# METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

Volume 1

## **AUGUST 1934**

Part 8

## I.-PROPERTIES OF METALS

(Continued from pp. 337-310.)

The Reflecting Power of Aluminium and Its Alloys in Different Regions. D. H. Clewell and J. Wulff (*Phys. Rev.*, 1933, [ii], **44**, 952).—Abstract of a paper read before the American Physical Society. The reflecting powers of aluminium, beryllium, magnesium, silicon, and silver alloys have been measured throughout the region 2000–7000 A. at normal incidence by photographic intensity studies and by photoelectric measurements. The polished alloys have been compared with films of the same metals in reflecting power. Electron diffraction and chemical studies permitted a control of physical and chemical studies permitted a control of physical and chemical composition of the films. Here component metals were evaporated at the same time from different filaments at the proper temperature and separately. From the above data, the most efficient reflectors for the region of 2000–7000 A. have been determined: aluminium-silicon 2000–3000 A.; aluminium-silicon 3000-6000 A. an alloy film containing aluminium 85. silver 10, and silicon 5% has approximately the same reflecting power (80–85%) from 2300–5800 A.—S. G.

Magneto-Resistance of Bismuth Films at Low Temperature. C. T. Lane (*Phys. Rev.*, 1934, [ii], **45**, 733-734).—A note. Thin films of bismuth were prepared by evaporation on to strips of mica. With a current passing parallel to the long side of the film, the change in resistance produced by a magnetic field of about 16 kilogauss parallel to the surface of the film was measured at  $+20^{\circ}$  and  $-180^{\circ}$  C. With comparatively thick films ( $0.5-4.0\,\mu$ ) the change at  $-180^{\circ}$  C. is much greater than at  $+20^{\circ}$  C, the ratio diminishing slightly as the film becomes thinner. At about  $0.4\,\mu$  the curve changes direction abruptly, and indicates that the magneto-resistance will be independent of temperature for zero film thickness. This is explained by assuming that the diamagnetism of bismuth is due to electrons moving in long free paths in definite crystallographic directions, the paths being limited by a secondary structure in the threkness of the film equals the unit of the secondary structure.—W. H.-R.

Two New Phenomena at Very High Pressure [Allotropy of Bismuth and Phosphorus]. P. W. Bridgman (*Phys. Rev.*, 1934, [ii], 45, (11), 844–845).— A note. At room temperature with pressures above 25,000 kg./cm.<sup>2</sup> bismuth is transformed into a new modification with a volume decrease of about  $9^{\circ}_{0}$ . Extrapolation of the curve for the liquid indicates that the new allotrope at a higher temperature would melt with an expansion of the order  $4^{\circ}_{0}$ , in contrast to the abnormal contraction which takes place when the ordinary modification melts. The change from white to black phosphorus has also been studied.—W. H.-R.

The Longitudinal Thermoelectric Effect: (I.) Copper. P. C. Feng and William Band (*Proc. Phys. Soc.*, 1934, 46, 515-522).—F. and B. show that the e.m.f. can be regarded as of like nature with the Thomson potential as defined by Sommerfeld and Frank. The potential gradient in copper is not a linear function of the temperature gradient but requires quadratic and cubic terms for its expression. The linear term is retained for the Thomson effect,

<sup>\*</sup> Denotes a paper describing the results of original research.

<sup>†</sup> Denotes a first-class critical review.

which is thus distinguished from the e.m.f. which arises in asymmetrical states.-J. S. G. T.

The Absorption and Reflection of Gold Between 380 A. and 1400 A. I. B. Liben and H. M. O'Bryan (*Phys. Rev.*, 1933, [ii], **44**, 952).—Abstract of a paper read before the American Physical Society. With a one-meter vacuum spectrograph and a "hot-spark" between Carboloy electrodes, the reflection from gold mirrors at various angles of incidence, and transmission of thin gold films have been determined. Sputtered gold mirrors gave more reproducible reflecting powers than evaporated surfaces. At normal incidence 12% of 1000 A. is reflected with a gradual decrease to less than 1% of 400 A. The absorbing films were evaporated on celluloid films about  $10^{-6}$  cm. thick. The gold films appeared green by transmitted light and from their absorption in the region 2500-6000 A. are estimated to be from  $10^{-6}$  cm. to  $3 \times 10^{-6}$  cm. thick. The absorption coeff. is about  $5 \times 10^5$  per cm., showing that gold is almost as transparent as celluloid from 1000 to 400 A. Films of silver and selenium show quite different absorption in this region. Preliminary calculation by means of Fresnel's equations from the reflection data give values of the extinction coeff. which agree in order of magnitude with those from direct absorption. The oil-coated plates used were tested for reciprocity failure in the near ultra-violet and in the extreme ultra-violet gave parallel characteristic curves indicating no failure of this law over an intensity range of 30. The magnitude of the absorption in this region accounts for 3 electrons per atom of gold. This includes some of the O, IV, V electrons as well as the conduction electron.—S. G.

On Insects which Perforate the Lead Sheathing of Aerial Cables. Walter Horn (Arch. Post Telegr., 1933 (July), and Ann. Postes Télég. Téléph., 1934, 23, 559–573).—Damage by insects to cable sheathing is of widespread occurrence. Several typical cases are described and illustrated. General features are the cessation of insect attack when the inner (paper) sheathing is reached, the presence of pulverulent lead and lead compounds outside the borings, the absence of deformation or of preferential intercrystalline attack (thus disposing of certain previously suggested causes of failure) and the location of attack in the neighbourhood of cable suspensions. Protective measures have not so far proved of universal value: they include the use of arsenical lead for sheathing, an additional protective coating of rubber or copper (cost prohibitive), a tallow coating (temperate climates only), organic coatings of poisonous character (apt to deteriorate and to facilitate rather than inhibit attack). H. suggests the use of a modified suspension, of a light surface oxidation of the sheathing, and a closer attention to the surface condition of cables, as well as certain methods of entomological investigation.-P. M. C. R.

Manganese. M. Déribéré (*Métaux et Machines*, 1934, 18, 163-167).—A detailed review of the sources, production, properties, principal ferrous and non-ferrous alloys, and industrial applications of manganese. A *bibliography* of each section is given.—P. M. C. R.

\*The Specific Heat of Nickel and of Some Nickel-Copper Alloys. K. E. Grew (*Proc. Roy. Soc.*, 1934, [A], **145**, 509-522).—The specific heats of pure nickel and alloys of copper with 94.0%, 87.2%, and 78.8% of nickel have been determined over the temperature range  $-180^\circ$  to  $450^\circ$  C. Values of the specific heat,  $S_1$ , due to intrinsic magnetization and of the excess specific heat, S, over the "normal" value for a substance without intrinsic magnetization but otherwise similar are deduced.  $S_1$  accounts for a part only of S; the existence of a second term,  $S_1$ , having a common origin with the ferromagnetism, is necessary to account for the total excess  $S_1$ —J. S. G. T.

Adsorption of Hydrogen by Palladium Black under High Pressure. V. Ipatieff, Jr., and W. G. Tronow (J. Physical Chem., 1934, 38, 623-633).--The

solubility of hydrogen in palladium black at  $15^{\circ}$ ,  $25^{\circ}$ ,  $100^{\circ}$ ,  $150^{\circ}$ ,  $200^{\circ}$ , and  $300^{\circ}$  C. at pressures of from 1 to 27 atm. is investigated. J. S. G. T.

The Reaction of Sodium with Dry Oxygen. B. L. Herrington (J. Physical Chem., 1934, 38, 675–682).—Sodium amalgams exposed to oxygen dried over phosphorus pentoxide for more than a year were found to be instantly covered with a protecting film which prevented further action. Sodium will react with dry oxygen at room temperature with the emission of light, but the reaction ceases unless water vapour is present to prevent the formation of protective films. It remains to be proved that oxygen can be made so dry that it will not react with sodium.—J. S. G. T.

\*The Mechanism of Plastic Deformation of Crystals. I.—Theoretical. II.— Comparison with Observations. G. I. Taylor (Proc. Roy. Soc., 1934, [A], 145, 362-387 and 388-404).-The fact that the macroscopic distortion of metal crystals is a shear parallel to a crystal plane and in a crystal direction, and the fact that this remains true even when the distortion is large, show that the plastic strain must be due chiefly to the sliding of one plane of atoms over its immediate neighbour in such a way that the perfect crystal structure is re-formed after each atomic jump. Slipping occurs over limited lengths, L, of the slip-plane, and it is shown that this type of plastic strain gives rise to elastic stresses near the two dislocations which occur at the two ends of each of these lengths L. The assumption that such dislocations will migrate through the crystal, owing, possibly, to temperature agitation, then leads to a definite picture of the mechanics of plastic distortion. This theory of strain hardening gives a parabolic relationship between stress and plastic strain which agrees well with results obtained with metals crystallizing in the cubic system. L is found to be of the order  $10^{-4}$  cm., agreeing with the order of magnitude of faults found in metals and rock-salt. The system of faulting or mosaic structure limits the free motion of centres of dislocation. The actual strain occurs inside the "blocks" of the mosaic structure, and the crystallographic nature of the faults is immaterial from the point of view of the theory.-J. S. G. T.

Scattering of X-Rays by Cold-Worked and Annealed Beryllium [Theory of Cold-Worked Metals]. James E. Boyd (*Phys. Rev.*, 1934, [ii], 45, 832-834).— Geiss and — van Liempt (*Z. anorg. Chem.*, 1924, **133**, 107; 1925, **143**, 259) suggested that the charge distribution in the atoms of a cold-worked metal differs from that of the atoms of the same metal in annealed crystals, and if so a change in the atomic structure factor (*F*) curve is to be expected. B. has investigated the intensities of reflection from different planes of powdered beryllium crystals before and after annealing, and the atomic structure factors derived from these results show no change with annealing. The beryllium was of 99.5% purity, and was brittle [*Note by abstractor:* pure beryllium is ductile], but some flattening of the particles occurred on grinding.—W. H.-R.

\*Comparative Studies on Creep of Metals [Iron, Nickel, Cobalt, Silver, Iron-Chromium-Nickel Alloy, and Iron-Chromium-Silicon Alloy] Using a Modified Rohn Test. C. R. Austin and J. R. Gier (*Metals Technology*, 1934, (Feb.), *A.I.M.M.E. Tech. Publ.* No. 544, 1-21).—A modification of the Rohn test has been used to investigate the creep properties of iron (99-967%), nickel (98-78%), cobalt (99-32%), fine silver, and some ferrous alloys. The effect of the method of application of the load on test results is examined. At the higher temperatures the effects of minute amounts of plastic deformation on resistance to further creep become of less importance. Methods for obtaining derived curves which show the results more clearly are described, and the advantages of the method are emphasized.—W. H.-R.

\*Elastic Behaviour and Creep. M. F. Sayre (Amer. Soc. Mech. Eng., Preprint, 1933.)—No clear-cut differentiation appears to exist between creep effects which occur below the elastic limit and the more pronounced plastic yield which occurs at higher stresses. One apparently merges gradually into

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the other. In general, the amount of creep and hysteresis seems to be definitely related (a) to the temperature of the metals and (b) to its state of internal stress.-W. P. R.

'Hooke's Law Amended [Elastic Phenomena in Instrument Springs]. R. W. Carson (Instruments, 1934, 7, 109-112) .- In designing instrument springs. account must be taken of clastic ageing (a slow permanent change in clastic properties) and elastic lag. Ageing is caused by internal stresses and can be prevented by suitable heat-treatment. Lag is of two types— statical hysteresis " or " elastic back-lash " which is nearly independent of time, and "hereditary hysteresis" or "time lag" which is similar to creep, is influenced by internal stresses, and can be controlled by heat-treatment. A critical survey of these phenomena is given, together with a bibliography of 21 references.-J. C. C.

