained in the first part of this paper. The remainder deals principally with the use of the arc furnace for melting high-duty cast irons in the foundry.—J. C. C.

High-Frequency Melting Furnaces. D. H. Beckmann (*A.E.G. Mitt.*, **1933**, 111–115).—The principle of the high-frequency induction furnace is briefly considered, and suitable frequencies are quoted for various materials. The construction of transformer, furnace, and condensers is described and illustrated, and appropriate types of furnace are suggested for works and laboratory installations.—P. M. C. R.

Thermal Conductivity of Acheson Graphite. A. P. Crary (*Physics*, 1933, **4**, 332–333).—The thermal conductivity of Acheson graphite has been measured over the range − 150° C. to + 700° C. The conductivity decreases very slightly between − 150° C. and 200° C., and then more rapidly at higher temperatures. The law relating the thermal conductivity (K) with the temperature (T ° C.) proposed by Bidwell, *viz.* $K/aC = B + A/T$, in which aC is the atomic heat, and A and B are constants, is confirmed.—J. S. G. T.

Electric Arc and Arc Resistance Furnaces and Their Power Factor. Axel Wejnarth (*Trans. Electrochem. Soc.*, 1933, **63**, 309–343).—The subject is discussed theoretically and mathematically, and the conclusions have been confirmed by experiments on carbide and ferro-alloy furnaces.—A. R. P.

A Molybdenum Resistance-Furnace of New Design. G. Burrows and F. L. Clark (*J. Sci. Instruments*, 1933, **10**, 248–250).—Describes the design of a tube furnace using molybdenum resistance strips as heating elements. An input of less than 2 kw. increases the temperature to 1850° C., at which the furnace may be used continuously. Higher temperatures can be reached for a short time, but are limited by the available refractories, which are at present of alumina. Notes on refractories for high temperatures are given.—W. H.-R.

Modern Resistance Furnaces in Industry. E. Schmidt (*A.E.G. Mitt.*, 1933, 116–122).—The economy, durability, and easy control of resistance furnaces make them especially suited for heat-treatment; models intended for various temperature ranges are illustrated and described. Melting, soldering, and drying furnaces are also considered.—P. M. C. R.

On Silit II Heating Rods. Fr. J. Mann (*Siemens Z.*, 1933, 13, 155–158).—The properties of Silit and its use as a heating element in electric furnaces are discussed.—M. H.

FUELS.

Industrial Uses of Town's Gas. C. M. Walter (*Fuel Economy Rev.*, 1933, 12, 30–35).—The applications of town's gas to normalizing and annealing furnaces and as a fuel for transport work are briefly reviewed.—J. S. G. T.

Limits of Inflammability of Natural Gases Containing High Percentages of Carbon Dioxide and Nitrogen. G. W. Jones and R. E. Kennedy (*Amer. Gas J.*, 1933, 139, (2), 21–23).—In continuation of a previous part (*J.*, this volume, p. 576), tables are given for the composition limits of inflammability of methane, ethane, nitrogen, and carbon dioxide mixtures and of mixtures of propane with carbon dioxide and butane with nitrogen.—J. S. G. T.

Effect of Atmospheric Humidity in Gas Calorimetry. Francis Fahey (*Gas Age-Record*, 1933, 72, 149–152).—A formula and tables are given for determining the effect of atmospheric humidity on the calorific value of gases of nominal calorific value 210–2000 B.Th.U. per ft.^{3}.—J. S. G. T.

The Advantage of Clean Coal to Industry. R. A. Mott (*Fuel Economy Rev.*, 1933, 12, 6–8).—When the reduction in efficiency in the use of coal expressed in pence per ton, including the cost of transport of ash to and from the consumer's works, exceeds 6*d.* per ton, the reduction of ash content by coal cleaning is desirable. British coals are the most readily cleaned of all coals.—J. S. G. T.

XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from pp. 577–581.)

Refractory Materials for the Induction Furnace. J. H. Chesters and W. J. Rees (*J. Iron Steel Inst.*, 1931, 123, 479–494; discussion 495–500; also (abstracts) *Refractories J.*, 1932, 8, 283–286; and *S. African Eng.*, 1931, 42, 143–144). —The steep temperature gradient between molten metal and water-cooled coil demands from linings for induction furnaces of the coreless type a good sintering ability, high corrosion resistance, and low shrinkage. Methods of grading and testing lining materials are discussed. Factors tending to increase the durability of linings are: the use of materials of higher slag resistance; a reduction in the permeability of the material, by better grading or by attaining a higher sintering temperature; an improvement in the hot strength of the lining, effected either by the use of a bond, by the crystallization of the material, or by the interaction of 2 ingredients to form a bonding compound. The use of pre-burned materials is also discussed. Points raised in the discussion were the importance of heat-insulation, the relative merits of fritting-in and of pre-burning, the use of zircon, and the adsorptive energy of lining materials.—P. M. C. R.

Highly-Refractory Cements for Electric Furnaces. Anon. (*Compressed Air Mag.*, 1933, 38, 4109).—A description of two grades of magnesia cement for electric furnace linings. A cement for use with ferrous alloys gave 76 consecutive heats with a pouring temperature of about 1730° C.; another gives good results with high-copper and other non-ferrous alloys. The refractory consists mainly of the very pure Californian magnesite, carefully graded before the addition of special binding materials. The method of application is of great importance and is fully described.—P. M. C. R.

Relation Between the Alumina Content and the Temperature of Incipient Softening (of Refractories). Marcel Lepingle (*Chim. et Ind.*, 1930, Special No. (March), 320–331; *C. Abs.*, 1930, 24, 5450).—After discussing theoretically the effect of increasing Al_2O_3 contents in binary Al_2O_3–SiO_2 refractories, bringing out the practical impossibility of judging of the quality of a refractory merely from its total Al_2O_3 and Seger cone fusibility, results are given and discussed of tests carried out on samples of various compositions by the Hecht method (heating a cylinder 50 mm. high by 35·7 mm. in diam. under a constant load of 2 kg./cm.^{2} and noting the temperatures at which expansion ceases, at which the sample begins to give way, and at which the rate of collapse tends to infinity) and of compressive tests after heating for 1 hr. at 250°, 500°, 750°, 1000°, 1250°, and 1500° C. For all refractory products there is an "incipient fusibility" temperature which is scarcely indicated by the usual determination of the temperature of incipient softening. This temperature seems to depend on the content of fluxing agents, their distribution, and the ease with which vitrification can take place. Determination of the compressive strength after baking at various temperatures affords a method of determination, by comparison, of the quality and probable behaviour, in the fire, of different refractories.—S. G.

Refractory Material from Chrome–Steel Slag [Siemensit]. Anon. (*Compressed Air Mag.*, 1933, 38, 4178).—The physical and mechanical properties of Siemensit are described. See *J.*, this volume, pp. 210, 328.—P. M. C. R.

The Production of Dense Fireclay Masses by Mixing Fractions of Various Grain Sizes. Hans Pickler (*Tonind. Zeit.*, 1933, 57, 334–335, 356–357).—The density of products made from crushed and graded burnt clay depends on the fineness of the finest particles, on the distribution of grain-size in the various fractions, and on the amount of intermediate-sized fractions. Maximum density cannot be obtained by increasing the quantity of fine material in the mixture if the quantity of intermediate material exceeds a certain limit.—B. Bl.

Preparation of Articles Resistant to Slags from Magnesia and Alumina. Hermann Salmang and Nikolaus Planz (*Arch. Eisenhuttenwesen*, 1933, 6, 341–345).—Describes the best conditions for the manufacture of refractory slag-resisting crucibles of magnesia, alumina, spinel, and mixtures of 45% magnesia and 55% alumina and of 2% magnesia and 98% alumina.—J. W.

XVII.—HEAT-TREATMENT

(Continued from p. 582.)

Heat-Treatment of Aluminium Castings. Wirt S. Scott (*Metal Progress*, 1933, 24, (3), 21–24).—Uniformly high quality in light alloy castings necessitates not only good foundry practice, but also close temperature control and even heat distribution in subsequent heat-treatment. The responsibilities of the metallurgist with regard to existing heat-treating equipment are discussed. A pit-type electric furnace is described and illustrated, and the procedure in the case of alloys of aluminium 95, copper 5% is recorded. The furnace has shown a maximum variation in heat distribution of not more than ± 8° F. (4·5° C.) over a period of 2 years, with an operating temperature of 1000° F. (538° C.). The annealed castings show a tensile strength of 12·4 to 14·4 tons/in.^{2}, with elongation 8–12%.—P. M. C. R.

Cold-Treating Dural with Solid CO_2. Anon. (*Amer. Machinist (Eur. Edn.)*, 1931, 75, 439–441; and (abstract) *Technique moderne*, 1932, 24, 188–189).—The rapid age-hardening of Duralumin rendered it necessary to use rivets made of this material within 15 minutes after treatment. It was found that keeping the rivets at a low temperature retarded the hardening process; the results of ageing and storage at various temperatures are shown graphically. Various methods of rivet storage at low temperatures are described: the chilling medium most in favour is solid carbon dioxide. Possible developments of the method are outlined.—P. M. C. R.

The Tempering of Duralumin Sheet in Relation to the Time of Heating. N. V. Geveling (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1929**, (10), 640–650).—[In Russian.] The time necessary for complete heat-treatment of Duralumin sheet has been determined by: (1) direct measurement with a thermocouple of the temperature inside the specimen; (2) by the differential thermocouple, one junction of which was inserted into the specimen, and the other immersed in the heating bath, and (3) a complex thermo-electric system consisting of a Duralumin ribbon (an end of which was permanently immersed in the heating bath), the salt of the bath, and the specimen itself; on immersing the specimen in the bath a couple is formed between the salt and the specimen until the latter attains the temperature of the surrounding medium. By the first two methods sheets 0·3–0·6 mm. thick reached the temperature of the bath in 26–60 seconds after immersion and according to the third method 16–120 seconds. The time required for complete dissolution of $CuAl_2$ and Mg_2Si into solid solution has been determined from mechanical tests on similar sheets heat-treated at 485° C. for 15 seconds to 60 minutes, quenched, and aged for 7 days at room temperature. Annealing for 65 minutes before quenching was found to be necessary for obtaining the maximum ageing effect.—N. A.

On the Annealing of Duralumin. S. M. Voronov and P. A. Vargunin (*Tehnika Vosdushnogo Flota* (*Technology of the Aerial Navy*), **1931**, (12), 833–843; **1932**, (1), 40–57).—[In Russian.] Duralumin containing copper 4·35, manganese 0·90, magnesium 0·50, silicon 0·28, and iron 0·65%, was hot-rolled with 2 reheatings, from 50 mm. to 4·5 mm. sheet and then cold-rolled to 3 mm. without previous annealing. Subsequent cold-rolling to 0·4 mm. thick was carried out with intermediate annealing at 3, 1·5, 0·8 mm. The annealing temperatures were 300°, 350°, 375°, 400°, 450°, 475°, 500°, and 525° C., and the specimens were quenched after 1, 3, 5, 10, 15, 30, 60, or 180 minutes. Normal values for the mechanical properties of annealed Duralumin (tensile strength 23 kg./mm.^{2} and elongation 15%) are obtained after heating for 30 minutes at 325° C. or for 10–15 minutes at 350° C., respectively. The most reliable criterion of quality of Duralumin is the tensile test. Examination of the structure shows that the elongation of the Duralumin grains is preserved even after 3 hrs.' annealing at 525° C. In works' practice it appears that the best results are obtained with a preliminary heating to just above the "critical annealing temperature" (350° C.), rapid cooling to just below the normal annealing temperature, and holding this temperature for the appropriate time. This procedure reduces the annealing time to 50–60% of that generally required. A production technique is worked out and types of annealing furnaces are discussed.—N. A.

XVIII.—WORKING

(Continued from pp. 582–584.)

Investigation of Aluminium and Duralumin Tubes. I. U. Pedder (*Karelskiy Nautchno-Issledovatelskiy Institut* (*Scientific and Research Institute of Karelia*), **1933**, (2), 1–18).—[In Russian.] The wide and increasing uses of aluminium and aluminium alloy tubes in structural and mechanical engineering have caused greater attention to be paid to the problem of their strength and reliability. This investigation was accordingly carried out to determine: (1) the chemical composition; (2) the best methods of testing; (3) the reliability; (4) the macro- and micro-structures. The chemical composition of the aluminium tubes varied between iron, 0·39–0·70; silicon, 0·27–0·51; copper, trace–0·12%; and the composition of the Duralumin was copper, 4·27–4·60; magnesium, 0·55–0·70; manganese, 0·40–0·50; silicon, 0·12–0·24; iron, 0·37–0·52%. Reliability was tested by hydraulic pressure registered on a recording manometer. Examination of the structure revealed that the danger area of the tubes is the inner surface, which is always the first to develop cracks. These are almost invariably longitudinal in the case of aluminium, but are occasionally transverse in the case of Duralumin. There is also a tendency for minute cracks to develop first at points of local strain and these gradually spread. It is concluded that: (1) external flaws influence the mechanical properties of tubes; (2) the reliability both of aluminium and Duralumin tubes does not depend on the rate of change of internal pressure when the external pressure is unity; (3) reliability is not a constant value for tubes of the same material, but depends on the relation $n = \frac{R}{R_1}$ where R and R_1 are the internal and external radii respectively; (4) there is no apparent connection between reliability and tube thickness; (5) the thicker the walls of the tubes, the greater the amplitude of variation of the maximum pressure which can be borne by the tube; (6) destruction of the tube structure always starts near the fracture of the inner surface layers. It is recommended that the safety pressure be taken as half that recorded in the tests.—M. Z.

The Bending of Copper Tubing. Anon. (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1933, 9, 149).—Directions are given for the bending of copper tubing of varying forms and sizes.—P. M. C. R.

Temperature Control on Sheet and Tinplate Rolls. Anon. (*Fuel Economist*, 1933, 8, 666).—In connection with a previous paper on this subject (*ibid.*, 1933, 8, 489) attention is directed to the necessity for correct preheating of the rolls before use in order to reduce breakages.—J. S. G. T.

Adjustable Sheet-Straightening Machine. Anon. (*Mech. World*, 1933, 93, 290).—Sheets which require straightening frequently have local buckles which are difficult to remove. A new machine is illustrated and described which has adjustable rolls by means of which pressure can be applied as desired to part of the sheet.—F. J.

Nichrome Ribbon Manufacture. S. A. Pogodin (*Sobshenia Leningradskogo Instituta Metallov* (*Communications of the Leningrad Institute of Metals*), 1933, (13), 97–106).—[In Russian.] Suitable conditions for the manufacture of Nichrome ribbon (nickel 57, chromium 14–18, manganese 3, carbon 0·25, silicon 0·47, sulphur 0·03%, and iron the remainder) have been determined. The alloy is melted in a high-frequency furnace in graphite crucibles lined with magnesite, and cast at 1450° C. Before hot-rolling the 70–75 kg. ingots are heated at 900°–950° C. for 2–3 hrs., then at 1150° C. for not less than 2 hrs. The furnace is preferably oil-fired with sulphur-free oil so as to prevent contamination of the metal with sulphur. Rolling must begin at 1150° C. and finish at not below 950° C. Such a narrow rolling range necessitates the use of two- or three-high mills, or of continuous mills. The rolled sheets (3–4 mm. thick) are annealed at 1050°–1100° C. for 3 hrs. The sheets are then cold-rolled with intermediate annealings in a muffle furnace after every 4 passes. Before rolling and after every annealing the metal should be pickled at 60° C. in a 20% sulphuric acid containing 2% of potassium bichromate. The thickness is reduced from 3 mm. to 0·10 mm. in 19 passes; the last reduction not exceeding 0·05 mm. in order to obtain a ribbon of uniform thickness.—N. A.

On the Use of Phosphor–Bronzes for Wire. S. D. Tzypurdeev (*Metallurg* (*The Metallurgist*), 1932, 7, (12), 60–65).—[In Russian.] The difficulties of using phosphor–bronzes for the manufacture of wire, owing to the brittleness of the alloy at high temperatures are examined (cf. N. M. Nadejdin, *Metallurg*, **1931**, (8)). Various techniques of casting and rolling were tested, and the conclusions reached that existing methods of casting and hot-rolling are unsuitable, and that another type of alloy with similar mechanical properties should be employed. It is also suggested that the method of centrifugal casting might be advantageously employed.—M. Z.

A Note on the Effect of a Backward Pull Upon the Tension Required to Draw Wire. F. C. Thompson (*Iron Steel Inst. Advance Copy*, **1933**, 1–5).—Mild steel and 7% nickel-silver wires were drawn with a backward pull applied by a dead weight. As the back tension increased, the pull needed to effect the reduction increased in a linear relationship. This observation corrects a contrary statement previously made by T. and his associate. The results of similar tests carried out in the University of Sheffield are discussed.—J. H. W.

High-Speed Wire-Drawing. Anon. (*Mech. World*, 1933, **94**, 790).—A (British) wire-drawing machine is illustrated and described. It is suitable for drawing ferrous and non-ferrous metals to any dimension between 30 and 50 S.W.G. at drawing speeds up to 5000 ft. per minute. A variable-speed gear gives any spooling speed from 2000 ft. to 4000 ft. per minute at will while the machine is running.—F. J.

Wire-Drawing Dies. Richard Saxton (*Met. Ind.* (*Lond.*), 1933, **43**, 169–170).—The properties and applications of stone and of steel dies for wire-drawing are compared and the drawing angles found efficient in practice for various metals are given.—J. H. W.

Winding Machines with Constant Tension. K. Ruf (*Heraeus Vacuumschmelze* [*10th Anniv. Volume*], **1933**, 388–395).—Devices are described and illustrated by the aid of which fine wires and strip may be wound on reels at constant tension.—A. R. P.

Making a Seamless Neck. John Langton (*Mech. World*, 1933, **93**, 103–105).—The drawing of tapered-sided seamless shells always presents more difficulties than that of straight-sided shells, for which reliable empirical rules are available. A method described and illustrated has been tried in practice. —F. J.

Forging and Stamping Light and Ultra-Light Alloys. E. Decherf (*Aciers spéciaux*, 1933, **8**, 102–108).—Concludes the description of rough shaping, consisting of complete hammering of the initial billet, the stamping only requiring one pair of dies. Stamping flanged connecting rods in steel and in a light alloy are compared and the use of rough stamping dies for this purpose is described. See *J.*, this volume, p. 214.—J. H. W.

Close Limits on Machine Forging Work. S. A. McDonald (*Mech. World*, 1933, **93**, 599–601).—The utility and advantages of the forging-machine (as distinct from the drop-forge) are discussed.—F. J.

Small-Screw Production. H. Bentley (*Mech. World*, 1933, **93**, 624–625).—Considerable development has taken place during recent years in methods of manufacturing screws up to ⅛-in. in diam. Cold-forging and finishing machines are being used to an increasing extent for the production of the various types of small steel and non-ferrous metal screws, these machines being used for heading, nicking, and thread rolling, and tests made on the finished products have shown them to be equal in strength to screws produced by hot-forging or by turning from the solid bar. The cold-heading, slotting, and screwing operations are described.—F. J.

Tools for Aluminium. Anon. (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1933, **9**, 139–140).—Suitable modifications in the adjustment and cutting angle of tools, as well as in lubrication, must be made in order to obtain the best results in machining aluminium and its alloys. Directions are given for setting and selection of tools for cutting, drilling, grinding, sawing, and threading.—P. M. C. R.

Recent Investigations in Theory of Metal Cutting. Friedrich Schwerd (*Amer. Soc. Mech. Eng. Preprint*, 1933,).—In order to study the formation of the "built-up edge" which occurs in metal cutting, a special method of lighting and photography has been developed. The source of light was obtained by a discharge of condensers at a tension of 50,000 v. and with instantaneous currents of from 10,000 to 20,000 amp. By this means instantaneous exposures of 0·000001 second are possible.—W. P. R.

Cemented Carbide Cutting Tools. Malcolm F. Judkins (*Amer. Soc. Mech. Eng. Preprint*, 1933).—J. gives photomicrographs of typical carbide compositions in use at present. Relatively large differences in depth of cut produce only a slight shortening of tool life, but small differences in the amount of feed per revolution shorten the tool life considerably.—W. P. R.

The Economic Uses of Cemented Carbide and Other High-Duty Alloy Tools. J. H. Garnett and E. W. Field (*J. Inst. Production Eng.*, 1933, **12**, 224–251; discussion, 252–266).—A description is given of the characteristics and methods of manufacturing tungsten carbide, molybdenum–titanium carbide, and Stellite (cast cobalt–chromium–tungsten alloy). In connection with cutting-tool practice, a review is given of shank materials, tool shapes, and cutting methods. Detailed comparisons are made between the cost of machining with cemented carbide and high-speed steel tools on typical classes of work. Examples of the successful application of cemented carbide tools are quoted.
—J. C. C.

Oils for Use in the Cutting and Drilling of Metals. Walter Reichel (*Maschinenbau*, 1933, **12**, (3), 61–66).—v. G.

XIX.—CLEANING AND FINISHING

(Continued from pp. 584–585.)

Modern Methods of Cleaning Metals. C. J. S. Warrington (*Canad. Chem. and Met.*, 1933, **17**, 77–78).—Pickling baths for removing scale and oxides with inhibitors for preventing dissolution of the metal, and degreasing by organic solvents are discussed.—A. R. P.

Use of Chlorinated Solvents in Degreasing Metallic Articles. Anon. (*Galvano*, 1933, (15), 15).—Some details of the trichlorethylene vapour cleaning process are given.—E. S. H.

Apparatus for Degreasing Metallic Articles with Trichlorethylene. Anon. (*Galvano*, 1933, (16), 19–21).—The apparatus and cleaning procedure are described.—E. S. H.

Use of Chlorinated Solvents for Cleaning Metallic Articles. Anon. (*Galvano*, 1933, (14), 17–18).—The advantages of the trichlorethylene process are discussed.—E. S. H.

The Pickling of Metals. Anon. (*Heat-Treat. and Forging*, 1931, **17**, 959–960, 965; and (abstracts) *Mech. World*, 1932, **91**, 39–40; *Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 44–45).—Sulphuric acid is the most usual pickling medium; the questions of concentration, de-greasing, acid consumption, maintenance of acid bath, temperature, pickling time, the use of inhibitors, and possible substitutes for sulphuric acid are considered. Adjustments of bath concentration for certain materials are indicated, with corresponding temperature range and allowing for the effect of inhibitors. Some average pickling times are given, but these are subject to modification owing to surface condition of material, varying accessibility to pickling fluid, and handling arrangements.—P. M. C. R.

Chemical Coloration of Brass. [Georg Gross] (*Galvano*, 1933, (11), 25–26).—Translated from *Metallwaren-Ind. u. Galvanotech.*, 1932, **30**, 455; see *J.*, this volume, p. 279.—E. S. H.

Sand Blast for Cleaning Metal Surfaces. A. S. Jamieson (*Power Plant Eng.*, 1933, 37, 398).—The advantages of a portable sand-blasting plant are enumerated, and suitable working pressures, nozzle materials, receptacles, and protective measures are indicated, together with a variety of applications.—P. R.

XX.—JOINING

(Continued from pp. 585–590.)