An Elementary Discussion of Ferromagnetism. Francis Bitter (Proc. Roy. Soc. 1934, [A], 145, 629-644).-The statistical theory of spontaneous magnetization, based on a model consisting of a geometrical array of magnetic elements, of which only the nearest neighbours interact, is discussed. An attempt is made to show quantitatively that discrepancies between the magnetization curves predicted by the theory and experimental curves for iron and nickel crystals in weak fields are due to crystal imperfections.

J. S. G. T.

# **II.**—**PROPERTIES OF ALLOYS**

(Continued from pp. 340-346.)

\*Internal Stresses in Quenched Aluminium and Some Aluminium Alloys. L. W. Kempf, H. L. Hopkins, and E. V. Ivanso (Metals Technology, 1934. (Feb.), A.1 M.M.E. Tech. Publ. No. 535, 1-23) .- Cylindrical bars of pure (99.97%) aluminium, and of 5 ternary or quaternary aluminium-rich alloys were cast and machined to form eylinders of from 5 to 7 cm. in diameter, and 26-29 cm. in length, which were annealed at 343 C. to remove casting and machining stresses. The specimens were heated at different temperatures up to 538° C., and then quenched in (a) ice-water, (b) oil at 25° C., or (c) boiling water in order to give 3 different rates of cooling. The resulting internal stresses were then determined by (1) machining off successive layers of the metal and measuring the change in length of the cylinder (Heyn, J. Inst. Metals, 1914, 12, 3), or (2) by boring out the cores of the cylinders, and measuring the variations in length and diameter (Sachs, Z. Metallkunde, 1927, The latter method permits the determination of the longitudinal, transverse, and radial stresses. The internal stresses increase with the rate **19**. 352) of cooling, and under extreme conditions may reach values of the order 10,000-30.000 lb./in.2, the outside of the cylinders being in compression, and the centre in tension. The details of stress-distribution are illustrated graphically. It is concluded that in castings or forgings of smaller size quenched or heattreated under commercial conditions internal stresses will not lead to trouble, particularly if the quenching is in hot water. Internal stress can be removed in a short time only by heating above 260° C.-W. H.-R.

Some Peculiarities in the Physical Properties of Iron-Aluminium Alloys. C. Sykes and H. Evans (Proc. Roy. Soc., 1934, [A], 145, 529-539).-The electrical resistivity at room temperature of iron-aluminium alloys containing from 11 to 16% of aluminium by weight, is shown to depend on the rate of cooling of the specimens from about 600° C. Alloys in this range consist of a single solid solution at all temperatures concerned. Rearrangement of atoms takes place in the alloys under slow cooling conditions, and the more regular atomic arrangement so produced leads to a decrease in resistance. Atomic rearrangement occurs over a considerable temperature range even under conditions of very slow cooling .-- J. S. G. T.

**Special Alpax Alloys.** P. Barrand (*Rev. Aluminium*, 1934, **11**, 2421–2423).—The mechanical properties and limitations of Alpax (Silumin) are summarized and the work that has been done on the effects of adding manganese, copper, magnesium, zinc, cobalt, and nickel to the alloy is reviewed. The results of Petit's experiments on the alloys containing manganese 0.5 and magnesium 0.2-0.3% are briefly described. Of these alloys, the one containing manganese 0.5 and magnesium 0.3% (silicon 12-13%) is recommended for an alloy having the highest elastic limit, but by reducing the manganese to 0.3%, a higher percentage elongation is obtained. The alloys are usually quenched and tempered, but even tempering alone gives an alloy with better mechanical properties, especially the elastic limit, than ordinary Alpax.—J. H. W.

\*Dimensional Changes in Die-Casting Alloys. Metastable Beta Phase in Aluminium-Zine Alloys.—II. R. G. Kennedy (Metals and Alloys, 1934, 5, 124-126).—Cf. Met. Abs., this volume, p. 346. The hardness of the 78-3% zine alloy quenched in ice-water increases to a maximum of 120 (Baby Brinell) in 40 minutes, then decreases rapidly; for the 83% zine alloy under the same conditions the maximum hardness of 100 is reached in 6 minutes. In both cases no change in hardness occurs on prolonged storage at — 70° C., but on warming to 0° C. after this treatment the same changes occur as though the alloy were quenched in ice directly. The contraction which occurs during the hardnening is almost completely suppressed by addition of 0.21% of magnesium, although X-ray examination shows that the transformation of  $\beta$  to  $\alpha + \gamma$  is not affected by this addition. Apparently the contraction is compensated for by the precipitation of a magnesium-rich phase during ageing.—A. R. P.

\*Solubility of Oxygen in Solid Copper. F. N. Rhines and C. H. Mathewson (Metals Technology, 1934, (April), A.I.M.M.E. Tech. Publ. No. 534, 1-17).-The solid solubility of oxygen in copper has been measured between 600° and 1050° C. by exposing copper of purity greater than 99.99% to the action of air at different temperatures for long periods, removing the scale, and then determining the composition of the inner saturated portion by analysis. The solubility increases from 0.007% oxygen at 600° C. to about 0.015% at 1050° C., in fair agreement with the results of Hanson, Marryat, and Ford (J. Inst. Metals, 1923, 30, 197), but in contradiction to those of Vogel and Pocher (Z. Metallkunde, 1929, 21, 333, 368). Age-hardening could not be observed, but evidence was obtained of the precipitation of cuprous oxide on re-annealing at low temperatures. Oxygen can be removed from solid copper by heating at high temperatures in vacuo without the use of reducing agents, whilst cuprous oxide also decomposes on heating at low pressures. The pressure-temperature diagram of the system copper-cuprous oxide is discussed. -W. H.-R.

New Requirements for Copper Alloy Tubes. D. K. Crampton (Metal Progress, 1934, 25, (66), 20–24).—The need for higher quality and greater durability in copper alloy tubing has been intensified by severer service conditions, the increased use of softened water, the installation of circulating systems in hot-water lines, and the earthing of electrical eircuits on water pipes. Modifications in design and in production equipment are described for tubes of hard and soft temper copper. The development of the sweated joint has resulted in an increased use of copper tubing in water and compound air systems. The Admiralty alloy for condenser tubing has serious competitors in aluminium-brass (copper 76, zinc 22, aluminium 2%), cupro-nickel, and copper-nickel-aluminium-bronze (92:4:4%). The treatment of copper intended for refrigeration tubing is fully described.—P. M. C. R.

\*Contribution to Our Knowledge of the System Copper-Lead-Sulphur. W. Guertler and G. Landau (*Metall u. Erz*, 1934, 31, 169-179).—All alloys in the lead-lead sulphide system are two-phase and show a strong tendency to

segregation; 51 alloys in the ternary system lead-copper-sulphur have been investigated, and the results are shown in a ternary diagram. Alloys having a composition near the quasi-binary system lead-cuprous sulphide separate into three layers on cooling, the middle layer consisting of a little cuprous sulphide in lead and appearing to be formed by the reaction of lead sulphide in the top layer with the copper in the lower layer during cooling from 942° to 600° C. The results show that two-layer copper-lead alloys used for bearing metals can be made practically homogeneous by addition of 0.67-1.6% of

sulphur, and casting from above 960° C., followed by slow cooling.—A. R. P. \*Action of Hydrogen Sulphide on Copper-Lead-Sulphur Alloys. W. Guertler and G. Landau (*Metall u. Erz*, 1934, 31, 269–272).—Passage of hydrogen sulphide through molten lead-copper-sulphur alloys first sulphidizes the copper, forming an upper eutectic layer of cuprous sulphide and lead sulphide; later a middle layer of cuprous sulphide in lead forms. The bottom layer consists of cuprous sulphide and copper in lead. Below 942° C. the reaction ceases.—A. R. P.

Mechanical Properties of Standard Ingot Bronzes. E. Moustacas (Cuivre et Bronze, 1932, (31), 17-25; (32), 19-25; (33), 23-27).—A general discussion of the relative mechanical properties of certain standard railway bronzes made from new metals, partly of new metal, or wholly of reclaimed metal. Some details of the tolerances allowed, and of the qualities demanded in bronzes used on French railways are included. A résumé of the discussion is given. The general conclusion appears to be that a certain amount of twicemelted metal is preferable in a casting, but that comparative tests are likely to be misleading unless the test-pieces are taken from identically similar positions in the moulding boxes or on the castings.—W. A. C. N.

**Bronzes.** M. Godfroid (*Rev. Fonderie moderne*, 1934, 28, 141-145, 163-165).—The definition of a bronze is discussed, and the melting, properties and applications of ordinary bronze, "aluminium-bronzes," and special bronzes containing phosphorus, lead, zinc, and nickel are described.—J. H. W.

†Studies on Cast Red Brass for the Estimation of a Basic Classification of Non-Ferrous Ingot Metals for Specification Purposes. C. M. Saeger, Jr. (Met. Ind. (Lond.), 1934, 44, 607-609; and Found. Trade J., 1934, 50, 359-361, 370, 395-398).—Read before the Institute of British Foundrymen. An investigation has been made for purposes of classification of the tensile strength, Brinell hardness, electrical resistance, and density of alloys having the nominal composition : copper 85, tin, zinc, and lead each 5%. The alloys were made from virgin and remelted metal, and were poured at  $1040^{\circ}-1260^{\circ}$  C. They were classified as : (1) bars from chill ingots; (2) bars from "immersedcrucible" ingots, and (3) sand-cast bars. The addition of 0.1% sulphur lowers the physical properties less than higher casting temperatures. The addition of up to 0.6% of iron improved the physical properties, but raised the electrical resistivity. A number of references are given.—J. H. W.

\*Electrical Conductivity and Equilibrium of Binary Alloys. XII.—The Lithium–Bismuth System. G. Grube, H. Vosskühler, and H. Schlecht (Z. Elektrochem., 1934, 40, 270–274).—The equilibrium diagram of the lithium– bismuth system has been constructed from the results of thermal analysis and electrical resistance determinations. The compound,  $Li_3Bi$ , melting at 1145° C., is formed, and the compound, LiBi, is formed by the peritectic reaction at 415° C. This latter exists in 2 polymorphic forms, the transformation temperature being 400° C. The solid solution range of the system cannot be determined.—J. H. W.

\*The Lithium-Magnesium Equilibrium Diagram. Otto H. Henry and Hugo V. Cordiano (*Metals Technology*, 1934, (Feb.), A.I.M.M.E. Tech. Publ. No. 536, 1-14).—The constitution of the magnesium-lithium system has been investigated by thermal and microscopic methods. Cooling curves were taken using a closed steel crucible for all except the magnesium-rich alloys, which were melted under flux. The solid solubility curves were investigated by annealing for a few hours only. The two metals are completely miscible in the liquid state, and partly miscible in the solid state to form 2 primary solid solutions separated by a 2-phase area. The magnesium-rich solid solution extends to approximately 4.9% lithium by weight at 550° C., and the solubility limit probably increases with temperature up to 591° C. At this temperature a peritectic reaction takes place, and the solid solution in lithium is formed, the solubility limit at the peritectic temperature being approximately 90.2% magnesium by weight. The solid solubility of magnesium in lithium decreases with temperature, and is estimated tentatively as about 88% magnesium at room temperature.—W. H.-R.

\*The Mechanism of the Oxidation of Magnesium Alloys at High Tempera-R. Delavault (Compt. rend., 1934, 198, 1929-1932). - The mechanism tures. of the oxidation of solid magnesium and magnesium alloys at high temperatures has been investigated. The specimens consisted of commercially pure magnesium and its alloys with 0.2-10% of sodium, thallium, calcium, zinc, cadmium, aluminium, lead, tin, bismuth, silicon, copper, and silver in the form of small cubes with one polished face, and were heated in an electric furnace in contact with air. Micro-examination in oblique light showed that (1) all parts of the specimen which exhibited protuberances had started partial fusion, with two distinct appearances according as to whether the expansion due to the partial fusion had or had not been compensated by deformation of the rest of the metal; (2) the protuberances nearly always appeared between the crystals and in those places which first showed signs of fusion. Thus when magnesium contains 10% or less of a foreign metal, oxidation begins through the medium of a liquid phase on which are formed protuberances which offer a large surface in contact with air. A recent study of calcium shows that this phenomenon is not confined to magnesium .-- J. H. W.