Light Metal Rivets. K. Guler (*Z. Metallkunde*, 1933, 25, 214–217).—(1) Sheets and profiles of aluminium alloys should always be riveted with rivets having the same or only slightly different composition, otherwise severe corrosion takes place due to potential differences. This is shown by corrosion experiments in sea-water with Avional and Duralumin sheets riveted with Avional, Duralumin 681a, and Duralumin 681n. Rivets of the latter, with a composition different from that of the sheets, were practically completely destroyed by intercrystalline corrosion. (2) The influence of annealing and ageing on the mechanical properties of Avional (silicon 0·3–0·6, iron 0·3, manganese 0·5, magnesium 0·55, copper 3·8, aluminium 94·4%) and Anticorodal (silicon 1·0, iron 0·3, manganese 0·7, magnesium 0·65, copper 0·1, aluminium 97·25%) is described and shown graphically. Avional is quenched at 490°–510° C. and age-hardened at room temperature, whereas Anticorodal must be quenched at about 550° C. and aged at 130°–160° C.—M. H.

Rivets for VLW Light Alloys (Lautal and Bondur). Anon. (*Z. Flug. u. Motor.*, 1933, 24, 210).—A summary of Leaflet No. 42, published by Vereinigte Leichtmetall-Werke, Bonn. Directions are given for the use of rivets in Bondur, Lautal, Pantal, Scleron, Albondur, Allautal, KS-Seewasser, BS-Seewasser, Mangal, and Silumin.—P. M. C. R.

The Application of the Hydrogen Brazing Method to the Manufacture of Internal Combustion Engines. Fr. Sass (*J. Amer. Soc. Naval Eng.*, 1933, 45, 330–343).—A method for connecting steel parts by welding them with copper in a hydrogen atmosphere is described, where the welding material is a copper–nickel–zinc alloy with a melting point of approximately 1150° C., as such an alloy is found to give a better joint than pure copper. The process is carried out in a special electric furnace, in which a hydrogen atmosphere is maintained, with the result that parts are obtained which are entirely free of scale, and, being automatically annealed by the brazing process, are also free of internal stress. The furnace and the process are described in detail, together with the manufacture of such parts as cylinder covers, piston heads, and fuel lines of Diesel engines.—J. W. D.

On the Choice of Solder for Aluminium. M. O. Kornfeld (*Vestnick Elektropromishlennosti* (*Messenger of the Electrical Industry*), 1932, (1), 19–20).—[In Russian.] Joints which are exposed to moisture should be made with high-melting solders such as aluminium–zinc or aluminium–silicon alloys. Low-melting solders are useful only if the joint is protected from moisture; the best solders for this purpose are pure zinc or zinc with 5% aluminium.—N. A.

The Arc Welding of Aluminium and Some Properties of the Welded Metal. L. Anastasiadis (*Z. Metallkunde*, 1933, 25, 97–98, 141).—Theoretical considerations with regard to the electric arc welding of aluminium with the aid of a suitable flux are put forward. Practical hints for butt-welding which proved to be most suitable are dealt with. Successful experiments were carried out with commercial aluminium and aluminium containing 5% silicon. Photomicrographs of welded joints are given. The joint of a butt-welded aluminium sheet (8 mm. thick) had a tensile strength of 15 kg./mm.^{2} and an elongation of 25%, compared with 15 kg./mm.^{2} and 40% for the soft sheet.—M. H.

The Welding of Aluminium. Werner Fröhlich (*Canad. Chem. and Met.*, 1933, 17, 56–58, 79–80).—The factors which affect the resistance to corrosion and strength of welds in aluminium and its alloys are discussed. Methods of welding and suitable fluxes and welding rods are described.—A. R. P.

Joints in Aluminium Pieces. Anon. (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*, 1933, 9, 137–139).—The following welding and joining processes are reviewed: hammer-welding, (gas) fusion welding, spot, seam and butt-welding, soldering, and riveting. The aluminium oxide skin necessitates the use of fluxes, or of the chlorine–hydrogen flame, in gas welding; practical directions are given for various types of work, and for the subsequent treatment of joints. The special applications of the different electrical processes are considered, as are those of soldering; the latter is of especial value in the repair of casting defects. Approximate compositions and properties of soldering alloys are given. Riveting is stated to be especially applicable to aluminium and its alloys, affording in certain cases the only practicable method of joining.—P. M. C. R.

Welding Castings in Light Alloys of Aluminium. Anon. (*Soudeur-Coupeur*, 1933, 12, (4), 8–9).—Some general advice on the welding of castings is given and 4 examples are illustrated with particulars of the welding technique used in each case.—H. W. G. H.

Ultra Modern. Anon. (*Oxy-Acetylene Tips*, 1933, 12, 39).—Describes the repair, by oxy-acetylene welding, of a cast aluminium ornamental plaque, 4 ft. in diameter.—H. W. G. H.

Welded Aluminium Sheet-Metal Work. Anon. (*Soudeur-Coupeur*, 1933, 12, (4), 5–7).—Twenty examples are illustrated and brief particulars given.
—H. W. G. H.

Welding Aluminium. Anon. (*Soudeur-Coupeur*, 1933, 12, (4), 4).—Hints on technique are given.—H. W. G. H.

The Indispensable [Aluminium] Flux. Anon. (*Soudeur-Coupeur*, 1933, 12, (4), 1–3).—Describes the effects of the alumina film on weldability and the invention of the first effective flux by Paul Odam. It is emphasized that the manufacture of such a flux requires great care, particularly to ensure complete dryness of the constituents.—H. W. G. H.

Repair by Welding of Locomotive Copper Tube Plates. Anon. (*Soudeur-Coupeur*, 1933, 12, (3), 1–4).—For a successful repair, the essentials are: good preparation for welding, rapid working, absolutely regular functioning of the blowpipes, and thorough hammering of the weld metal and the neighbouring parent metal until almost cold. Two large (about 3000-litre) blowpipes, fitted with hand shields, are used, and the filler rods, about ¼ in. diameter, are of pure copper, sometimes containing a little phosphorus. No flux is used. The special technique employed is fully described in this article, which is illustrated by photographs of repairs in various stages of execution—H. H.

Tests Tell the Story. Anon. (*Oxy-Acetylene Tips*, 1933, 12, 82–83).—For carrying potash solution, copper piping with bronze joints was found mechanically and chemically suitable. The bronze welding rod was more economical and easy to use than copper rod.—H. W. G. H.

Improvements.—Oxywelding of Brass and Bronze Improved by Correct Flame Adjustment. Anon. (*Modern Eng.*, 1932, 6, 317–319).—From *Oxy-Acetylene Tips*, 1932, 11, 119–122; see *J.*, this volume, p. 398.—H. W. G. H.

The Oxy-Acetylene Welding of Lead. R. Meslier (*Rev. Soudure autogène*, 1931, 23, 2414–2415; and (translation) *Mech. and Welding Eng.*, 1932, 6, 72–73).—The technique of oxy-welding lead can be readily acquired by a moderately skilled worker, and welded lead structures, several of which are illustrated, are not subject to hair-cracks, slag inclusions or other common defects. The preparation of lead sheet for horizontal, vertical, and inclined welding is described.—P. M. C. R.

Arc Welding of "Nickel-Clad" and "Monel-Clad" Steel Sheets. Rud. Müller (*Elektroschweissung*, 1932, 3, 229–230).—The steel side of the sheet is welded first, in the usual way, penetration being intentionally incomplete. After careful cleaning of the deposited metal, flux-coated nickel or Monel metal electrodes are used to complete the weld from the opposite side. For thin sheets, the complete weld may be made of the nobler metal. The Arcatom process is also used with success. It is important to avoid, as far as possible, contamination of the nickel or Monel metal deposit with iron. This can be detected by placing over the seam a strip of blotting paper soaked in concentrated ammonia and leaving it for some days in the air.—H. W. G. H.

New Method of Welding the Extra-Hard Alloy "Pobedit."—I. G. E. Varshavski (*Neftjanoe Khoziastvo* (*Oil Economy*), **1932**, (12), 24–32; *Brit. Chem. Abs.*, **1933**, [B], 672).—[In Russian.] The manufacture of Pobedit, a solution of tungsten carbide (WC) in cobalt, is described. The metal is welded to the drill with yellow copper and $Na_2B_4O_7$.—S. G.

The Welding of Drills with the Alloys "Wokar" and "Pobedit." V. S. Fedorov and N. G. Postarnak (*Neftjanoe Khoziastvo* (*Oil Economy*), **1933**, (2), 109–112).—[In Russian.] A critical examination, based on experimental data, of the instructions for welding super-hard alloys.—N. A.

Galvanized Piping. Anon. (*Oxy-Acetylene Tips*, 1933, **12**, 133–135).—Except in piping exposed to highly corrosive agents such as dilute acids or alkalis, welded or bronze-welded joints in galvanized pipe have been found to be entirely satisfactory in practice. Even though the galvanizing is removed to some extent in welding, the exposed metal is more highly resistant to corrosion than that of a threaded joint.—H. W. G. H.

The Welding of Non-Ferrous Metals. Ernst Greger (*Z. Öster. Ing. Arch. Vereines*, 1933, **85**, (29/30), 161–163).—The principles of the various methods of welding copper, aluminium, and their alloys, as well as nickel, silver, and lead, are briefly discussed.—J. W.

The Resistance Welding of the Non-Ferrous Metals. M. von Schwarz and F. Goldmann (*Z. Metallkunde*, 1933, **25**, 142–143, 194–196).—(1) The methods, process, and practice of resistance welding (spot-, seam-, butt-, and edge-welding) are discussed. (2) The absolute tensile strength and the specific shear strength of spot-welded joints of age-hardenable aluminium alloys (experiments were carried out with Duralumin) can be increased by thermal after-treatment (ageing), the increase of the former being the higher the thicker the sheet. Spot-welding of age-hardenable aluminium alloys can be performed in such a way that the strength of the joint is considerably increased without after-treatment. This is due to the complex nature of the age-hardening phenomena and the special features of the spot-welding method.
—M. H.

Modern Machines for Electric Resistance Welding. H. Wilbert (*Siemens Z.*, 1933, **13**, 153–155).—Machines for butt-, seam-, and spot-welding are described.—M. H.

Development of Electric Spot-Welding Machines. E. R. Ruck (*A.E.G. Mitt.*, **1933**, (4), 122–125).—Several spot-welding installations are described and illustrated, together with an automatic control apparatus.—P. M. C. R.

The Modulator Process—a New Method of Seam Welding. E. Rietsch (*A.E.G. Mitt.*, **1933**, (4), 125–128).—The Modulator process permits seam-welding to be carried on with uninterrupted current but with intermittent feed. The modulator, a single-phase transformer, neutralizes fluctuations in current arising from local supply or from variations in the section or surface of the material. The apparatus is therefore applicable to thin or thick sheet with no special surface preparation, and the method can be applied to copper, aluminium, and brass as well as to iron and steel.—P. M. C. R.

Concerning Stress Distribution in Fillet Welds. Otto Mies (*Elektroschweissung*, 1932, **3**, 141–147).—Theoretical analysis of stress distribution in fillet welds is followed by calculation of the best shape of fillet in the light of M.'s conclusions.—H. W. G. H.

Concerning the Distribution of Stresses in Weld Seams. —— Pilgram (*Elektroschweissung*, 1932, 3, 231–233).—A short theoretical analysis.—H. H.

Correct Measurement of Weld Seams. Hans Schmuckler (*Elektroschweissung*, 1932, 3, 211–212).—A weld gauge and scriber are described. The former can be used to measure the reinforcement of butt welds and also the " throat " and " leg length " of fillet welds by means of three graduated slides. The scriber is designed for scribing the " leg lengths " of large fillet welds. It is pointed out that the gauge measures the true effective " throat " of fillets of unequal " leg length."—H. W. G. H.

A New Weld Gauge and Scriber. E. P. S. Gardner (*Elect. Welding*, 1933, 2, 178–179).—Describes the gauge and scriber designed by Schmuckler (see preceding abstract).—H. W. G. H.

Standard Equipment for Contact Electrowelding Manufactured by the " Elektrik " Works. A. I. Ahun (*Vestnick Elektropromishlennosti* (*Messenger of the Electrical Industry*), 1933, (2–3), 2–5).—[In Russian.] A brief description of the equipment supplied by the " Elektrik " Works according to the 1932 schedule.—N. A.

Gas Absorption During Welding Studied in Controlled Atmosphere. Anon. (*Automotive Ind.*, 1933, 69, 190).—A special welding hood with controlled atmosphere is used by the Westinghouse Electric Manufacturing Co. in a study of nitrogen absorption by welds. Absorption is greater with low proportions of nitrogen than when the welding atmosphere contains 98% of the gas; it is therefore assumed that the nitrogen is absorbed in the form of one of its oxides.—P. M. C. R.

Automatic Arrangements for Carbon Arc Welding. Carl Ritz (*Siemens Z.*, 1933, 13, 150–153).—A brief illustrated description of some welding apparatus for special purposes.—M. H.

Maintenance Costs Cut by Arc Welding. A. F. Davis (*Gas Age-Record*, 1933, 72, 129–130, 134).—Repairs by arc welding are exemplified and illustrated.—J. S. G. T.

The Physics of Electric Arc Welding. Anon. (*Mech. World*, 1933, 94, 725–727).—In producing a stationary arc the ability of a hot cathode to emit electrons is utilized. The stream of electrons disrupts the air and increases the conductivity of the gap. The voltage required to maintain the arc is low and depends on the material, the arc-length, and the magnitude of the current. For arc-welding with alternating current of common frequencies, flux-coated electrodes are used in order to keep the arc stable.—F. J.

Automatic Arc-Welding Machines by the A.E.G. E. Thiemer (*A.E.G. Mitt.*, 1933, (4), 129–131).—Recent types of welding head carrying, respectively, tungsten and carbon electrodes are described and illustrated.—P. R.

Machine Welding by the Arcatom Process. E. Thiemer (*A.E.G. Mitt.*, 1933, (4), 131–133).—The welding head described carries two tungsten electrodes, and is said to be suitable for the welding of all classes of metal. There is less general heating of the material than in the autogenous welding process, and the protective hydrogen flame is so adjusted that there is no wastage of gas. A special application to the welding of tubes is illustrated.—P. R.

Electric Welding in England. Henry E. Metkaf (*Vestnick Ingenerov i Tehnikov* (*Messenger of the Engineers and Technologists*), 1933, (3), 101–105).—[In Russian.] The following subjects are discussed: electrodes; designs of welded articles; training of welders and equipment of shops; electric welding in shipbuilding, and in machinery, automobile, and locomotive construction. —N. A.

Electrical Welding Equipment. Anon. (*Vestnick Elektropromishlennosti* (*Messenger of the Electrical Industry*), 1933, (2–3), 5–6).—[In Russian.] New Russian types of apparatus are described.—N. A.

Comparative Study of Oxy-Acetylene and Arc Welding. R. Meslier (*Rev. Soudure autogène*, 1933, 25, 2678).—A short introduction emphasizes that the choice of welding method often depends on local conditions which this preliminary article does not pretend to discuss. Although each case must be studied on its own merits, the general principles may be outlined. The nature of the metal to be welded is the first consideration, and the acetylene process is preferred for non-ferrous metals and cast iron. For steels, the choice of process is governed by other factors such as the works facilities, the properties required in the weld, the preparation of the parts to be welded, the type and position of the welds, the possibility of deformation, and the thickness and size of the articles to be welded. Where water-tightness is required, for example, the oxy-acetylene process gives the best results, but difficulty is found in welding internal angles, where the arc process is ideal, as also in all cases where the preparation of the work allows for fillet welding. Vertical and overhead welding is more easily accomplished by oxy-acetylene, but the arc process usually produces less distortion. Very heavy masses and very thick sheets can be welded only by the arc method, but very thin material is more easily welded with the blowpipe. The immediate fusion produced by the arc makes it superior where short runs of welding are necessary, as in structural work. [*Note by abstractor.*—Subsequent articles in this series deal with specific examples of welded work, for which the two processes are compared. These examples are, however, all ferrous.]—H. W. G. H.

Noteworthy Progress. Anon. (*Oxy-Acetylene Tips*, 1933, 12, 5–9).—A review of oxy-acetylene developments during 1932, containing brief references to the economy of oxy-acetylene welding for thin aluminium and the use of an oxidizing flame for brasses and bronzes. Mention is made of the increased importance of testing, procedure control, and the education of welders.—H. H.

Innovations and Tendencies in Autogenous Welding. R. Granjon (*Rev. Soudure autogène*, 1933, 25, 2750–2758).—A general survey of new ideas and tendencies is followed by a more detailed description of improvements in equipment for both arc and blow-pipe welding. Diagrams, photomicrographs, and photographs illustrate the article.—H. W. G. H.

A New Medium for Protected Gas Welding. Anon. (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1933, 9, 163).—Certain metallic carbonyls find advantageous application in "protected" gas-welding processes, as they evolve a relatively large volume of carbon monoxide in proportion to an almost negligible residue of metal, thus affording efficient protection for the weld together with the minimum of contamination. Iron pentacarbonyl is especially recommended, but the carbonyls of nickel, uranium, chromium, and vanadium are also successfully used. Hydrocarbons, certain of the higher alcohols, or waxes may be used as binding material for solid carbonyls, and metallic powders may be added to carbonyls for introduction into the weld.—P. M. C. R.

Brewers Modernize Their Equipment. Anon. (*Oxy-Acetylene Tips*, 1933, 12, 149–153).—The use of the oxy-acetylene process for repair work and installation of new equipment are described. The principal non-ferrous metals concerned are aluminium, copper, and lead.—H. W. G. H.

The Design of Jigs and Fixtures for Welding. Anon. (*Oxy-Acetylene Tips*, 1933, 12, 101–107).—The importance of well-designed jigs and fixtures for production work is emphasized. Many useful designs are illustrated and typical applications described.—H. W. G. H.

Carbon Shapes and Paste. Anon. (*Oxy-Acetylene Tips*, 1933, 12, 41).—The use of carbon blocks, rods, sheet, and paste, particularly in repair work, is described.—H. W. G. H.

Draft Regulations Relative to the Classification, Construction, Use, Examination, and Testing of Acetylene Generators. —— (*Rev. Soudure autogène*, 1933, 25, 2758–2762).—These suggested regulations have been drawn up by a

Committee of the Chambre Syndicale de l'Acétylène et de la Soudure Autogène and are published in order to give opportunity for criticism, which is invited.
—H. W. G. H.

Method of Testing Low- and High-Pressure Hydraulic Valves for Safety against Back-Flow of Oxygen and Carrying-Over of Water. Eduard Sauerbrei and Gottfried Lottner (*Autogene Metallbearbeitung*, 1932, 25, 17–21).—An apparatus is described by which hydraulic back-pressure valves may be subjected to every mishap which could occur in working. The behaviour under sudden back-pressure of oxygen, pressure-volume relationships for different inlet pressures, the permissible speed of flow for different inlet pressures without sucking in of air, and, indeed, all characteristics can easily be determined.
—H. W. G. H.

Safe Storage of Cylinders and Carbide. Anon. (*Oxy-Acetylene Tips*, 1932, 11, 137–138).—An explanation of the principles underlying the regulations issued by the [U.S.] National Board of Fire Underwriters.—H. W. G. H.

For Teaching Autogenous Welding and Oxy-Cutting. M. Coutourier (*Rev. Soudure autogène*, 1932, 25, 2773–2775).—In a preliminary discussion on teaching welding, it is emphasized that scientific manual training is highly essential. Two aids to this are then described. These consist of specially designed work-benches, one for welding and the other for cutting. The first permits of holding small articles in all conceivable positions to give practice in every type of weld, and the second provides for training in both hand- and machine-cutting.
—H. W. G. H.

The Teaching of Autogenous Welding. A. Desmarges (*Bull. Soc. Ing. Soudeurs*, 1932, 4, [illegible]).—An account of the facilities available in France for obtaining tuition in welding.—H. W. G. H.

Oxy-Acetylene Welding Blowpipes with Several Flames for Hand Operation. E. Zorn (*Autogene Metallbearbeitung*, 1932, 25, 9–15).—A long description of two types of double-flamed "Griesheim" blowpipes. In the first, which is used for material of thickness 2–4 mm., the auxiliary flame preheats the work, and in the second, used for thicker material, the auxiliary flame preheats the welding rod. Both are used "right-hand," and considerable advantages are claimed in ease, quality, and speed of welding.—H. W. G. H.

Examination of Cutting Nozzles by Optical Means. P. Sam (*Rev. Soudure autogène*, 1932, 24, 2544).—Abstracted from an article by H. Melz and H. v. Conrady, *Autogene Metallbearbeitung*, 1932, 25, 283–287.—H. W. G. H.

Sheet Welding in Production. Earl Kelsey (*Welding Eng.*, 1932, 17, (4), 42–43; and (abstract) *Welding News*, 1932, 3, 24–25).—From a paper presented at Purdue University Welding Conference, Dec. 11, 1931. Acetylene welded joints are found particularly suitable for work which is subsequently to be enamelled. Butt-welding or certain of its modifications are almost invariably employed. Suitably designed jigs are employed to control or direct the expansion and contraction of the material, to facilitate handling, and to increase the speed of production; an example of their use is described. Certain details of welding practice are emphasized, and methods of finishing and testing are briefly indicated.—P. M. C. R.

Recent Developments in the Manufacture of Welded Structures. L. Miller (*Trans. Manchester Assoc. Eng.*, 1931–1932, 81–111; and (abstract) *Mech. World*, 1932, 91, 104–107, 125; discussion, 112–125).—A continuation of a paper read before the Association in 1929 (*ibid.*, 1928–1929, 119–148; this *J.*, 1930, 44, 665). The paper deals mainly with ferrous materials, but is of general interest; it deals with the economies effected by adopting welded construction, the necessary modifications of design, the training of welders, the development of apparatus and technique, and some examples of welded structures.—P. M. C. R.

Carbon Dioxide as Flame Preventer in Welding. Floyd Sandell (*Oil Weekly*, 1933, 70, (3), 24).—The execution of oil-tank repairs by fusion welding involves either expensive cleaning or great danger from the ignition of explosive gases. The injection of carbon dioxide into containers needing repair is found to prevent ignition even when acetylene torches are employed.—H. H.

Conventional Representation of Welds on Drawings. Association Belge de Standardisation (*Soudeur-Coupeur*, 1933, 12, (3), 6–12).—This report is published by a sub-committee appointed by the A.B.S. to work in conjunction with the main committee for designs and technical documents. The work of the committee is described and its proposals, subject to modification, are fully and clearly illustrated. They cover all methods of welding and all types of weld, and include both definitions and symbols.—H. W. G. H.

XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 536–537.)

New Uses of Binary Alloys of Aluminium and Magnesium. Anon. (*Alluminio*, 1933, 2, 168).—A note on some new aluminium alloys of the Magnalium type. Hydronalium, Duranalium, BS-Seewasser, contain 7–10% magnesium, 0·2–0·6% manganese, and have good mechanical and chemical properties (cf. J., this volume, 490, 549).—G. G.