Nickel-Chromium. I.-Nickel Alloys Resistant to Corrosion. Nickel Informationsbüro G.m.b.H. (Nickel-Handbuch, 1934, 60 pp.).-A very brief summary is given of the nature of corrosion, the factors which are instrumental in promoting it, and the chemical and physical reactions involved. The following points are dealt with : the effect of nickel and chromium in raising the resistance of iron to corrosion; the relevant portion of the ternary diagram in relation to the corrosion properties of the various alloys, among which are included nickel-chromium, nickel-chromium-iron, nickel-iron (containing also molybdenum, copper, silicon, &c.), austenitic chromium steels, pearlitic and martensitic chromium-nickel steels, nickel cast-iron. Numerous tables indicate the resistance of these materials to the action of various industrial chemicals. A review is given of factors to be borne in mind when choosing an alloy for use in corrosion conditions with a list of parts commonly used in the food, building, sanitation, chemical, ceramic, glass, engineering, railway, shipping, and metallurgical industries in which nickel bearing alloys may be used. Brief instructions are added for the working of the alloys-forging, annealing, hardening, deep-drawing, welding, soldering, polishing, sandblasting, and etching.-W. A. C. N.

Electrical Properties of Copper-Nickel Resistance Alloys. S. Kimura and T. Aizawa (Japan Nickel Rev., 1933, 1, 391).—[In English and Japanese.] Abstracted from Res. Electro-tech. Lab. (Tokyo), 1926, No. 171, 1-10. See J. Inst. Metals, 1926, 36, 447.—W. A. C. N.

#### III.—STRUCTURE

## (Metallography; Macrography; Crystal Structure.)

#### (Continued from pp. 347-348.)

\*The Beilby Layer. G. I. Finch, A. G. Quarrel, and J. S. Roebuck (*Proc. Roy. Soc.*, 1934, [A], 145, 676–681).—From observations made on metal films deposited on polished and etched surfaces, employing an electron diffraction camera, it is concluded that the existence of the Beilby layer has been raised from the realm of hypothesis to that of established fact.—J. S. G. T.

Studies upon the Widmanstatten Structure. VI.—Iron-Rich Alloys of Iron and Nitrogen and of Iron and Phosphorus. Robert F. Mehl, Charles S. Barrett, and H. S. Jerabek (*Metals Technology*, 1934, (April), *A.I.M.M.E. Tech. Publ.* No. 539, 1–18).—W. H.-R.

\*Multiple Laue Spots from Aluminium Crystals. A. Komar and W. Obukhoff (*Phys. Rev.*, 1934, [ii], **45**, 646).—A note. See *Met. Abs.*, this volume, p. 347.—W. H.-R.

\*Disintegration of Sputtered Deposits [ot Metallic Films of Bismuth, Antimony, and Gold]. Ellis A. Johnson and Louis Harris (*Phys. Rev.*, 1934, [ii], 45, 630-634).—Factors affecting the deposition and disintegration of metallic films by cathodic sputtering are investigated, and the results discussed.—W. H.-R.

\*The Crystal Structure of Mercury. C. Hermann and M. Ruhemann (Z. Krist., 1932, 83, 136–140; C. Abs., 1932, 26, 5467).—Single crystal measurements were made on an unoriented crystal of mercury at — 50° C. The data secured were successfully interpreted in accordance with the structure proposed by McKeehan and Cioffi (*Phys. Rev.*, 1922, [ii], 19, 444) on the basis of powder photographs, thus confirming their results.—S. G.

\*The Effect of Thermal Agitation on Atomic Arrangement in Alloys. W. L. Bragg and E. J. Williams (Proc. Roy. Soc., 1934, [A], 145, 699-730).-Equilibrium states of an alloy are considered and the degree of order of the structure as a function of temperature is calculated. The ordered structure has a lower potential energy than the disordered structure, but thermal agitation promotes disorder. Above a critical temperature the structure is completely random. As the temperature is lowered, order sets in abruptly at the critical temperature and, at first, increases rapidly. It becomes complete only as absolute zero is approached. This characteristic sudden onset of order causes a sharp inflection in curves showing the variation of resistivity, lattice spacing, and specific heat with temperature. These inflections simulate a phase-change, but actually there is no such change. A general law for the dependence of rate of relaxation on temperature is derived, and this enables the effects of annealing and quenching to be predicted. The rate of relaxation depends on the "activation energy" required to surmount a potential barrier when two atoms exchange position. An alloy is a system of dynamical equilibrium; it receives its character at a point in its history when the temperature is just sufficiently high for interchange to occur. Maxima and minima in physical properties do not imply the existence of compounds; they are statistical effects.-J. S. G. T.

About the Origin of the Mosaic Structure in Metal Crystals. A. Goetz (*Phys. Rev.*, 1934, [ii], **45**, 138).—Abstract of a paper read before the American Physical Society. In order to explain the periodicities of higher orders (secondary or mosaic structures) it is suggested that an aggregation of groups takes place during an interval of temperature of a few degrees *above* the melting point. These aggregates ("groups") are of approximately equal size and their existence is essential for the formation of a solid crystal. If their formation is prevented, undercooling results down to a temperature at which

the group formation is more probable. The support for this hypothesis is found partly in experiments by G. concerning the "survival" of crystalline qualities of single crystals beyond the melting point; partly in Webster's experiments on the phenomena of undercooling as a function of previous heating; partly by the fact that the X-ray analysis of liquid metals whose structure in the solid state deviates much from close-packed arrangements does not give an indication of a statistical distribution of the molecules in the liquid. It is suggested that the mosaic structure in solids is caused by the slight structural deformation which the molecules at the surface of the groups possess in the moment of the transition into the solid state. The variation in the size of these groups as well as slight inaccuracies of their packing may serve to explain the failure to observe diffraction patterns of such structures and also the dependence of such structures on the methods of growth of the crystal .- S. G.

The X-Ray Investigation of Microstructure. W. E. Schmid (Arch. tech. Messen, 1934, 3, (35), T62).-See also Met. Abs., this volume, p. 348. Important applications of X-ray examination are enumerated and described, notably the determination of (a) the crystalline or amorphous nature of the sample examined; (b) grain-size in crystalline materials, and (c) crystal orientation.-P. M. C. R.

Practical Auxiliaries in the Evaluation of Atomic Structural Investigations. Maximilian v. Schwarz and Oskar Summa (Forschungsarb. Metallkunde u. Rontgenmetallographie, 1932, (6), 40 pp.; C. Abs., 1933, 27, 3390).-Mathematical formulæ, methods, graphic aids, tables, curves, &c., useful in the evaluation of X-ray analysis data, are presented. -S. G.

# IV -CORROSION

#### (Continued from pp. 348-351.)

Contribution to the Question of the Influence of the Heat-Treatment of Hardenable Aluminium Rolling Alloys on Their Resistance to Corrosion by Sea-Water. Oskar Summa (Korrosion u. Metallschutz, 1934, 10, 57-58).-A theoretical discussion of the part played by the structural constituents of aluminium alloys in the corrosion of the alloys by sea-water and the effect of heat-treatment on the electrochemical behaviour of the constituents.

-A. R. P.

\*Action of Acids on Iron and Copper [Corrosion of Sugar Factory Apparatus]. J. Zamaron (Bull. assoc. chim. sucr. dist., 1933, 50, 108-113; C. Abs., 1934, 28, 3932).-Abnormal corrosion of diffusion battery steel calorizator 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 one-tenth as great in sulphuric acid and much less in acetic acid.

-S. G.

On the Resistance to Corrosion of Bronzes. O. Dahl (Korrosion. Bericht über die 111. Korrosionstagung, Berlin, 1933, 23-34; discussion, 35-36).-A review of recent work on the resistance of tin, tin-zinc, nickel, aluminium, and beryllium-bronzes to corrosion, especially by sea-water. 19 references are given.-A.R.P.

\*Influence of the Annealing Treatment on the Resistance to Corrosion of Condenser Tubes. E. Schumann (Korrosion. Bericht über die 111. Korrosionstagung, Berlin, 1933, 47-57; discussion, 58-60).-The tests were made on tubes of an alloy containing copper 70.43, tin 0.87, iron 0.02, aluminium 0.05, lead 0.03, and zine 28.6% in hard tap-water and in salt-water (about 1.2% sodium chloride). The resistance to corrosion was found to depend chiefly on the internal stress, the best resistance being obtained with annealed tubes having a medium-size grain. This structure was obtained by annealing at 400° C.; with increasing annealing temperature the grain-size became coarser and the corrosion-resistance fell to a minimum at 650° C., whereas with a lower annealing temperature than 400° C. the protective film first formed tended to break owing to residual stress in the metal. Removal of the skin produced in annealing considerably reduced the resistance to corrosion. A laboratory apparatus for testing the behaviour of condenser tubes in corrosive media is described.—A. R. P.

\*Corrosion of Brass in Water Subjected to  $p_{\rm H}$  Correction. Edward W. Moore (J. New England Water Works Assoc., 1934, 48, 47-58; C. Abs., 1934, 28, 3818).—Dezincification seems to decrease from  $p_{\rm H}$  6.0 to a minimum at  $p_{\rm H}$  10.0 and then to increase slightly. This condition appears to be reversed for copper. The tests covered a  $p_{\rm H}$  range from 6.0 to 11.0. Discussion emphasizes the importance of salts in solution and suggests that  $p_{\rm H}$  control will not solve the problem.—S. G.

Zinc in Drinking Water. August G. Nolte and Warren A. Kramer (*Amer. City*, 1934, 49, (4), 63-64; C. Abs., 1934, 28, 3816).—Tap-water in contact with galvanized piping reacts with the zinc to form a basic zinc carbonate. The highest concentration found from any much-used tap was 5 p.p.m. The presence of dissolved carbon dioxide hastens the solution of zinc, whilst dissolved sulphates retard solution. It is concluded that zinc in concentrations found in drinking water has no harmful physiological effects.—S. G.

Prevention of Corrosion [in Tannery Liquors]. M. P. Balfe (Leather World, 1933, 25, 1217; J. Amer. Leather Chem. Assoc., 1934, 29, 171; C. Abs., 1934, 28, 3935).—Applied protective coatings are unsatisfactory for metals in contact with moving tanning liquors. Suitable alloys are: for acid pickle and chrome tan liquors—Monel metal; for lime liquors—iron, because oxide film forms; for tan liquors—copper-alloys (oxide film); for bleach liquors—aluminium-brass ( $Al_2O_8$  film).—S. G.

\*The Corrosive Properties of Dichloroethane and Trichloroethylene. S. S. Drozdov and N. S. Drozdov (*J. Chem. Ind.* (*Moscow*), **1934**, (2), **53**–54; *C. Abs.*, 1934, **28**, 3704).—[In Russian.] Iron, lead, and copper are appreciably corroded by these solvents, but less so by their vapours. Extraction of the metals in a Soxhlet apparatus causes greater corrosion than mere standing in the solvents. The presence of water increases the corrosion. In all cases the iron is the most strongly corroded and the copper the least. Trichloroethylene acts more strongly than dichloroethane. Free chlorine ion is always found in the solvents after their action on the metals.—S. G.