Aluminium v. Tinplate for Fish Canning. Anon. (*Canning Ind.*, 1933, July; and *Aluminium Broadcast*, 1933, 4, (11), 13–14).—Experimental packs of various fish have shown no signs of hydrogen swells after storage for periods up to 3½ yrs. when the fish were first properly dried. The amount of aluminium dissolved in the contents varied from 10 to 100 parts per million.—J. C. C.

The Use of Aluminium in the Construction of Hydrogen Peroxide Bleaching Machinery. H. Tatu (*Rev. Aluminium*, 1933, 10, 2079–2086).—As the result of a series of experiments, aluminium is considered a very suitable material for the construction of bleaching machinery using hydrogen peroxide. The tests consisted in comparing the resistance of aluminium with that of other commonly used materials, such as glass, porcelain, iron, and copper, to the action of dilute alkali solutions, bleaching baths and hydrogen peroxide. The construction of the machinery in aluminium is described.—J. H. W.

The Use of Light Metals in Salt Works. E. Siegmund (*Metallwirtschaft*, 1933, 12, 91–92).—The aluminium alloys KS-Seewasser and the somewhat harder BS-Seewasser have shown a very good resistance to corrosion in salt works.—v. G.

Aluminium in the Cotton and Wool Industries. J. R. Whitelegg (*Textile Manufacturer*, 1933, June, July; and (reprint) *Aluminium Broadcast*, 1933, 4, (10), 8–16).—The characteristics of aluminium and aluminium alloy sheet, and of the aluminium casting alloys are described, and a detailed account is given of their applications in textile machinery.—J. C. C.

Technical and Constructive Treatment of Light Metals. W. Zarges (*Metallwirtschaft*, 1933, 12, 59–62).—Technological considerations for the use of light metals in constructional parts.—v. G.

Light Metal-Alloy Pistons and Rods in High-Speed Industrial Engines. Benedict J. Isidin (*Trans. Amer. Soc. Mech. Eng.*, 1931, 53, 109–115; and (abstract) *Marine Eng.*, 1931, 54, 349–350).—A paper read before the Oil and Gas Power meeting of the Society. Suitable aluminium alloys used for pistons and piston rods preserve the necessary rigidity required and overcome thermal difficulties, and such parts operate cooler and give better performances than when iron and steel alloys are used. Cast and heat-treated alloys are recommended for pistons and strong wrought alloys for connecting rods, and a saving in weight of 50 and 40%, respectively, is obtained in these parts when compared with ferrous materials. Problems in piston design such as (1) estimation of heat absorbed by piston head; (2) determination of thermal stresses; (3) determination of stresses due to explosion pressure; and (4) proper provision for heat transfer from head to rings and piston skirt are also fully discussed in relation to aluminium alloys.—J. W. D.

Duralumin Applied to Aircraft Construction. W. H. Lewis (*J. Roy. Aeronaut. Soc.*, 1933, 37, 681–693).—The composition, heat-treatment, and age-hardening of Duralumin are discussed. Corrosion properties and methods of protection against corrosion are mentioned, special reference being made to anodic oxidation. The properties and advantages of Duralumin as a structural material for aircraft are discussed in detail, and stress values are given. Typical forms of construction are illustrated.—H. S.

Hull and Float Maintenance. J. Jarvis (*Aircraft Eng.*, 1933, 5, (48), 27–30).—Reference is made to the working of Duralumin, Alclad, and " stainless " steels in the construction and maintenance of hulls and floats in these materials. Riveting and defects produced in riveting are described in detail. Methods of protection are described briefly.—H. S.

Fast Light Cruisers of Recent Construction. —— Bunje (*Allégement dans les Transports*, 1933, 2, (9–10), 116–118).—A brief description of the customs cruisers " Brumuser " and " Bremse," of which the superstructure, machinery, foundations, framework, and partitions are of V.L.W. light alloy. —R. B. D.

Axle Boxes in Light Alloys. M. Hug (*Allégement dans les Transports*, 1933, 2, (9–10), 111–116).—Tests made of railway axle-boxes cast in various aluminium alloys by repeated blows with 50 kg. weights followed by blows with a heavy drop hammer suggest the possibility of a new application of light alloys. Boxes in certain alloys are now being tested in service.—R. B. D.

The Pullman Aluminium Car. P. Parke (*New York Railroad Club Proc.*, 1933, May; and *Aluminium Broadcast*, 1933, 4, (11), 2–8).—An aluminium sleeper car exhibited at the Chicago Exhibition is described. It weighs 96,980 lb., as compared with 180,000 lb. for a steel Pullman of similar design. —J. C. C.

On Contact Unions of Aluminium and Copper. L. E. Mashkilleyson and M. S. Sokolov (*Vestnik Elektropromishlennosti* (*Messenger of the Electrical Industry*), 1932, (4), 192).—[In Russian.] The best electrical contact between copper and aluminium is obtained by cleaning the contact surfaces under a layer of vaseline, greasing them over with it, and covering the contact immediately on assembly with an asphalt varnish.—N. A.

The Aluminium Experimental Free-Transmission Cables on the Isle of Sylt. Committee for Aluminium Free-Transmission Cables of the Deutsche Gesellschaft für Metallkunde (*Z. Metallkunde*, 1933, 25, 170–172; and (short abstract) *V.D.I.-Nachrichten*, 1933, 13, (29), 4).—The surface condition and the changes in tensile strength and electrical conductivity of free-transmission cables of copper, Aldrey, and aluminium (99·6% and 99·2%) during exposure for 5 years to extremely severe weather conditions have been investigated. The light metal cables proved to be as satisfactory as those of copper.—M. H.

Aluminium in Central Stations—Bars and Connecting Lines. M. Preiswerk (*Alluminio*, 1933, 2, 209–215; and *Schweiz. Tech. Zeit.*, 1933, 220).—The use of aluminium in electric generating stations, transformer stations, and distributing systems, in the form of bus-bars, rods, tubes, and wires, has the following advantages: good behaviour in case of short circuits or arcs, facility of erection, good joints, economy.—G. G.

Competition for Chairs in Aluminium. Anon. (*Alluminio*, 1933, 2, 166–168).—Details of a competition for designs of aluminium chairs promoted by the *Bureau de l'Aluminium*, Paris.—G. G.

Aluminium Foil. Anon. (*V.D.I.-Nachrichten*, 1933, 13, (24), 2).—A short note on the use, manufacture, and properties of aluminium foil.—J. W.

Alfol, a Metallic Insulator. Anon. (*Science et Industrie*, 1933, 17, 438).—Alfol consists of layers of aluminium foil 0·007 mm. thick, separated by light

non-metallic packing; its density, thermal conductivities at various temperatures, approximate melting-point, and working temperature range are given.
—P. M. C. R.

Aluminium Foil as a Heat Insulator. H. N. Bassett (*Eng. Rev.*, 1933, 47, 160).—The substitution of aluminium foil for dull-surfaced insulators produces a 75% reduction of heat-flow across an intervening air-space. Suitable arrangements of aluminium foil are described, and heat losses at various temperatures are compared for 85% magnesia composition and aluminium.
—P. M. C. R.

Aluminium Foil—A Heat Insulator for Power Plant Equipment. Anon. (*Power*, 1933, 75, 717–718).—The use of aluminium foil as a heat-insulating material in power-plant equipment is described.—F. J.

[Stelliting] Latest Diemaking Practice Used in a Chinese Plant. Anon. (*Machinery* (*N.Y.*), 1933, 39, 470–471).—Examples of the use of Stellite-coated stamping and forming dies are described and illustrated.—J. C. C.

Advances Made in the Field of Gas Welding and Cutting. Anon. (*Machinery* (*N.Y.*), 1933, 39, 386–387).—A general review. Reference is made to applications of the process of hard facing with Stellite.—J. C. C.

The Advantages of Using Copper and Brass in Metallic Cappings. The Bad Effect of Rust on Paint Work. J. Meyral (*Cuivre et Laiton*, 1933, 6, 215). —An essay on the bad effects which accrue when artistic ironwork is used in exposed positions, and the advantages of using copper, which acquires a patina that is much more permanent than rust and ordinarily need not be covered with paint.—W. A. C. N.

A Copper Membrane Gas-Molecule Sieve. Callendar's Theory of Osmosis. D. L. Warrick and Edward Mack, Jr. (*J. Amer. Chem. Soc.*, 1933, 55, 1324–1332).—Copper membranes were prepared by distillation of the zinc from thin sheet 70 : 30 brass (0·0028 cm. thick) *in vacuo* in a quartz tube at temperatures from 400° to 900° C. The membrane thus prepared was clamped and sealed in a pipe coupling with large-surfaced steel ends. After evacuation, gas was admitted to one side and the transpired portion collected in the low-pressure side. Typical rates of transpiration are given for a number of gases. The membranes prepared at 600°–900° C. were far more porous to the small molecule gases than membranes made at lower temperatures, and would readily pass large molecules, such as C_6H_6, which the low-temperature membranes completely obstructed. The transpiration was a molecular rather than a viscous flow. Experiments using copper membranes with water and sugar solution gave results which agreed with predictions from Callendar's theory of osmosis sufficiently well to support the theory.—R. G.

Ten Years' Progress in Copper–Nickel Condenser Tubes. Robert Worthington (*Marine Eng. and Shipping Age*, 1933, 38, 266–267).—A brief review, showing the wide extent to which copper–nickel condenser tubes have gained acceptance during the last decade, not only in American, British, and foreign navies, but also in all large merchant fleets. They have been fitted to vessels sailing practically all the recognized sea routes of the world, and have successfully withstood the action of the many varying kinds of cooling waters to which they are subjected. It is stated that such tubes are now generally recognized by marine engineers to be the best available, and are being fitted in increasing numbers to provide against condenser failures. In the new ships of the U.S. Navy, 330,000 lb. of copper–nickel tubes are being fitted. See also *J.*, this volume, p. 531.)—J. W. D.

(U.S.) Navy Orders Nickel–Copper Condenser Tubes. Anon. (*Daily Metal Reporter*, 1933, 33, (101), 3).—Cf. preceding abstract. 330,000 lb. of nickel–copper condenser tubing are to be installed in a new cruiser, and 6 new destroyers, for the U.S. Navy. The specified composition of the alloy is copper 75, nickel 20, and zinc 5%.—P. M. C. R.

Compo Bearings. Anon. (*Automobile Eng.*, 1933, 23, 347).—Oil retaining bushes of phosphor–bronze are produced as die-pressings by a process which leaves the structure of the material so porous that it absorbs oil in quantities up to 40% of the volume of the material. The material, which is not merely a compressed body of a mechanical mixture, but a true alloy with a solid solution structure, is strong and will withstand a pressure of 75,000 lb./in.^{2}, and its high oil content permits bearing loads much greater than those carried by ordinary bearing metals. Bearings of this alloy do not require either oil grooves or lubricator holes such as are necessary in bushes of ordinary phosphor–bronze.—J. W. D.

Characteristics and Conditions of Employment of Some Copper Alloys as Bearing Metals. M. A. Ricard and H. Ackermann (*Cuivre et Laiton*, 1933, 6, 239–242).—These alloys exhibit microscopical evidence of a texture favourable to their use as anti-friction metals. On the other hand, their high copper content preserves their malleability and plasticity. Comparisons are made with the ordinary white-metal bearing alloys. The rapid development of the Diesel engine furnishes an example of the possibilities of copper-base bearing metal alloys. The discussion is illustrated by a series of photomicrographs. —W. A. C. N.

High-Duty Brass and Bronze Castings. J. Arnott (*Metallurgia*, 1933, 7, 185–186).—High-duty castings calling for either high strength or resistance to some form of wear are considered for different types of severe service conditions.—J. W. D.

Lead in Building. Anon. (*V.D.I.-Nachrichten*, 1933, 13, (24), 2).—F. W.

Lead Pipe for Interior Plumbing Systems. Anon. (*Dutch Boy Quarterly*, 1933, 11, 12–13).—The advantages of lead pipe are summarized.—E. S. H.

Beautiful Architectural Lead Work, King's County Hospital (New York). Anon. (*Lead*, 1932, 2, (6), 4–5; 1933, 3, (1), 4–5; and (summary) *Met. Ind.* (*Lond.*), 1932, 41, 494).—An account of the extensive applications of lead in a recent hospital building. Details of lead work at window-heads, sills, mullions, grilles, and spandrels are illustrated: the building is roofed with lead sheet, which is also used for gutters and in many ornamental details.—P. R.

Monel Metal in Filtration and Dry Cleaning Equipment. Anon. (*Nickel Bull.*, 1933, 6, 98–99).—Describes the application of Monel metal in the form of finely woven multiplex or Hollander cloth in leaf filters.—J. H. W.

Jewellers Set High Standard for Platinum. Anon. (*Daily Metal Reporter*, 1933, 33, (113), 6).—An international conference of jewellers, recently held at Rome, agreed that all articles labelled as "platinum" shall contain at least 95% of that metal.—P. M. C. R.

Consumption of Silver in the Arts and Industries of the United States. Charles White Merrill *et al.* (*U.S. Bur. Mines Economic Paper* No. 14, 1932, 1–18; and (short abstract) *Met. Ind.* (*Lond.*), 1932, 41, 122).—The report shows the quantities of silver used in various industries in 1928 and 1929 and is based on a canvass begun in 1930. The U.S.A. are second only to Mexico in the mine production of silver, and are first in the production of secondary silver and in refining. Among occidental nations they are first as regards silver monetary stocks, and are also the world's leading consumers of silver in the arts and industries. Whilst extensive additional uses for other common metals have been found during recent years, the absorption of silver has not increased at an equivalent rate, in spite of its adoption on a large scale for photography, dental amalgams, solders, and electroplating. Data are given for the silver-consuming industries of the U.S.A. and the relative importance of the various avenues of demand is discussed. In the chemical industry silver compounds are mainly intermediate products. Sterling silver ware accounts for more than one-third of the total consumption of the metal in industry, but the high ratio of returned scrap to finished products reduces the relative importance of actual consumption. The motion picture productions consume, nowadays, the largest amount of silver absorbed by the photographic industry.—W. A. C. N.

Silver Consumption in the Arts and Industries of the United States in 1930 and 1931. Charles White Merrill (*U.S. Bur. Mines Information Circ.* No. 6647, 1932, 1–7).—See preceding abstract for consumption 1928–1929. The consumption of silver in the U.S.A. is practically static. Figures are tabulated showing the amount of silver used in all the important silver-using trades in that country, during each year of the period 1928–1931.—W. A. C. N.

Block Tin Pipe for Draught Beer Equipment. George O. Hiers (*Dutch Boy Quarterly*, 1933, **11**, 9–10).—Block tin pipe, having an internal diameter of 0·375 in., external diameter of 0·515 in., and a bursting strength of 1200 lb./in.^{2}, is used for conveying beer from the kegs to the bar. A cooling coil of about 50 ft. of block tin pipe is inserted. The tin is not corroded and does not give a taste to beer; it is pliable, easily soldered, and can withstand considerable internal pressure. The pipes are cleaned regularly with solutions of sodium carbonate or trisodium phosphate. Tin-lined lead pipe is sometimes used, but requires replacing when the tin lining becomes worn through cleaning. Taps and ferrules are usually of tin-lined brass.—E. S. H.

The Use of Titanium in Steelmaking. George F. Comstock (*Blast Fur. and Steel Plant*, 1933, **21**, 412–414).—Discusses the application of titanium as a deoxidizer and alloying element in the steel industry.—R. Gr.

The Patent Position in the Field of Hard Metals. K. Becker (*Metallwirtschaft*, 1933, **12**, 64–65).—A review of the German and foreign patent literature dealing with sintered tool alloys containing hard carbides, especially tungsten carbide.—v. G.

Zinc-Base Alloy Die-Castings Find Steadily Widening Field of Commercial Application. Joseph Geschelin (*Automotive Ind.*, 1933, **69**, 72–75).—The economy, good finish, and excellent casting properties of the recently developed zinc alloys for die-casting have led to their widespread adoption for a variety of purposes, which are tabulated. Tables also give the effects of two years' normal ageing on the properties of four such alloys, and also the impact strength, tensile strength, and elongation of sand-cast malleable iron, sand-cast brass, cast-iron, and die-cast aluminium alloys (analyses unspecified) compared with those of the new zinc alloys.—P. M. C. R.

Metal and Gelatin Foils. Heinrich Wiesenthal (*Kunststoffe*, 1932, **22**, 150–151).—A short account is given of the manufacture and use of tin and aluminium foil.—J. W.

Thermostatic Metals. Anon. (*Metallurgia*, 1933, **8**, 140).—The use of bimetal strip in the manufacture of thermostats is discussed. Various combinations of dissimilar metals are used depending on the accuracy required, and a special manufacturing process is necessary to ensure absolute rigid and permanent union between the two metals, if accurate and consistent results over extremely long periods of use are to be attained. In designing an instrument it is often possible to calculate the exact amount of movement in the element for a given change of temperature, and a formula is given for such a calculation. —J. W. D.

The Metallurgists' Contributions to Automotive Development. P. M. Heldt (*Automotive Ind.*, 1933, **69**, 64–68).—The increased uses in the automotive industry of recently developed alloys are reviewed. Apart from the alloy steels, the materials considered are the zinc-base die-casting alloys, aluminium alloys in pistons, cylinder heads, trucks and body-work, and magnesium and its alloys in light castings.—P. M. C. R.

Design Improvements Bring About Better Evaporation. Anon. (*Chem. and Met. Eng.*, 1933, **40**, 253–254).—The Buffalo Foundry and Machine Co. has employed a number of new methods in the production of its lead evaporators.

Tube sheets are covered with sheet lead, making the protective covering an integral part of the tube sheet. The tubes are also of a new type, consisting of pure lead reinforced by a perforated inner tube which adds strength without impairing the heat transfer.—F. J.

The Non-Ferrous Metals at the Motor Exhibition. Anon. (*Metallwirtschaft*, 1933, **12**, 92–94).—v. G.

XXII.—MISCELLANEOUS

(Continued from pp. 597–598.)

Auguste Mesnager (1862–1933). Anon. (*Rev. Mét.*, 1933, **30**, 171–172).—An obituary notice and biography.—H. S.

A Half-Century of Research on Metals and Alloys. The Exhibit of the Scientific Research Laboratories at the XIIIth Salon de l'Aéronautique (18 Nov.–4 Dec. 1932). L. Guillet and J. Galibourg (with preface by H. Le Chatelier) (*Rev. Mét.*, 1933, **30**, 119–141).—Metallurgical microscopes, apparatus for thermal analysis, and thermo-magnetic studies, dilatometers, macrographs, X-ray spectrographs, electron spectrographs, mechanical testing machines, and hardness-testing machines exhibited are described. Exhibits of metals and alloys illustrating materials formerly used as well as modern products are described briefly. Brief reference is made to a number of documents of special historic interest which were exhibited.—H. S.

Non-Ferrous Metals in Germany. —— Wolf (*V.D.I.-Nachrichten*, 1933, **13**, (24), 1).—A short review.—J. W.

Development of the German Metal Industry with German Materials. W. Guertler (*Maschinenkonstrukteur*, 1933, **66**, 111–112); **German Materials for the Metal Industry.** W. Guertler (*V.D.I.-Nachrichten*, 1933, **13**, (24), 1–2).—Abstract of a lecture on the development of German metal technique from German materials.—J. W.

Alloy Iron Ring Carriers Reduce Cylinder Wear and Give Aluminium Pistons Longer Life. E. Mahle (*Automotive Ind.*, 1933, **68**, 578–582).—Most cylinder wear is traceable to excessive wear on the piston rings and consequent wear on the cylinder bore. Working conditions are considered, and the operating temperatures are found to be sufficient to cause substantial softening of the piston alloy. The introduction of ring carriers of hard (nickel-bearing) cast iron is found almost entirely to eliminate ring wear. The effect on Brinell hardness of various temperatures is shown by a series of comparative curves for grey iron, aluminium–copper, aluminium–silicon, and magnesium. Wear coeffs. for the same materials are given, and several designs of pistons with hard ring carrier are illustrated.—P. M. C. R.

Skirt Wear Not to Blame. Anon. (*Automotive Ind.*, 1933, **68**, 407–408).—An account of cylinder wear on Bohnalite pistons, with a chart showing the distribution of wear for three passenger models. Considerations affecting wear are summarized.—P. M. C. R.

Copper and Bronze in Antiquity. H. Bréau (*Cuivre et Laiton*, 1933, **6**, 225–226).—The only metals employed in alloys used in the earliest days were copper, tin, and lead, with small percentages of accidental ingredients, such as iron and zinc. Bronzes of Grecian times were principally made of an alloy approximately: copper 62, tin 32, lead 6%. The Romans increased the copper content to about 84% and reduced the tin to 6%. Instances of early methods of producing articles from such alloys and of the processes involved are given. *Cera perduta* casting is mentioned as one of the earliest operations. The advances made in technique through successive centuries are discussed.
—W. A. C. N.

Gold and Silver as Money Metal. T. A. Rickard (*Trans. Inst. Min. Met.*, 1932, **41**, 132–139; discussion, 140–233; and (abstract) *Indust. Australian*, 1932, **87**, 68).—The joint use of silver with gold as standard coinage is advocated on account of the decreased production of gold. It is not anticipated that silver production can increase sufficiently to disturb appreciably such a dual monetary standard, as much of the world's silver is now a secondary product of the beneficiation of ores of other metals (copper, lead, and zinc), and (in discussion) only 8% of this silver is used to-day for coinage. Discussion and correspondence are appended.—P. M. C. R.

Gold in Canada. A. H. A. Robinson (*Canad. Dept. Mines, Mines Branch* No. 730, 1932, 1–92; and (abstract) *Science and Art of Mining,* 1933, **43**, 200–201).—The physical and chemical properties of gold are described, and the composition of some of its common alloys is given. The economic importance of the metal is emphasized. A summary of the modes of occurrence of gold, and of the history of gold production, leads to a more extended survey of the Canadian gold production.—P. M. C. R.

Goldsmiths' and Silversmiths' Work: Past and Present. W. Augustus Steward (*J. Roy. Soc. Arts*, 1933, **81**, 837–846, 853–863; and (summary) *Met. Ind.*, (*Lond.*), 1933, **43**, 125–128, 178).—Cantor Lectures. The sources and production of gold and silver are reviewed. Methods of working the metals and their alloys are summarized and prehistoric, Egyptian, Sumerian, Assyrian, Mycenæan, Hellenic, and later examples are described in some detail.—P. M. C. R.

Manganese: General Information. Robert Ridgway (*U.S. Bur. Mines Information Circ.* No. **6729**, 1933, 1–30; and (summary) *Metallurgia*, 1933, 8, 111–113).—Information is given under the following headings: properties of manganese, manganese minerals, and the mode of their occurrence, world sources and details of production from the various sources, metallurgical and chemical uses of manganese ores, marketing and prices of ores, exports from the principal producing countries and imports into the most important consuming countries for the years 1926–1931, political and commercial control, *bibliography*.—A. R. P.

Manganese for National Defence. Report of Sub-Committee on Manganese of the [A.I.M.M.E.] Committee on Industrial Preparedness. —— (*Amer. Inst. Min. Met. Eng., Contrib.* No. 48, 1933, 1–35).—This report is chiefly concerned with the question of securing adequate supplies of manganese ores in the U.S.A. The various sources of supply of the ores and the characteristics of the different types of manganese ore are described. The article is of more interest to steel metallurgists than to the non-ferrous industries.—A. R. P.