\*Experiments on the Newton Water and Treatments for the Control of Corrosion. F. Wellington Gilcreas (J. New England Water Works Assoc., 1934, 48, 105–116; C. Abs., 1934, 28, 3818).—An effort was made to duplicate domestic conditions—12 hrs. of movement and 12 hrs. of rest. Untreated and aerated water, without and with soda ash to give  $p_{\rm H}$  8·2, was used. Dissolved oxygen, carbon dioxide, and  $p_{\rm H}$  were determined. Corrosion losses on wrought iron, galvanized iron, brass pipe, and copper tubing are shown. The treatment adopted did not include aeration, but corrected the  $p_{\rm H}$  with soda ash to between 7·6 and 8·0. The treatment started in December 1931 and the results are considered to be satisfactory.—S. G.

Corrosion Studies in Steam Heating Systems. R. R. Seeber, F. A. Rohrman, and G. E. Smedberg (*Heating, Piping, Air-Conditioning*, 1934, 6, 124-126; *C. Abs.*, 1934, 28, 3704).—Progress made to date is reported on the investigation of the relationship of oxygen, carbon dioxide,  $p_{\rm H}$  value, and method of operation on the corrosive properties of condensate in steam heating systems. -S. G.

\*Corrosion and Fatigue. K. Laute (Korrosion. Bericht uber die 111. Korrosionstagung, Berlin, 1933, 1-10; discussion, 10-11).—Under alternating compression-tension stresses (100 million cycles) the endurance limit of electrolytic copper in water is the same as in air; this applies to the hard-drawn metal, annealed metal, and coarsely crystalline annealed metal. Welding and brazing reduces the endurance limit to the same extent in air and water. Values are also given for various steels showing a big reduction in the endurance limit und r water. —A. R. P.

Effect of Corrosion on Fatigue Limit. H. Ochs (Schriften Hess. Hochschulen, 1932, (4), 55-59).-S. G.

Influence of Volta Effect on Corrosion. R. J. Piersol (Metal Cleaning and Finishing, 1934, 6, 109-114; C. Abs., 1934, 28, 3704).—A discussion. Methods for determining electrode potentials are given.—S. G.

On the Influence of Surface Films on Corrosion [of Metals].—I. Willy Machu [with W. J. Müller] (*Oesterr. Chem.-Zeit.*, 1934, 37, 46-50).—The detection and properties of protective films on metals are discussed and methods of producing such films are described briefly, with especial reference to the formation of sulphate films on lead.—A. R. P.

Outline of Stray Current Electrolysis. Ira D. Van Giesen (J. Amer. Water Works Assoc., 1934, 26, 653-671).—A general review dealing with the action of stray currents in causing corrosion of underground structures, methods of reducing leakage currents, and the preparation of electrolytic surveys.—J. C. C.

10th Report of the Corrosion Committee of the Association Suisse des Electriciens and Three Associated Societies. J. Landry and others (Bull. Assoc. Suisse Elect., 1934, 12, 322-324).—The work undertaken by the Committee in 1933 includes : (1) experiments on corrosion of metallic objects by soil electrolysis, using a controlled current of known strength; (2) periodical inspection of most of the federal and municipal railways and tramways, with a view especially to investigating the corrosion of welded joints and the effects of short circuits in supply cables: (3) corrosion tests on lead, light alloys, and various types of ferrous materials, some galvanized, in 3 different soils, with variable and reversible current, reproducing the conditions of subterranean conductors in the neighbourhood of tramways or electric rails. Reports on the soil-corrosion of pipes were received.—P. M. C. R.

Gold as a Corrosion Resistant. P. Steen and O. P. van Steewen (Werkstoffe u. Korrosion, 1933, 8, 37-39; C. Abs., 1934, 28, 3043).—Gold in the form of plating has the advantages of being resistant to oxidation, acids, and alkalis; it has low heat radiation coeff., small grain-size and other advantages, which are discussed.—S. G.

# V --- PROTECTION

(Other than Electrodeposition.)

# (Continued from pp. 351-352.)

Electrolytic Oxidation of Aluminium by the Eloxal Process. E. Herrmann (Schweiz. Tech. Z., 1933, (46), 695).—The electrolyte consists of a 3-10% aqueous solution of oxalic acid containing 0.1% chromic acid, and is used at a temperature of  $15^{\circ}$ - $30^{\circ}$  C. D.c. or a.c. may be employed. For thin films that are afterwards to be coloured only 1–2 kw.-hr. per in.<sup>2</sup> are required. For denser films it is necessary to have 10-12 kw.-hr. per in.<sup>2</sup>. In general, agitation of the baths is not undertaken.—W. A. C. N.

Application of Aluminium to Reaction Chambers Prevents Metal Loss. H. R. Leland (Nat. Petroleum News, 1934, 26, (15), 25-26).—Read before the (U.S.) Western Refiners' Association. An account of the performance of metallized aluminium coatings on the interior walls of refinery reaction chambers. The coating gave satisfactory service in coke chambers, a flash tower, a Dow surge pot, and boiler tubes. Metallizing with 18-8 has been successfully applied to worn plungers. Methods of application and inspection are described in some detail.—P. M. C. R.

New Methods of Protection from Corrosion. R. Doczekal (Sparwirt., 1933, 11, (1), 20-22; Build. Sci. Abs., 6, 165; C. Abs., 1934, 28, 3367).—The Parker process is described. Variations of weight are shown which were observed with test-specimens of steel exposed to various reagents after Parkerizing, Sherardizing, coating with tin, nickel, zinc, or painting. Results are given of an accelerated corrosion test in which steel protected by various methods, including the Parker process, was sprayed with a corrosive solution and observation was made of time required for rust to appear. Reference is made to the Parkolite spray process, the Bonderite process, the Protal process for aluminium, and also to the Udylite process for the electrodeposition of cadmium.—S. G.

The Varying Behaviour of Zinc Protection Plates in the Boilers of Railway Ferryboats. R. Kühnel (Korrosion. Bericht über die 111. Korrosionstagung, Berlim, 1933, 42-46).—Wide variations in the life of protective plates of zinc in boilers have been investigated; the zinc contained  $1-1\cdot7\%$  lead and minor amounts of iron, but no relation was found between the composition and the rate of corrosion. Hard plates behaved much better than soft ones the best life being obtained when the Brinell hardness exceeded 46.—A. R. P.

Painted, Lacquered, and Pickled Surfaces and Their Resistance to Corrosion. P. Steen and O. P. van Steewen (*Bauing.*, 1933, 14, 160–162; *Build. Sci. Abs.*, 6, 127; *Sci. Abs.*, 1934, 28, 3367).—The corrosion-resistance of steel, copper, and aluminium surfaces which have not been galvanized, but are protected by coatings of oil paint or lacquer, the properties of oils and lacquers which are essential to the prevention of corrosion beneath the paint, and methods of pickling, which, besides affording protection, also produce definite colours are discussed.—S. G.

\*Study of the Anticorrosion Power of Paints on Tinned Cans. A. Vila (Recherches et Inventions, 1933, 14, 308–318; C. Abs., 1934, 28, 3915).—Comparative tests were carried out on 4 laboratory-prepared paints and 22 commercial paints and 6 commercial varnishes, which were applied to tins (over 1000 altogether) and exposed to the atmosphere for about 1 year. Four paints, all of which contained only or largely ferric oxide as pigment, in various oils, showed little or no change at the end of the test; but it should be noted that the colour of these paints (red in all cases) does not lend itself readily to observations of small changes in appearance.—S. G.

Tests Carried Out on Anticorrosion Paints. A. Vila (Recherches et Inventions, 1933. 14, 318-321; C. Abs., 1934, 28, 3915).—A brief discussion showing the difficulties of obtaining a satisfactory rapid test for evaluating the quality of anticorrosion paints and that no satisfactory artificial ageing test has as yet been devised. The quality of anticorrosion paints is due essentially to their impermeability to agents exerting a destructive action on the surface to be protected. So far, the most satisfactory test devised is the mercuric chloridesodium chloride test (see following abstract).—S. G.

The Permeability of Anticorrosion Paints. A. Vila (Recherches et Inventions, 1933, 14, 328-331; C. Abs., 1934, 28, 3915).—The mercuric chloridesodium chloride test is described. When the test was applied to a number of paints that had been subjected to exposure to the weather over a prolonged period, the results were in agreement with those of the exposure tests.—S. G.

Anticorrosion Paints. Study of the Anticorrosive Power of Commercial Paints. A. Vila (Recherches et Inventions, 1933, 14, 290–303; C. Abs., 1934, 28, 3915).—A more detailed description of the tests comparing white lead and aluminium paints on the one hand with lead-free paints, both commercial and prepared in the laboratory, on the other.—S. G.

\*Tests on Anticorrosion Paints. A. Vila (*Recherches et Inventions*, 1933, 14, 303–308; C. Abs., 1934, 28, 3915).—A description of the tests carried out (on 8 steels) on 28 different paints under 4 sets of conditions (over 1000 test strips). —S. G.

# VI.-ELECTRODEPOSITION

#### (Continued from pp. 352-354.)

The Preparation of Silver Baths by Anodic Dissolution of Fine Silver. K. W. Fröhlich (*Mitt. Forschungsinst. Edelmetalle*, 1934, 8).—Silver-plating baths can be prepared by electrolysis using large sheet silver anodes and small copper-rod cathodes in a cyanide solution containing 50–75 grm. of potassium cyanide per litre. The cathode is preferably surrounded by a porous clay diaphragm, and current is supplied at 3 v. to give an anode current density of 0.4 amp./dm.<sup>2</sup> with a cathode current density of 200 amp./dm.<sup>2</sup>. About 50 grm./litre of silver can be dissolved in this way in about 6 hrs. with the deposition of less than 1 grm. of silver on the cathode.—A. R. P.

\*The Electrodeposition of Tantalum from Aqueous Solutions. N. Isgarischew and A. F. Prede (Z. Elektrochem., 1934, 40, 295-297).—Different types of solutions for the electrodeposition of tantalum have been investigated, especially those containing glucose, potassium salicilate or resorcinol. Cathodic deposition is possible from all 3 solutions. In the case of the first two, metallic deposition ceased a short time after the beginning of the test, the initial current efficiency being very low; this, however, was not observed in the case of the resorcinol solution.—J. H. W.

A Method for Measuring the Adherence of Electrodeposits. P. Jacquet (Compt. rend., 1934, 198, 1313-1315).—A method for measuring the adherence of electrodeposits depends on the fact that a deposit can be separated from its base if one of its extremities is detachable. For instance, a strip is marked out with varnish in the middle of one face of a (nickel-plated steel) sheet and part of the sheet immersed in a 0.5 grm./L aqueous solution of peptone. The whole sheet is then made the cathode in a copper-plating bath. By filing the edges, the coating its raised from the peptoned part of the sheet, and a tongue is cut from the coating thus raised in line with the marked strip. The sheet is then clamped in a horizontal position and the strip is detached by means of weights or a compound lever attached to the other end of the tongue. Experimental errors are not more than  $20^{\circ}_{,0}$ , which is sufficiently accurate for a systematic study of the adherence of the deposits. Cf. J. Inst. Metals, 1933, 53, 313.—J. H. W.

# IX.-ANALYSIS

# (Continued from pp. 355-358.)

Micro-Analysis. J. Gordon Pearson (*Chem. Eng. Min. Rev.*, 1934, 26, 279–283).—A list of the reagents and strength of the solutions required, and details of tests for the micro-analysis of Ba, Ca, Sr, Mg, Ag, Cu, Hg, Bi, As, Sb, Fe, Cr, Mn, Ni, Co, Al, Na, K, and dioxide and 17 acid radicles, all vouched for by P. are described, and references for each test are given.—J. H. W.