Twenty Years of Mercury Vapour Power Development. Anon. (*Power Plant Eng.*, 1933, **37**, 263–268).—An historical survey of the development of the mercury boiler from 1913 to the present time.—P. M. C. R.

Mercury in Native Silver. W. H. Newhouse (*Amer. Mineralogist*, 1933, 18, 294–299).—Silver amalgams are known to occur in a number of mining districts: the presence of small proportions of mercury in native silver, is less generally recognized but is very frequent, especially when associated with cobalt ores. Metallographic investigations of native silver or silver–antimony may give rise to erroneous conclusions as to temperature conditions if the frequent presence of a significant proportion of mercury is overlooked. The origin of native silver amalgams is considered.—P. M. C. R.

Silver—Its Place as Currency. H. S. Denny (*Indust. Australian*, 1933, 88, 107–108).—The composition of certain British coinage alloys is discussed, with a historical survey of the standardization of coinage. Silver production is analyzed, and the possible effects of the proposed Australian restandardization are considered.—P. M. C. R.

Pewter—To-Day and Yesterday. Anon. (*Dutch Boy Quarterly*, 1933, **11**, 14–15).—Mainly historical. From the 11th to the 18th century pewter contained about 5–15% of lead, but modern pewter consists of tin hardened with a small amount of antimony and copper. The absence of lead removes the former objection to the use of pewter as a container for foods of acid content. —E. S. H.

The Lord Warden of the Stanneries. Anon. (*Tin*, 1933, (June), 7–8).—The control and administration of the tin mines and workings of Cornwall and Devon from the 12th to the 19th centuries are outlined.—J. H. W.

Powder Metallurgy. Charles Hardy (*Eng. and Min. J.*, 1933, 134, (9), 373–374).—Cf. *J.*, this volume, p. 468. Reviews the subject, outlining the methods of production, the properties, applications, and advantages.—R. Gr.

The Metallurgical Aspect of Coal-Face Machinery. J. R. Jenkinson (*Colliery Eng.*, 1933, 10, 231–233).—The application of modern metallographic methods to colliery work is described. Their incidence with regard to selection of materials, repair, and breakdown in service is indicated, with illustrations.—P. M. C. R.

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XXIV.—BOOK REVIEWS

(Continued from pp. 603–608.)

Alfred Mond, First Lord Melchett. By Hector Bolitho. Med. 8vo. Pp. xi + 392, with a frontispiece and 16 illustrations. 1933. London: Martin Secker. (21*s.* net.)

Alfred Mond, First Lord Melchett, was an outstanding figure in the industrial development of post-war Britain. He will, I think, be remembered chiefly as the founder of Imperial Chemical Industries, that mighty concern which embraces within its control all sorts of manufactures from high explosives to "Zip" fasteners. He was much else beside—barrister, art connoisseur, politician, Zionist leader—and in each achieved no small measure of success. He was one of the first of our great industrialists who saw what a great contribution science could make to industrial development. Still, great as was his appreciation of science, he was not a scientist of anything like the stature of his father, Ludwig Mond. At Cambridge he devoted a great part of his time to teaching the undergraduates to play poker, with the result that when the pass lists of the Science Tripos were published he was able to telegraph his father "Ploughed: Alfred." Even so, he became, like his father, a Fellow of the Royal Society (I note this is not included in his list of distinctions in an early page of the book), and, in his later years, five Universities conferred honorary degrees on him. He had an ambition to become Prime Minister of England: he served in the Government as Minister of Health. Here in this book his life story is told: much of it is taken up with an account of his political career. Metallurgists will find most to interest them in the life story of Ludwig Mond which prefaces the main theme. Here is given an interesting account of Ludwig Mond's development of the manufacture of soda at Winnington, the discovery and development of the carbonyl process for the manufacture of nickel, and the establishment of the Power Gas Corporation. Old Ludwig strikes one as having been a lovable sort of person, not without a keen sense of humour. Exemplifying this, let this suffice: In 1898, the birth of Alfred Mond's son, the present Lord Melchett, was expected. The baby did not arrive as early as was anticipated, and Ludwig, inconvenienced thereby, as he was due to leave for Italy, remarked, "In all their lives, women have only one calculation to make and they always get it wrong." Ludwig's courtship of Frida Löwenthal reads like an idyll. Altogether, the book is interesting reading and its price is very reasonable. I have noted two important misprints, *viz.* Harber for Haber (p. 292), and C. S. Jagger, the distinguished sculptor who executed a death mask of Lord Melchett, which illustrates the book, becomes William Jagger in the index.—J. S. G. THOMAS.

Greek and Roman Plated Coins. By William Campbell. (Numismatic Notes and Monographs, No. 57.) Fcap. 8vo. Pp. 174, with numerous plates and illustrations. 1933. New York: American Numismatic Society, Broadway at 156th St.

Many of the problems of coin-making in ancient times are still unsolved, and a metallographical examination of a number of specimens, followed by attempts to reproduce the structure, are the best means at our disposal for arriving at a reasonable explanation of the methods employed. Professor Campbell has given an account of his examination of a number of Greek and Roman coins which consist of a copper core (with one exception) coated with silver. Such coins were produced either officially by the mints when they were short of silver, or by forgers of the period. In any case, one is justified in assuming that the coins are of the period which they purport to be and are not modern forgeries. In discussing possible methods of manufacture, therefore, one must take into consideration the means at the disposal of the ancient coiners and the extent of their metallurgical knowledge. Their possible methods of coating copper with silver were as follows: (1) by dipping a copper blank into molten silver; (2) by means of the Sheffield Plate method, *i.e.* by hammering a layer of silver on to the copper and heating until diffusion had taken place; (3) by joining the two metals by means of silver-solder; (4) Professor Campbell also suggests that the blanks may have been covered with the powdered copper–silver alloy and heated until the alloy "ran" and covered the surface. The difficulty of coating *two* sides of a blank by this method is obvious. Similarly, dipping the blank into molten silver presents certain difficulties, the chief being that marks where the tongs held the blank would inevitably remain. However the silver was applied, the coins would be struck after plating.

Professor Campbell sectioned the coins, mounted them in fusible alloy, and polished and etched them. The large number of photographs show a layer of silver, a layer of copper and silver eutectic, and the copper core. Particular care was also taken to examine the section at the periphery, because if the silver was put on in the form of sheet, overlapping and joining at this point would be most noticeable. All the coins showed some corrosion between the two layers of metal. Although the structure of the copper is shown by etching, in no case has the structure of the silver layer been described, nor is it shown in any of the photographs. This seems to be a serious omission, as the structure of the silver might prove to be a valuable clue. At the periphery of certain coins there was distinct overlapping of the silver layer, and in some cases the eutectic had diffused between the two parts. Two experiments are described in which a silver strip was heated between two copper strips with and without a silver solder. Both gave similar structures, but the specimen with the solder gave a more uniform union. The evidence everywhere is inconclusive, and Professor Campbell thinks that both methods were employed. References to the literature on plated coins and the use of solders in antiquity are included in the pamphlet, but do not throw any light on the problem. It must be admitted that the use of silver solder makes the process much more difficult and is not justified by the evidence given. The only fact that definitely emerges from this investigation is that the copper and silver were heated in contact until diffusion took place. A more careful investigation of the structure of both copper core and silver coating would probably give more information, and this side of the problem has been almost completely neglected.—C. F. Elam.

Phase Rule Studies: An Introduction to the Phase Theory. By J. E. Wynfield Rhodes. With an Introduction by E. L. Rhead. Cr. 8vo. Pp. x + 131, with 58 illustrations. 1933. London: Oxford University Press (Humphrey Milford). (6*s.*)

Gibb's phase rule is one of those magnificent generalizations of physical theory which, whilst it can be rigorously established only by the use of abstruse and recondite mathematics, is comparatively simple in its applications. Some text-books attempt a more or less rigorous proof of the rule; most are content with a statement of the rule, without proof. This little book is included in the latter category. And it is well, I think, that students of chemistry and metallurgy should accept the rule as an act of faith, as, except for the mathematician, the beauty of the rule is found in its applications. The book treats the subject in a simple manner, and applications of practical importance are reached almost at its beginning. A brief introduction is followed by the discussion of systems comprising one, two, three, four, or more components and their graphical representation, miscellaneous applications, *e.g.*, to liquid, crystals and allotropy, and experimental methods employed in phase-rule work. There is a brief bibliography and an adequate index. The author's obligations to the larger work of Findlay and that on metallography by Desch are obvious. As one who read both these works in his student days, I can say unashamedly that I found them difficult. This little book, used as an introduction to the larger volumes, would have helped me much. It is as a very necessary introductory book on the phase rule that I unhesitatingly recommend the book to all students of metallography and chemistry. It is beautifully clearly printed, and its whole make up is satisfactory in every way; its price is extremely reasonable.—J. S. G. Thomas.

Werkstoffprüfung in der Eisen- und Stahlgiesserei. Ein Handbuch für den Gebrauch in der Praxis. Von Gerhart Tschorn. (Die Betriebspraxis der Eisen-, Stahl-, und Metallgiesserei. Eine Sammlung von Einzelabhandlungen aus dem Gebiete praktischer Giessereitechnik. Herausgegeben von Hubert Hermanns. Heft 19.) Med. 8vo. Pp. vii + 196, with 169 illustrations. 1933. Halle (Saale): Wilhelm Knapp. (Brosch., R.M. 12; geb., R.M. 13.30.)

This book deals exclusively with the testing of ferrous materials, but the general principles that are discussed are equally applicable to non-ferrous work. Initially there is a review of the objects of strict examination of metals and alloys, followed by a description of the essential details in the lay-out, erection, and equipment of a laboratory. It is emphasized that all testing should be carried out systematically, and schemes for its development and the recording of results are suggested. The proper location of the test-pieces and their preparation for examination are thoroughly discussed. The actual methods of testing are divided into 8 sections as follows: (1) chemical analysis, qualitative and quantitative; (2) fuels; (3) examination of fluxes; (4) refractories; (5) slags; (6) physico-mechanical properties, including the usual physical tests and the determination of specific gravity, magnetic properties and X-ray exploration; (7) metallographic inspection; (8) tables of composition of raw materials and final products. Various useful tables comprise the last section of the book. Illustrations, figures, and tabular matter have been carefully selected, and are included in very clear fashion. Where necessary, mathematical explanations are given, but there is no overburdening of the text with intricate calculations. Primarily intended solely for the works' metallurgist in whose hands the examination and testing of all materials—from the raw state to the finished product—mainly lie, it should also be valuable to all those having connection with foundry work and to students who desire to obtain a fairly comprehensive insight into casting methods and the testing of castings.—W. A. C. Newman.

Wechselwirkung zwischen Röntgenstrahlen und Materie in Theorie und Praxis. Herausgegeben von J. Eggert und E. Schiebold im Auftrage der Deutschen Gesellschaft für Technische Röntgenkunde beim Deutschen Verband für die Materialprüfungen der Technik. (Ergebnisse der technischen Röntgenkunde, Band III.) Med. 8vo. Pp. ix + 211, with 114 illustrations in the text. 1933. Leipzig: Akademische Verlagsgesellschaft m.b.H. (Brosch., M. 17; geb., M. 18.80.)

This handy little volume, comprising 19 lectures delivered at a Conference held in Münster in May, 1932, summarizes very concisely the present-day position of the theory of X-rays and their technological applications. The authoritative character of the lectures will be realized if we mention, by way of example, that Professor Laue, the discoverer of the diffraction of X-rays, contributes a section on the place of X-rays in general physical theory, whilst Professors Eggert and Schiebold discuss recent X-ray technique. Other contributors include Professors Debye, Heisenberg, Mark, Coster, Dr. Seemann, and Dr. Regler. The lectures of most interest to metallurgists are probably those contributed by O. Fischer (Recent apparatus for testing materials with X-rays), M. Widemann (Modern X-ray methods of testing heavy metal products), F. Regler (Quantitative measurements of elastic stresses in technical samples and steel work by X-rays), W. Schmidt (Measurements of thermal expansion of iron by means of X-rays), and E. Schiebold (Investigations of crystal structure during 1930–1932). Most of the sections conclude with a brief bibliography of the subjects discussed. The volume is well printed on good paper and the illustrations are very clear. An adequate subject-index is provided. The price of the volume is not unreasonable, and the book can be heartily recommended to physicists and metallurgists.—J. S. G. THOMAS.

Spectroscopy in Science and Industry. An Introductory Manual Describing its Applications to Industrial and other Practical Problems. By S. Judd Lewis. Cr. 8vo. Pp. vii + 94, with 41 illustrations. 1933. London and Glasgow: Blackie and Son, Ltd. (3*s.* 6*d.* net.)

This book describes the principles and practice of spectrum analysis clearly and simply. The author gives detailed accounts of the apparatus and methods used for recording both absorption and emission spectra, and also useful instructions for interpreting the results obtained. He devotes a section to quantitative methods which gives a fair impression of the present state of this rapidly-growing subject, to which he has himself contributed.

The chapters on the scientific and industrial applications of spectrum analysis are most instructive and stimulating reading, metallurgical applications are touched on here, but not in great detail.

The book as a whole is sufficiently readable to be recommended to the average person who is interested in science; it should certainly be read by every analyst. Unfortunately, it does not give much guidance as to where further information on the subject can be obtained; sources are cited for points of detail, but there is no bibliography. There is an index, and reasonably few misprints occur.—E. VAN SOMEREN.

Die Chemische Emissionsspektralanalyse. II Teil.—**Anwendung in Medizin, Chemie, und Mineralogie.** Von Walther Gerlach und Werner Gerlach. Med. 8vo. Pp. viii + 191, with 73 illustrations. 1933. Leipzig: Leopold Voss. (R.M. 13.)

Although this book is not written for the metallurgical worker, no metallurgist who uses spectrum analysis should ignore it.

The book begins with a most valuable description of the various light-sources used in obtaining spectra, which with modern variations of the spark and arc are six in number. The authors then proceed to a less detailed account of the experimental technique and apparatus in general.

A valuable discussion of the sensitivity of spectrum analysis, and the influence of discharge conditions on sensitivity follows; this and the following chapter, on quantitative analysis by homologous lines, collect and discuss material which has not yet been summarized elsewhere. The authors' criticisms, based on a wide experience of the subject, are particularly valuable. The extent of the tables of homologous lines published so far is still disappointingly small; workers outside Germany largely use other methods.

A long section on the detection and estimation of metals in animal and vegetable organic materials follows; apart from the interesting technique used by some workers this section is of no importance to the metallurgist. It is followed by a useful section collecting work which has been done on special problems, such as the detection of antimony in copper and of small quantities of some rarer elements. Unfortunately the experimental details given are not always sufficiently complete to be a guide to other investigators.

A short section on minerals is followed by two very useful tables. The first is of the coincidences between spectrum lines which are likely to be confusing in analytical work, the second is on checking the purity of metals spectrographically without making a full quantitative analysis. Platinum, iridium, rhodium, aluminium, silver, zinc, and lead are dealt with in this table.

The book closes with a bibliography of recent papers on spectrum analysis, and an index which covers the first volume of the work as well as this one. The bibliography surprisingly omits the Japanese workers, such as Iwamura.

One of the authors, with fresh collaborators, is preparing a further volume of tables for quantitative chemical spectrum analysis.—E. VAN SOMEREN.

Organic Reagents for Metals. By the Staff of the Research Laboratory of Hopkin & Williams, Ltd. Pp. 61. 1933. London: Hopkin & Williams, Ltd., 16–17 Cross St., Hatton Garden. (1s.)

The search for specific reagents for metals or groups of metals has occupied the time of numerous investigators during the past 20 years, and as a result many valuable new analytical methods involving the use of complex organic compounds have been discovered. Within the last few years the price of these reagents has been so reduced as to bring them within the reach of all analysts, but, with few exceptions, details of the processes involved are scattered through the journal and abstract literature of the world. Analysts will therefore welcome this little book, in which are given procedures for the use of 17 of the most important of these reagents for the detection and determination of metals, together with copious references to the literature. All the procedures given have been tested in the authors' laboratory, and in many cases minor modifications have been made in the original method to increase the accuracy or otherwise improve the method. The substances discussed include "cupferron," α-benzoinoxime, dihydroxytartaric acid, dimethylglyoxime, 8-hydroxyquinoline, α-nitroso-β-naphthol, picrolonic acid, salicylaldoxime, and zinc uranyl acetate, besides several reagents for spot tests. Every metal analyst should possess this book.—A. R. POWELL.

Handbuch der technischen Elektrochemie. Herausgegeben von Victor Engelhardt. Erster Band. 3 Teil: *Die technische Elektrolyse wässeriger Lösungen. A.—Die technische Elektrometallurgie wässeriger Lösungen. Die Galvanotechnik.* Bearbeitet von Gerhard Elssner. Roy. 8vo. Pp. xiii + 448, with 214 illustrations. 1933. Leipzig: Akademische Verlagsgesellschaft m.b.H. (Brosch., M. 39; geb., M. 41.)

In the preface to Part II of Volume I it was stated that the section on electrodeposition could not be ready in time for inclusion in its proper place in Volume I, but fortunately, by obtaining the assistance of Dr. Elssner, it has appeared much earlier than was expected, and now forms the final part of this volume.

After a short discussion of the applications of electrochemical theory to electrodeposition, the author embarks on a detailed consideration of the practical aspects of the subject. In a section occupying about 100 pages existing information is summarized under various headings, of which the chief are types of plant, factory layout, power generation and distribution, switching, temperature control and filtering of the electrolyte, preparation of work before plating, automatic plant, and costing. The various types of plant and apparatus are well illustrated by photographs and line drawings. Then follows a series of chapters, occupying about one-third of the book, each devoted to a particular metal and the special technique which it involves. This information is somewhat condensed, but very full references to the literature are given, in which the work of English and American authors appears to predominate. The section closes with an account of the electrodeposition of alloys.

The last section of the book deals with "Galvanoplastik," or the fabrication of finished or partly finished pieces by electrodeposition. This chapter is particularly interesting, since there is very little published information on the subject. The volume maintains the high standard of the "Handbuch," and should be an invaluable reference book in every metallurgical library. The only criticism that can be levelled at the production of the book is its weight—nearly 3 lb.—which makes it very inconvenient to handle.—C. J. SMITHELLS.

Die Bedeckungstheorie der Passivität der Metalle und ihre experimentelle Begründung. Von W. J. Müller. Med. 8vo. Pp. 102, with 65 figures and 31 tables. 1933. Berlin: Verlag Chemie G.m.b.H. (Br., R.M. 6; geb., R.M. 7.)

This book will be welcomed by all workers on passivity and corrosion of metals and allied subjects, for it collects the fundamental data and theoretical conceptions on which all serious work on these subjects must of necessity be based. The introductory chapter gives a short account of the theoretical basis of the earlier work on the subject. The development of the subject is considered in the following chapters, and it is shown that anodic passivity is a time phenomenon, and from this fact the film theory of passivity is developed. It is shown in the two final chapters that by means of this theory it is possible to explain the most involved phenomena of passivity. The theory is not based on any special assumption, but on the laws of Ohm, Faraday, and Hittorf, together with the conception of metallic potential as put forward by Nernst.

Much information on the subject, collected from a very wide and diffuse literature, has been incorporated in the book. A certain amount of the author's unpublished data is also included.

The book therefore gives a very acceptable account of the nature of passivity, and puts forward a new basis on which the problems of corrosion may be investigated. Consequently this volume becomes a necessity for all those engaged in the study of corrosion and the protection of metals, and to these it can be warmly recommended.—James F. Spencer.

Die Formsande und Formstoffe. Vorkommen, Eigenschaften, Aufbereitung und Prüfung. Von Karl Schiel. (Die Betriebspraxis der Eisen-, Stahl- und Metallgiesserei. Eine Sammlung von Einzelabhandlungen aus dem Gebiete praktischer Giessereitechnik. Herausgegeben von Hubert Hermanns. Heft 18.) Med. 8vo. Pp. viii + 155, with 87 illustrations. 1933. Halle (Saale): Wilhelm Knapp. (Br., R.M. 8.80; geb., R.M. 10.)

This book is divided into two main sections. The first one deals with natural sand, the second with foundry sand. The former comprises a general discussion of the structure of sands and sandstones, the manner in which sands are derived from earlier rock formations, the investigations of sands from the chemical and physical points of view, and their classification into groups according to composition and utility. The special characteristics which are discussed are: (1) refractoriness; (2) clay content; (3) grain-size; (4) percentages of iron; calcium, and the alkalis; (5) binding power; (6) gas permeability. The greater portion of the book deals with foundry sands, and the discussion is divided under seven headings as follows: general description; preparation, principles underlying the use of these sands in various forms; facing and parting media; examination in the laboratory; works' examination based on small scale tests; a list of German foundry sands. The preparation of the sand embraces such questions as the uses of new and old sand, sand mixing, core-making, binding materials. The various adaptations and uses of dry and green sand moulds in both non-ferrous and ferrous foundries are clearly defined. In addition to the determination of the properties already mentioned for natural sands, the chapter on laboratory investigation includes a discussion on such physical characteristics as tensile and compressive strength, shear strength, and also on the relationship of the results of the examination of sands to practice. Throughout, the book is commendably illustrated by diagrams and photographs, and the effects of varying conditions during both trials and ordinary employment are tabulated and also translated into graphs. Many of the forms of apparatus that are given are novel.—W. A. C. Newman.

Modern Materials Handling. By Simeon J. Koshkin. Med. 8vo. Pp. 488, with 174 illustrations. 1932. New York: John Wiley & Sons, Inc. ($6.00); London: Chapman and Hall, Ltd. (37*s.* 6*d.* net).

The general scope of this book is a detailed discussion of modern methods of handling various classes of materials that are met with in works' practice. The underlying principles that govern the choice of a particular type of plant and the considerations appropriate to a great number of illustrative examples are dealt with exhaustively. Data relating to the design and performance of standard equipment are next given to illustrate the main points which are considered. In brief, the contents include chapters on cranes of all types, general overhead transportation, trucks, conveyors, photo-electric control, hoists, elevators, coal and ash handling, and transport of foundry materials. Where it is necessary to introduce formulæ they are reduced to their simplest form and adequately explained. It will be gathered, however, that the book will be most useful to those who have industrial undertakings in their charge, and that it deals only lightly with the nature of the metals and alloys of which the plants described are made. One serious criticism is that the illustrations are too small; an attempt has been made to crowd too many on to a page, with the result that in some instances the details are very faint, and in others either obscured or missing. In affording a general insight into the problems that are studied the book probably fulfils its purpose.—W. A. C. Newman.

The Principles of Electric Welding. Metallic Arc Process. By R. C. Stockton. Cr. 8vo. Pp. vii + 184, with 73 illustrations. 1933. London: Sir Isaac Pitman and Sons, Ltd. (7*s.* 6*d.* net.)

This is an elementary text-book based on lectures given by the author to part-time students at the Manchester College of Technology. It will appeal mainly, therefore, to those who have little knowledge of metallurgy. It refers almost entirely to the welding of ferrous materials.
—H. W. G. H.