Notes on the Analysis of Alkaline Tin Plating Solutions. M. R. Thompson (Monthly Rev. Amer. Electroplaters' Soc., 1934, 20, (10), 16–22). — Total Sn is determined by acidifying the solution with HCl, oxidizing any SnCl<sub>2</sub> with Brwater, adding 4 grm. of NH<sub>2</sub>OH·HCl and electrolyzing at 35° C. with 2 amp.; it may also be determined volumetrically with FeCl<sub>3</sub> in the usual way. Stannous Sn is determined by acidifying with HCl and titrating the hot solution directly with FeCl<sub>3</sub>. Free NaOH is determined by removing the Sn with an excess of SrCl<sub>2</sub> solution and titrating the filtrate with standard acid; carbonate can be determined only by acidifying and collecting the CO<sub>2</sub> in KOH.—A. R. P.

\*Simplifications in the Method of Separation of Metals by Graded Potential. A. J. Lindsey and H. J. S. Sand (*Analyst*, 1934, 59, 328-335).—Lassieur's work is critically reviewed; the values given by L. for the potential at which the various metals are deposited are not generally applicable owing to polarization of the auxiliary electrode and its back-resistance. A modified auxiliary electrode is described, together with a potentiometer arrangement for determining the correction required for direct readings from this electrode.—A. R. P.

\*The Determination of Bismuth in Copper. E. W. Colbeck, S. W. Craven, and W. Murray (Analyst, 1934, 59, 395–399).—Bi may be quantitatively removed from Cu by heating fine turnings of the metal for 1 hr. in H<sub>2</sub> at 1060° C., the Bi being deposited as a mirror on the cool parts of the tube. The deposit is dissolved in HNO<sub>3</sub> and the Bi determined colorimetrically by the iodide method. Sb and As are removed from the Cu by the same method, but do not interfere in the Bi determination.—A. R. P.

\*An Indirect Method for the Determination of Cobalt. P. Spacu (Z. anal. Chem., 1934, 97, 192–193).—The Co is precipitated as  $Co(C_5H_5N)_4(SCN)_2$  and the excess of KCNS titrated potentiometrically with  $AgNO_3$ .—A. R. P.

\*An Indirect Method for the Potentiometric Determination of Copper. G. Spacu and P. Spacu (Z. anal. Chem., 1934, 97, 99-102).—The Cu is precipitated with  $C_5H_5N$  and a measured volume of 0·1N-KCNS, and the excess of the latter is titrated potentiometrically with  $AgNO_3$ .—A. R. P.

\*On the Potentiometric Determination of Copper. W. Hiltner and W. Grundmann (Z. anal. Chem., 1934, 97, 172–179).—The HNO<sub>3</sub> solution of the metal is diluted to 150 c.c., neutralized with NaOH, made just acid with HNO<sub>3</sub>, treated with 20 c.c. of 2N-CH<sub>3</sub>·CO<sub>2</sub>Na, 5 grm. of glucose, and a slight excess of 0·1N-KCNS, boiled, cooled, and filtered. The filtrate is acidified with 15 c.c. of 2N-H<sub>2</sub>SO<sub>4</sub> and 20 c.c. of 2N-CH<sub>3</sub>·CO<sub>2</sub>H, and the excess of KCNS is titrated potentiometrically with AgNO<sub>3</sub> using a AgI indicator electrode.—A. R. P.

\*On the Determination of Copper, Cadmium, and Nickel as New Complex Compounds. Alfred Taurins (Z. anal. Chem., 1934, 97, 27-36).—In the presence of an excess of NH<sub>4</sub>NO<sub>3</sub>, Cu is precipitated from ammoniacal solution by a 10% solution of K<sub>2</sub>HgI<sub>4</sub>, free from excess of KI, as the complex compound  $Cu(NH_3)_4(HgI_3)_2$  (4.91% Cu). From 2N-NH<sub>4</sub>OH containing 4% of KI Cd gives a similar compound (8.29% Cd) with K<sub>2</sub>HgI<sub>4</sub>; under the same conditions Ni gives the compound Ni(NH<sub>3</sub>)<sub>6</sub>(HgI<sub>3</sub>)<sub>2</sub> (4.43% Ni). Since Co also gives a precipitate like Ni, it should first be oxidized in ammoniacal solution to  $[ClCo(NH_3)_5]Cl_2$  by boiling with H<sub>2</sub>O<sub>2</sub>. All the complex precipitates can be weighed after washing first with a saturated alcoholic solution of the compound, then with  $(C_2H_5)_2O$ , and drying *in vacuo.*—A. R. P.

Conditions for the Potentiometric Titration of Copper with Sodium Sulphide Using a Platinum Electrode. Jang Bahadur Iha (J. Indian Chem. Soc., 1933, 10, 643-647).—Cu may be determined potentiometrically in sulphate solution containing a little  $CH_3$ : $CO_2H$  by titration with  $Na_2S$  solution using a Pt indicator electrode.—A. R. P.

\*The Determination of Zinc in Large Quantities with Particular Reference to the Analysis of Brass. L. C. Nickolls and J. G. N. Gaskin (Analyst, 1934, 59, 391-395).—The brass (2 grm.) is dissolved in 7 c.c. of HCl with the aid of the minimum amount of HNO<sub>3</sub> and the solution is evaporated to dryness on the water-bath. The residue is dissolved in hot water containing 5 grm. of Na<sub>2</sub>SO<sub>4</sub> and the Cu is removed by boiling for 1 hr. with a strip of Al sheet. The solution is then poured into an excess of 50% NaOH solution to dissolve the Al(OH)<sub>3</sub> and Zn(OH)<sub>2</sub> first precipitated, and the resulting solution is elec-

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trolyzed at 0° C. with a rotating gilt Pt cathode using 3.5 amp./dm.<sup>2</sup>. About 11 hrs. are required to deposit 1 grm. of Zn as a firm, closely-adherent plate, which is washed with acetone, and dried in a steam oven for 1 minute before weighing. Small amounts of Pb, Sn, Ni, or Mg do not interfere, Fe and Mn are removed by the NaOH treatment, As and Sn are precipitated with the Cu as well as large amounts of Ni, and large amounts of Pb are precipitated by the Na SO4. A. R. P.

# X.-LABORATORY APPARATUS, INSTRUMENTS, &c.

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

#### (Continued from p. 358.)

\*The Apparatus and Technique for Growing Large Specimens of Single-Crystal Zinc. C. A. Cinnamon (Rev. Sci. Instruments, 1934, [N.S.], 5, 187-190).-A modification of Kapitza's method (Proc. Roy. Soc., 1929, [A], 119, 358), is described, and has been applied to prepare a set of large zinc crystals which should be strain-free, of uniform cross-section (about 1.2 cm.2), about 35 cm, long, and of any desired orientation. A polycrystalline casting of the desired size and shape made in a horizontal mould is melted and then recrystallized after inoculation with a small single-crystal nucleus, set so as to determine the orientation of the growing crystal. A gross mosaic structure which may occur during the initial stages of growth of the crystal can be eliminated by a steep temperature gradient. The ratio of the temperature gradient in the stem of the mould to the rate of growth must approximate to a certain favourable, but not necessarily the same, value for each orientation.

-J. S. G. T.

\*Apparatus for Measuring Thermal Conductivity of Metals up to 600° C. [Conductivity of Pure Zinc, Pure and Commercial Nickel and Nickel-Chromium Alloys]. M. S. Van Dusen and S. M. Shelton (U.S. Bur. Stand. J. Research, 1934, 12, 429-440; Research Paper No. 668).-Apparatus for measuring the thermal conductivity of metals up to 600° C. is described. The method employed consists in comparing the conductivity of a metal, either directly or indirectly, with that of lead. Lead was selected as the standard, since previous measurements have established its conductivity within fairly close limits. Determinations are made by measuring the axial temperature gradients in two cylindrical bars soldered together end to end, one end of the system being heated and the other cooled, and the convex surfaces protected from heat loss by a surrounding guard tube. Data are given for the conductivity of commercial nickel, high-purity zinc, high-purity nickel, and several commercial nickel-chromium and other alloys widely used for heating elements and thermocouples.--S. G.

A Convenient Apparatus for Distilling Metals. R. V. Jones (J. Sci. Instruments, 1934, 11, 167-168).-A note. A glass apparatus is described for coating small articles (e.g. mirrors) with metals by evaporation. High meltingpoint metals are evaporated from a tungsten helix, and low melting-point metals from a small Alundum crucible heated by tungsten wire. The feature of the apparatus is that it can be opened easily and quickly. It is suitable for coating articles of which the dimensions do not exceed 5 cm.-W. H.-R.

The Photoelectric Cell and Its Use for Measuring the Polish and Colour of Metals. René Toussaint (Rev. Aluminium, 1934, 11, 2403-2414).---A description is given of various forms of the photoelectric cell and its accessory apparatus, and its use in determining the degree of polish of metals and the colour tints of various metallic surfaces.—J. H. W.

The Measurement of Welds. R. Cajar (T.Z. prakt. Metallbearbeitung, 1934, 44, 197-200).--An instrument in the nature of a special caliper, used both for the predetermination of the thickness of welds, especially at angles, and for their measurement after production, is described. Various types of instruments are illustrated and described.—W. A. C. N.

Two Variations of the Powder Method of X-Ray Analysis of Crystals. J. P. Blewett (J. Sci. Instruments, 1934, 11, 148–150).—Two focussing methods are described for X-ray crystal analysis by the powder method, one using a parallel, and the other a convergent beam of X-rays. Diffraction at angles of almost zero degrees can be observed, and the intensity is increased.

-W. H.-R.

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

(Continued from pp. 358-362.)

Acceptance Rejection Requirements in Specifications. H. F. Dodge (Amer. Soc. Test. Mat. Preprint, 1934, June, 1-14).—Specifications for quality materials and finished products impose requirements for individual quality characteristics to distinguish between what may be satisfactory for a given purpose and what may not. For many characteristics 100% inspection or testing is not feasible, hence reliance must be placed on sampling a part of the whole. Under these conditions, 100% conformity with requirements cannot be avoided. The sampling clauses included in specifications often provide criteria for the acceptance or rejection of lots of a product. These clauses constitute interpretations of the intent of the basic quality requirements and serve as a basis for action. With sampling, certain risks are assumed by the consumer and by the producer. One type of risk is discussed, and the relationship between (1) the distribution of such risks between size, is indicated for certain conditions.—S. G.

Internal Pressure Stress in Lead Pipes. Heinz Bablik and J. Krystof (Met. Ind. (Lond.), 1934, 45, 3-6).—An investigation into the best specifications for B.N.F. lead pipes has lead to the following conclusions: (1) the critical hydraulic pressure which lead tubes must withstand is the pressure of the repulsion plus the static water pressure; (2) for correct testing the hydraulic pressure which causes an increase of  $0.29_{\odot}$  in the internal diameter must be determined, and not the ultimate bursting pressure; (3) an increase in the hydraulic resistance is possible practically only by increasing the wall thickness so that its ratio to the internal diameter is unity, but it would not be commercially economical to raise this ratio above 0.6; (4) further increase in the hydraulic resistance can be effected only by raising the mechanical strength of the lead by alloying and heat-treating; (5) the B.N.F. alloy No. 1 gives a 64% higher yield-stress than pure lead.—J. H. W.

\*Investigating the Importance of Bearing Metals. J. R. Connelly (Amer. Soc. Mech. Eng. Preprint, 1933).—Describes a new test machine which reproduces wear under service conditions and gives variation in rate of wear with unit pressure. The essential elements of the new machine are a block of bearing metal with one side machined to a plane surface and a cylinder. The block is held by a constant-force tangent to the cylinder. The cylinder rotates in a bath of lubricant, and a depression is worn in the bearing metal. The test is run until there is no measurable increase in the depth of the depression with continued operation.—W. P. R.

\*Concerning the Effect of Notches and Laws of Similitude in Material Testing. A. Nadai and C. W. MacGregor (*Amer. Soc. Test. Mat. Preprint*, 1934, June, 1-13).—In a number of recent investigations on the various effects of stress concentration produced by notches, size effects, and other discrepancies have

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been observed. Some of these cases are briefly analyzed, and an attempt is made to include in the comparison factors such as the speed of deformation, geometrical and mechanical similitude. A few tests made with notched bars of steel and aluminium, in which the influence of the speed of plastic deformations was considered, and photoelastic tests with notched bars, are reported. —S. G.

**Transverse Bars Breaking Out of Centre.** F. Bacon (Bull. Brit. Cast-Iron Res. Assoc., 1934, 3, 291).—A note. Sometimes a transverse bar breaks out of centre—that is, away from the point immediately underneath the load when central loading is used. If a load W is applied at the centre, O, of a bar supported over a span L, and the bar breaks at P, distance x from O, then the section at P is weaker than the section at O, and if the weakness had occurred at O the bar would have broken under a smaller load  $W_1$ . This can be

calculated by the equation  $W_1 = W \cdot \frac{(L-2x)}{L}$ . W. H.-R.

\*The Creep of Wires at High Temperatures. W. O. Richmond (*Physics*, 1934, 5, 131-134).—Apparatus designed to make creep tests on wires *in vacuo* at high temperatures up to 1000° C. is described. Results of creep tests made on the alloy Konal at temperatures 800°-1000° C. show that Ludwik's logarithmic law connecting rate of deformation and stress holds for the higher creep rates and stresses, but certainly does not hold for the lower creep rates and stresses. A linear relation best expresses the variation of the minimum creep rate with temperature. The method used is readily adapted for making short-time creep tests.—J. S. G. T.

The Strength of Materials at High Temperatures. H. J. Tapsell (Métaux et Machines, 1934, 18, (245), 168–174).—The National Physical Laboratory method of determining limiting creep stress is described and contrasted with the method in general use in the U.S.A., and with that recently proposed by the American Society for Testing Materials. The representation of results is discussed. T. considers that the assumption of a constant rate of flow during a "secondary period" is untenable; that creep-test results are not representative without amplification by a study of flow under prolonged loading sufficient to produce fracture; and that only under certain conditions does the logarithmic time-elongation curve become a straight line. Shorttime testing methods based on "plastic flow" characteristics are described and criticized. T. prefers tests to be made over an extended period, as allowing for structural changes, if any, as indicating both primary and secondary flow properties, as registering more accurately the total deformation, and as wiping out initial differences in testing conditions which might vitiate shorttime tests.—P. M. C. R.

The Strength and Behaviour of Steels at High Temperatures [High Temperature Testing Apparatus]. W. H. Hatfield (*Proc. Inst. Mech. Eng.*, 1932, 123, 773-791).—A general lecture, including diagrams of high-temperature testing apparatus.—W. H.-R.

Method of Testing Individually the Even Distribution of Hardness on Specimens. C. Benedicks and C. F. Mets (Arkiv Mat. Astron. Fysik, 1934, 24A, (15), 14 pp.; and Tomkontorets Ann., 1934, 114, 4-22; C. Abs., 1934, 28, 3039).—A fine grating is produced automatically by parallel scratches with a diamond point. Microscopic examination of the scratches reveals local discrepancies of hardness, especially those caused by local work-hardening which cannot be detected by other methods.—S. G.

\*Influence of Speed of Testing on the Result of the Tensile Test. F. Fettweis (Arch. Eisenhüttenwesen, 1932, 6, 149–154; and (abstracts) Metallurgist (Suppt. to Engineer), 1932, 8, 179–180; J. Iron and Steel Inst., 1933, 127, 660).—Experiments confirm the observations of previous investigators, that not only the elastic limit and yield-point, but the elongation and reduction

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of area are all increased in different proportions by the carrying out of the tensile test at high speed.—S. G.

\*Time Effect in Testing Metals. H. Quinney (Engineer, 1934, 157, 332-334).—Describes a testing machine designed so that a tensile test can be carried out at a fixed rate of extension. Experiments carried out with the machine show that the yield stress obtained from tests made at normal speeds is largely influenced by the temperature reached in annealing and that the softer specimens with lower yield stress are more susceptible to the rate of extensions than those in the harder condition. Although Q. deals with mild steel and iron, the results are of general interest.—W. P. R.

Concerning the Effect of Strain and Rate of Strain on Tensile Tests at Normal and Elevated Temperatures. R. Beeuwkes (*Physics*, 1934, 5, 135-139).—Idealized cases of plastic flow are analyzed to ascertain the influence of constant coeff. of work-hardening and pure viscosity on tensile tests made at normal and elevated temperatures. The results indicate that more emphasis should be placed by experimenters on the changes in yield-stress (in the hardness) that occur in materials even without stress under exposure to time and high temperatures.—J. S. G. T.

The Tensile Test of Welded Joints. —— Czternasty (*Elektroschweissung*, 1934, 5, 56).—A test-piece is recommended having a short gauge-length. Typical dimensions are tabulated.—H. W. G. H.

\*Studies in Photoelastic Stress Determination. E. E. Weibel (Amer. Soc. Mech. Eng. Preprint, 1933).—Describes results on the determination of stress distribution in Bakelite models using the monochromatic fringe method. Another section of the paper describes an application of the membrane analogy in conjunction with the photoelastic fringe method to obtain a complete solution of a two-dimensional stress problem.—W. P. R.

\*Stress Concentration Produced by Holes and Notches. A. M. Wahl (Amer. Soc. Mech. Eng. Preprint, 1933).—The results of photoelastic tests on Bakelite models are plotted in the form of curves showing the relationship between the concentration factor K and the ratio d/w where d = diam. of hole or notch and w = width of specimen, and the two following empirical equations have been obtained:  $k = 3 - 3 \cdot 13d/w + 3 \cdot 76(d)^2/w - 1 \cdot 71(d)^3/w$  for a bar with a hole under tension or compression and  $k = 2 \cdot 75 - 2 \cdot 75d/w + 0 \cdot 68(d)^3/w$  for a bar with two semi-circular notches.—W. P. R.

\*Membrane Analogy Supplementing Photoelasticity. J. G. McGivern and H. L. Supper (Amer. Soc. Mech. Eng. Preprint, 1933).-W. P. R.

# XIII.-FOUNDRY PRACTICE AND APPLIANCES

#### (Continued from pp. 363-364.)

Fluxes in Brass Melting. Erich Weiss (Met. Ind. (Lond.), 1934, 44, 665).— In a letter commenting on a paper by T. Tyrie on "Fluxes and Slags in Brass Foundry Melting Practice" (see Met. Abs., this volume, p. 363), W. recommends the automatic filling of copper cartridges with the deoxidizing material, closing these cartridges at both ends and introducing them into the liquid metal with special tongs. For the removal of aluminium from brass he recommends an alternative method to the barium sulphate; the latter involves overheating the metal to  $1320^{\circ}$  C.-J. H. W.

Melting and Casting of Special Brass Alloys. Leo S. Ivanoff (Met. Ind. (Loud.), 1934, 45, 7-10).—The calculation of the required composition of special brasses containing 1-3% each of manganese, iron, nickel, aluminium, and tin on the basis of the "zinc equivalent" of these metals, the use and production of "hardeners" for melting, the addition of secondary material, loss of zinc, and the pouring of these alloys are discussed.—J. H. W.

**Pressure Casting.** M. Kessler (*Rev. Fonderie moderne*, 1934, 28, 157-161; discussion, 161-162).—Read before the Association Amicale et Mutuelle de Fonderie. The requirements for pressure casting and the alloys for which this process is suitable are described. Moulding machines and the composition and preparation of the moulds and the metal are described.—J. H. W.

Difficulties of Die-Casting Pure Aluminium. Anon. (Met. Ind. (Lond.), 1934, 44, 627-630).—The chief difficulties in die-casting pure aluminium are its hot-shortness and the absence of a freezing range, which prevents feeding. To overcome these some addition of other metals is made to the aluminium and the permissible departure from absolute purity is laid down. The method of die-casting the resulting metal is described in some detail, and pressure casting and slush casting are more briefly discussed.—J. H. W.

Cleaning Castings by Sand-Blasting. W. E. Warner (*Met. Ind. (Lond.)*, 1934, 45, 35).—A brief discussion of the form of abrasive, air pressure, and nozzle wear in sand-blasting castings and forgings.—J. H. W.

# XIV.-SECONDARY METALS: SCRAP, RESIDUES, &c.

#### (Continued from pp. 364-365.)

\*Recovery of Crude Copper from Scrap Brass by an Oxidizing Blast in a Basic Converter. Gotthard E. Lenk (Metall u. Erz, 1934, 31, 244–251).—Scrap brass containing copper 58, iron 7, zinc 30, lead 4, and tin 1% can be converted into 97-5–98-5% copper by blowing in a basic-lined converter provided that the iron is increased to 10% by addition of scrap; 2% of lime and 1-5–2% of quartz is all the flux necessary. The recovery of copper is about 85%, and the product can be readily refined by electrolysis. The remaining copper and all the iron pass into the slag, which contains about 15% copper and 20% zinc. The flue dust contains most of the lead and zinc as oxides and assays 80% cinc.—A. R. P.

## XV.-FURNACES AND FUELS

#### (Continued from pp. 365-366.)

**Possibilities of Application of Heating by Induction without Iron Core.** Wilhelm Fischer (*Elektrowärme*, 1934, 4, 77-82; *C. Abs.*, 1934, 28, 3663).— The principle is explained and curves are given from which the minimum frequency required for any material can be taken; the frequency must be higher the lower the electrical conductivity and the smaller the diameter of the material to be heated. Whilst up to 10,000-cycle generators can be used for producing the current, spark gaps are used for frequencies above 10,000 cycles per second. Advantages and applications in the chemical industry, melting of metals, &c., are discussed. The highest temperature obtainable depends only on the heat losses, no account being taken of the material in the crucible. The question of frequency is not simple with spark generators, since capacity and self-induction of the circuit determine the frequency; valve generators are more flexible.—S. G.

High-Frequency Induction Furnaces. W. S. Gufford (Met. Ind. (Lond.), 1934, 44, 411–414).—The construction, method of operation, and applications of high-frequency induction furnaces of sizes up to 4-ton capacity are described. —J. H. W.

The Construction of Electric Resistance Furnaces. G. W. Ashton (Machinery (Lond.), 1934, 44, 97–99).—The construction of a simple wire-wound muffle furnace with outside windings is described.—J. C. C.

Technique and Control of Temperature Gradient. Max Lang (*Elektrowarme*, 1934, 4, 83-86; *C. Abs.*, 1934, 28, 3670).—The problem and methods of temperature regulation of large industrial furnaces are discussed, and formulæ for proper regulation are developed.—S. G.

# XVI.-REFRACTORIES AND FURNACE MATERIALS

#### (Continued from p. 366.)

How Can I Increase the Life of a Graphite Crucible ? Max Schied (Z. ges. Giesserei-Praxis : Das Metall, 1934, 55, 187-191, 205-208).—The construction, constituents, and shape of graphite crucibles for metal melting are described, and the precautions to be taken as regards first heating, flame impingement, use of slags, seating, charging, and handling so as to increase the life of the crucible are discussed.—J. H. W.

## XVII.—HEAT-TREATMENT

#### (Continued from pp. 366-367.)

Bright-Annealing of Fine Copper Wire in the Continuous Furnace. Neil H. Knowlton and Theo. B. Bechtel (*Wire and Wire Products*, 1934, 9, 142-143, 156-157).—The equipment and process for the production of uniformly annealed fine spooled copper wire are described.—J. H. W. Heating or Annealing in Controlled Atmospheres. R. J. Cowan (*Metal* 

Heating or Annealing in Controlled Atmospheres. R. J. Cowan (Metal Progress, 1934, 25, 35-39, (1), 52).—Controlled flue-gas atmospheres have been successfully utilized in the annealing of a variety of non-ferrous and ferrous materials; certain atmospheres, not consistent with direct combustion, necessitate the use of a muffle, the material of which may itself act catalytically. The bright-annealing of copper-zinc alloys is especially noticed, staining, even in oxidizing atmospheres, being inhibited by the presence of small amounts of methanol vapour. A continuous belt-type muffle is illustrated and briefly described, as especially adapted for this process.—P. M. C. R.

#### XVIII.—WORKING

#### (Continued from p. 367.)

**Concerning the Distribution of Stress in a Laterally Compressed Strip.** C. W. MacGregor (*Physics*, 1934, 5, 140–145).—Photoelastic tests, in which the contact pressure distribution in a strip of Bakelite compressed between rollers is determined, are described. Results obtained by Sicbel and Lueg (*Mitt. K.-W. Inst. Eisenforechung*, 1933, 15, 1) relating to tests of the contact pressure distribution in a copper strip rolled under service conditions in a rolling mill are briefly referred to.—J. S. G. T.

A New Shrinkage Process; Expansion Fitting. Marc Rivière (Technique automobile et aérienne, 1934, 25, Part 2, (165), 42–45).—Parts to be fitted are immersed immediately before erection in liquid nitrogen at a temperature of - 196° C., their subsequent expansion ensuring a satisfactory fit. Tables give specific gravities, coeffs. of thermal expansion and contraction, weight of metal effectively cooled by 1 litre of liquid nitrogen, and volume of liquid nitrogen needed to cool 1 kg. of metal, for steel, cast iron, copper, brass, bronze, aluminium, and nickel. Suitable vessels for transport and for chilling are illustrated, and some erection processes are described in detail.—P. M. C. R.

Laboratory for Machine Tools and Works Methods in the Technical High School, Aachen. A. Wallichs (T.Z. prakt. Metallbearbeitung, 1934, 44, 1-4).— A description of the lay-out and plant of this laboratory.—W. A. C. N.

\*Use of X-Rays on Depth of Cold-Work by Machining. L. Thomassen and D. M. McCutcheon (Amer. Soc. Mech. Eng. Preprint, 1933).—By directing a beam of X-rays containing the molybdenum doublet against a flat piece of metal under an angle of 10° and recording the diffracted rays, a surface layer of thickness less than 0.0001 in. will produce practically all the diffracted rays. This gives a method of investigating the structure of thin films, and T. and McC. have used it to determine the depth of cold-work produced by various machining operations.—W. P. R.

#### XIX.-CLEANING AND FINISHING

#### (Continued from p. 367.)

**Detergents for Metal Cleaning.** M. B. Peterson (*Metal Cleaning and Finishing*, 1934, 6, 127–130; *C. Abs.*, 1934, 28, 3700).—A general discussion of the use and action of detergents in cleaning baths. The recently developed hymolal salts, consisting of salts of high-mol. alcohols, are recommended. The sodium salt known as "orvus" has new and distinctive properties making it indispensable for some types of metal cleaning work.—S. G.

The Use of Bituminous Compositions in Metal Finishing. J. Mitchell Fain (Metal Cleaning and Finishing, 1934, 6, 99–104, 130; C. Abs., 1934, 28, 3700). --Various types of bituminous coating materials, their pigmentation and application to metal products are discussed.—S. G.

\*Rapid Development of Patina on Copper After Installation. John R. Freeman, Jr., and Philip H. Kirby (*Metals and Alloys*, 1934, 5, 67-70).—For the development of a green patina on copper roofs and other installations the following solution is prepared : 90 lb. of ammonium sulphate and 3 lb. of copper sulphate crystals are dissolved in 100 gall. of water and 1 lb. 3 oz. of ammonia solution (d 0.90) are added, thus giving 110 gall. of solution. The copper is washed by spraying first with alkali solution, then with clean water, allowed to weather for a few days to develop a brown tarnish, and then sprayed with the above solution, which should fall on the metal is such a way as to cover it with minute droplets which do not run together. After complete drying the spraying is repeated; usually five sprayings with intermediate dryings are required. The resulting green patina adheres well and improves in adherence and beauty with ageing. Moisture, e.g. dew at night assists greatly in the development of the best effects. Examples of the use of the process for colouring a church spire and house roofs are described.—A. R. P.

Surface Treatment of Objects Made of Zinc Sheet or of Cast Zinc. Anon. (Illust. Z. Blechindustrie, 1934, 63, 591-592, 614-615).—The popularity of zinc as a protective medium can be appreciably increased by improving its appearance. The process of colouring, with the essential preliminaries of cleaning and de-greasing, is described, and the compositions of the solutions employed are given, with precautions as to handling. Zinc surfaces may be dyed, copper-plated, or given a brass or Tombak finish. Compositions are

given for these, and for brown, bronze, gold, yellow, orange, red, pink, green, blue and black finishes, and suitable wax emulsions are recommended for the final treatment of the coloured surfaces.—P. M. C. R.

## XX.—JOINING

#### (Continued from pp. 367-369.)

**Resistance Welding of Aluminium and Its Alloys.** D. I. Bohn (*J. Amer. Weld. Soc.*, 1934, **13**, (4), 4–7).—Successful spot and seam welding of aluminium alloys depends on establishing a very high thermal gradient from the point of weld to the electrode contact. The use of synchronous control is, therefore, highly desirable. With suitable technique, the strength of spot welds in the strong aluminium alloys should keep within 90 and 110% of the average strength. Spot welds in "Alclad" are practically as resistant to corrosion as the parent metal. No success has been obtained with flash-welding, but butt-welding has a limited field of application, mainly for architectural work.

-H. W. G. H.

The Welding of Aluminium Castings. W. Johag (T.Z. prakt. Metallbearbeitung, 1933, 43, 365).—A general description of the methods by which aluminium castings may be welded, the means of testing, and the efficiency of the process. The difficulties of rapid oxidation and the use of fluxes are discussed.—W. A. C. N.

Tests of Welds in Electrolytic Copper. W. J. Chaffee (*Welding Eng.*, 1934, 19, (5), 17–19).—Tensile tests on welds made by the "long-arc" method show that a phosphor-bronze rod of high tin content gives the best results. Deoxidized copper welding rod gives very poor results on material above in. thick.—H. W. G. H.

Hard-Facing. E. Lewis (*Indust. Gases*, 1934, 15, (1), 42–44).—Three classes of hard-facing materials are described—the iron-base alloys (Stoodite), nonferrous alloys (Stellite), and the tungsten-carbide group (Borium). Their properties, sphere of application, and recommended methods of deposition by the blow-pipe, are discussed.—H. W. G. H.

Welding Torch or Electric Arc. E. Stursberg (T.Z. prakt. Metallbearbeitung, 1933, 43, 394-397).—A discussion of the comparative advantages of these two methods of welding. Questions of cost, utility, and special applications are introduced.—W. A. C. N.

Studying Structural Stresses with the Aid of the Polariscope. E. W. P. Smith (*Welding Eng.*, 1934, 19, (4), 17–19).—The construction of a simple polariscope is explained and its use, in studying the distribution of stress in welded joints, is described.—H. W. G. H.

# XXI-INDUSTRIAL USES AND APPLICATIONS

#### (Continued from pp. 369-370.)

†Piston Material and Design. H. J. Maybrey (*Diesel Engine Users Assoc.*, 1934, 20 pp.).—The development of piston materials is reviewed and the design of pistons considered in so far as design has taken advantage of the specially selected alloys. The relative suitability of piston materials as regards thermal conductivity, density, and coeff. of linear expansion are determined by a formula. The materials compared are cast iron, "2.L.8." to "3.L.11." types of aluminium alloys, "Y"-alloy, and hyper-silicon aluminium alloys, and the relative values obtained for these alloys are 151, 585, 610, and 860  $\times$  10<sup>3</sup>. The latter class of alloys are binary aluminium-silicon alloys containing more

than 14% silicon, and it is stated that large quantities of pistons are turned out in alloys containing 20 and 25% silicon, and that very interesting results are obtained with a specially treated alloy of 35% silicon. Reference is also made to the "anodic" treatment of aluminium-silicon pistons and the advantages which might be obtained from it. An interesting discussion dealing with composition, treatment, design, and use of aluminium pistons is also

Beer Scale on Aluminium Vessels. H. Schnegg. Richard Seligman (Z. ges. Brauw., 1934, 57, 13–18, 21–27).—3.7 and 1.85% solutions of hydrochloric acid required 30 and 90 minutes, respectively, to enable the scale to be easily scraped off, and without appreciable corrosion of the metal. With periods longer than 4 hrs. the solubility of the metal continued to increase progressively. The addition of colloidal resinous substances did not reduce the solubility of the scale, but greatly inhibited the attack on the metal. Under these conditions, the use of 3.7% hydrochloric acid was recommended, and the results obtained compared favourably with those from 10% nitric acid. In a written communication in J. Inst. Brewing, 1934, 40, 228, R. S. criticizes the proposed use of hydrochloric acid as likely to cause damage to vessels which have been in use for any length of time.—H. W. G. H.

Aluminium at the "Deutsches Volk-Deutsche Arbeit" Exhibition. — Buschlinger (Werkstatt u. Betrieb, 1934, 67, (11/12), 217-218).—Exhibits at the above exhibition are enumerated and described : important items are : Alfol heat-insulation, aluminium alloy cables of high resistance to vibration stresses, damping apparatus for minimizing cable vibrations, and applications of the high reflectivity of aluminium and of certain alloys.—P. M. C. R.

The Future of Beryllium in Automobile and Aero Construction. Maurice Déribéré (*Technique automobile et aérienne*, 1934, 25, Part 2, (165), 58-61).— An account, with *bibliography*, of the sources, chemical and physical properties, manufacture and present uses of beryllium. A description is given of the alloys of this metal with copper, nickel, tin, and iron; brief notes are appended on light alloys containing beryllium.—P. M. C. R.

appended on light alloys containing beryllium.—P. M. C. R. Copper Tanks for the Hydrolysis of Fats. Rob Heublyum (Mat. grasses, 1934, 26, 10072–10073; C. Abs., 1934, 28, 3921).—A copper tank has been in continuous use since 1929 at the Krasnodar (U.S.S.R.) plant for the hydrolysis of fats by the Twitchell process without giving rise to any trouble. Definite cost figures cannot be obtained until the tank fails in service.

—S. G.

Springs for Measuring Instruments. G. Keinath (Arch. tech. Messen, 1934, 3, (35), r64-r65).—Some useful data are given for calculations relating to flat spiral springs. The relationships between tempering temperature and external diameter, hardness and elongation are shown graphically. The corrodibility and magnetic properties of steel have led to its partial replacement by non-magnetic copper alloys, the choice of which is influenced by working conditions. Specific resistances are quoted for copper-silicon-bronze, phosphor-bronze, and nickel-silver, with elastic moduli for the first 2 of the foregoing and for steel. The effect of temperature on the elastic modulus of Elinvar is comparatively slight, and certain light alloys of similar properties are being developed. The advantages of bimetal springs are considered, and the residual effects of working, loading and heat-treatment are discussed. —P. M. C. R.

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- Whitehead, T. N. The Design and Use of Instruments and Accurate Mechanism. Pp. xii + 283. London : Macmillan and Co., Ltd. (15s.)
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#### THESES.

- Tiedemann, Hans. Technisch-wirtschaftliche Probleme der Aluminium-Industrie. Pp. xii + 133. 8vo. 1934. Dissertation for the degree of Dr.-Ing. Breslau, Technische Hochschule.
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## XXIV.—BOOK REVIEWS

(Continued from pp. 335-336.)

Pressen von Nichteisenmetallen. Von W. Brunnekow. Demy 8vo. Pp. 20, with 13 plates. 1934. Berlin: VDI-Verlag G.m.b.H. (R.M. 1.60; to VDI members, R.M. 1.45.)

This is a short brochure on a subject which sooner or later will warrant a considerably more ambitious treatment, preferably from both an engineering and metallurgical point of view. The hot-stamping and hot-pressing of non-ferrous metals have, during recent years, become increasingly important, particularly when linked up with developments in die-casing. The author of the present volume has sought to do little more than introduce the subject, and as an "introduction" it may be commended to the attention of workers in this field. The text itself occupies only about 20 pages, and the greater part of the volume is occupied by illustrations and diagrams of machinery. The latter are useful to the English reader as illustrating the type of plant developed in Germany for die-casting, hot-pressing, stamping, and extrusion.

In his foreword the author emphasizes that his object is to promote a more intelligent understanding between the producer of hot-worked material and the ultimate user, an object which is always to be commended.—W. R. BARCLAY. Handbuch der anorganischen Chemie. Herausgegeben von R. Abegg, Fr. Auerbach und I. Koppel. In vier bänden. Kobalt und seine Verbindungen. Vierter Band. Dritte Abteilung, Lieferung I. Pp. xvi + 626, with 170 illustrations. 1934. Leipzig, Hirzel. (R.M. 58.)

The volume under review deals with the element cobalt, and commences with an account of the determination of the atomic weight, compiled by J. Meyer. The structure of the cobalt atom is then considered by E. Rabinowitsch. In this chapter the spectral and magnetic relationships are very fully considered and the data concerning the dimensions of the atom collected. The occurrence and history of the metal are treated in the following chapter by A. Kurtenacker, the distribution and the nature of the minerals are fully described, and the main sources of the metal and the production in various countries indicated. The technical production of cobalt and its separation from nickel by a large number of processes is described. The method of preparation and the applications of the metal are detailed. The same author contributes the following two chapters on the physical and chemical properties of metallic cobalt. This chapter is particularly complete, and includes a vast amount of numerical data. The chapters dealing with the divalent compounds of cobalt, the ammines of divalent cobalt. and the tervalent cobalt compounds follow, and are all written by A. Kurtenacker. These are very full, and have been put together with care and discretion. The chapter following on the alloys and compounds of cobalt with non-metals and with the metal of groups 1-6 has been written by J. Holluta; here we find compounds such as the nitrides, carbides, sulphides, borides, and phosphides, together with binary and ternary metallic alloys fully described. The concluding chapter, written by I. Koppel, deals with the colloidal chemistry of cobalt.

The book is excellently put together, is clearly written, and is accurate in its descriptions and in the numerical data it presents. A notable feature would appear to be the introduction of a very large amount of fundamental physical chemical data. The references, which are inserted after each chapter, are a valuable feature of the volume. They are numerous, some 3100 being included.

The volume is one which will find many to welcome it, and it may be recommended very warmly.-JAMES F. SPENCER.

# Metallgiesserei. Von Hans Steger. Lieferung 1. Pp. 30. Lieferung 2. Pp. 31-54. Lieferung 3. Pp. 55-84. Illustrated. Potsdam: Boness u. Hachfeld. (R.M. 0.90.)

These are the first three parts of an elementary primer on foundry methods intended for home study. In each "lesson" are given a lecturette, a resume of important facts and conclusions, revision in the form of question and answer, questions on the subject-matter to be answered, and a subject for an essay. The principal items dealt with are general consideration of metals and alloys used in foundries, separation of scrap metals, moulding, melting methods, types of furnaces, and die-casting. At the end a table of alloys in common use is given. The information given is neither comprehensive nor up-to-date. Presumably the aim is to deal with fundamental processes using, for the purpose, diagrams and illustrations that apply principally to ancient methods. The books would be extremely useful to those wishing to acquire an elementary knowledge of German metallurgical terms.—W. A. C. NEWMAN,

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By J. W. Mellor. Volume XIII.-Fe (Part II). Med. 8vo. Pp. ix + 948, with 381 illustrations. 1934. London: Longmans, Green and Co. (63s. net.)

The present volume of this excellent text-book continues the treatment of the chemistry of iron, which was started in Volume XII. The mechanical properties of iron and iron-carbon alloys are dealt with in the first 18 pages, whilst the succeeding 110 pages give an account of the thermal properties of the same materials. The optical, electrical, and magnetic properties are considered in the following sections. The chemical properties are next dealt with, and after this follows a very informative account of the corrosion of iron and steel, which occupies rather less than 100 pages. A consideration of the valency and atomic weight of iron constitutes the next section, and the treatment of the properties of iron is completed by an account of the passivity of the metal. The next 168 pages are devoted to a description of the alloys are considered in the treatment of using pages of the volume, about 200, are devoted to a consideration of the remaining pages of the volume, about 200, are devoted to a consideration of the contact of the volume, about 200, are devoted to a consideration of the contact of the volume, about 200, are devoted to a consideration of the oxides and hydroxides of iron and the ferrites and ferrates.

The present volume is written in the careful and clear manner which has come to be expected of the author. The material is very full and accurate, and an exhaustive bibliography is appended to each section. The volume presents a very full account of the chemistry of the materials with which it deals, and in all respects it is admirable and to be recommended without reserve.—JAMES F. SPENCER.

1934

Die Metallurgie des Eisens. Von R. Durrer. (Aus Gmelins Handbuch der anorganischen Chemie. Achte völlig, neubearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft.) Med. 8vo. Pp. vii + 423-1166, with 410 illustrations. 1934. Berlin: Verlag Chemie G.m.b.H. (Steif Kartoniert, R.M. 32; geb., R.M. 36, post free inland.)

The present work is identical in every respect with System nummer 59, Teil A, Lieferungen 3-5 of Gmelin's handbook. This portion of the handbook is published separately under the above title, with the object of providing a text-book on the metallurgy of iron and steel for those interested in the subject, without the large amount of purely chemical data which is found in the text-book itself. The portions of the text-book concerned have already been reviewed in the Journal of the Institute of Metals, and the remarks made there apply to the present work.—JAMES F. SPENCER.

Der Einfluss von Drehschwingungsbeanspruchungen auf die Festigkeit und Dämpfungsfähigkeit von Metallen besonders von Aluminium Legierungen. Von Hans Frankenberg. (Mitteilungen des Wöhler Instituts, Braunschweig. Heft 16.) Demy 8vo. Pp. iv + 55, with 62 illustrations. 1933. Berlin: NEM-Verlag G.m.b.H., Schöneberger Ufer 34. (R.M. 3.60.)

The work described in this publication is based on that undertaken by Bankwitz and published in Heft 11 of the Wöhler Institute journals. There are four sections, of which the first serves as an introduction and a review of previous work, and the last is a summary of the conclusions. The second section is devoted to standard static calibration curves of various ferrous and non-ferrous materials, the third to "Werkstoffdämpfung" (defined as "that work per unit volume which in every change of loading is converted into heat") and rate of oscillation, and the fourth to the mechanical properties of the materials under test. The object of the research is to supply answers to the following questions (1) What is the course of the "Dampfung" curve when alternations between 0 and 200 per minute are employed? (2) Does the "Dämpfung" of a material vary when the latter is maintained under constant stress for a lengthy period? (3) What influence have impurities in aluminium on the form of the alternating stress diagram? (4) Is there a reliable relationship between an alteration in the rate of alternations and the "Dämpfung"? (5) Is a greater or lesser number of small changes of form more potent in raising the plastic limit? (6) What is the effect of continued application of stress on the plastic limit? (7) What relationships exist between the "Dämpfung." rate of alternations, and fatigue-strength?—W. A. C. NEWMAN.

Dauerfestigkeit von Schrauben, ihre Beeinflussung durch Form, Herstellung und Werkstoff. Von Wilhelm Staedel (Mitteilungen der Materialprüfungsanstalt an der Technischen Hochschule, Darmstadt. Herausgegeben von A. Thum. Heft 4.) Demy 8vo. Pp. vi + 102, with 106 illustrations. 1933. Berlin: VDI-Verlag G.m.b.H. (R.M. 8.)

The fatigue-strength of screws is a matter that affects all, in different ways, and many will welcome the appearance of this small volume, written in a readable style and well illustrated with diagrams and excellent photographs of fractures. The author makes no attempt to summarize present knowledge of the subject, but succeeds admirably in giving a serviceable account of two years' experimental research carried out at Darmstadt. The outstanding feature of the investigation is the use of a novel type of repeated-impact machine, rationally designed for testing bolts and screws with measured blows causing longitudinal tension. By using a relatively heavy weight and small drop, it was found possible to work at speeds up to 380 blows per minute, i.e. four times as fast as had been employed in an earlier machine, although still only oneeighth of the speed of modern fatigue-testing machines working with harmonic cycles of stress. Eight of these new machines were maintained in operation during the course of the investigation. The results are plotted in diagrams with energy of blow as ordinate on a base representing the endurance to fracture; and the limiting safe value of the impact energy can be recognized before the endurance reaches two million blows. The results for different materials and different forms of bolt are compared with data for Wöhler and other tests. Bolts with reduced diameter of shank naturally, on account of their greater elastic elongation under the limited resistance of the screw, require blows with greater energy to cause fracture. The practical application of the results is discussed in an interesting manner, and the photographs of fractures-excellently reproduced-show the origin and progress of the cracks formed in a great variety of cases. -B. P. HAIGH.

Copper Welding by the Acetylene Process. By H. Martin. Demy 8vo. Pp. 46, with 34 illustrations. 1932. London: The Welding Journal, 30 Red Lion Sq., W.C.1. (2s. net.)

Here we are given full information "straight from the horse's mouth" about the welding of copper. The authors of almost every existing text-book on welding should read this little book. The first chapter describes the development and properties of deoxidized copper, the second deals with technique, and the last two are devoted to design and repair work. The photomicrographs might be much better: they fail to illustrate clearly the points they are intended to emphasize. The test results, given at the end, would be more useful if the methods of measuring yield-point and elongation were indicated. The tensile figures, however, are very illuminating.—H. W. G. HIGNETT.

The British Industrial Gases Manual of Oxy-Acetylene Welding and Cutting. The British Industrial Gases, Ltd. Post 8vo. Pp. 128, with 95 illustrations. London: British Industrial Gases, Ltd., 34, Victoria St., S.W.1. (1s. 6d. net.)

The equipment for high- and low-pressure welding is described, and the principles of the respective blowpipes are explained. Details of preparation and technique for welding various metals are then given, with full instructions for minimising troubles due to expansion and contraction. The non-ferrous metals dealt with are aluminium, copper, brass, bronze, nickel, and lead. Simple weld tests, defects, and "dont's" complete the information on welding, and the remaining 36 pages are devoted to cutting and miscellaneous tables. This booklet may be highly recommended to practical welders. Only one small criticism can be made : the service-ability of the book would be improved by a better binding, for which a small increase in price would be money well spent.—H. W. G. HIGNETT.

# Störungen beim Betrieb von Azetylenapparaten und ihre Beseitigung. Von Gottfried Lottner. Cr. 8vo. Pp. 63, with 19 illustrations. 1934. Halle a. S.: Carl Marhold. (Kart. R.M. 1.70.)

Into small space, the author compresses the results of a long and wide experience in the testing of acetylene plant. The various types of generator on the German market are classified, and the most popular examples are briefly described with diagrammatic illustrations which omit unnecessary details, but show clearly the important features. Recommendations for diagram ing troubles and putting them right are given in tabular form. Purifiers, hydraulic valve, and blowpipes are also dealt with, but more briefly and without classifying into types. This is an excellent little book, which should be useful to all interested in the generation and supply of acetylene. —H. W. G. HIGNETT.

Encyclopædia of Oxy-Acetylene Welding. Vol. IV.—Welding Non-Ferrous Metals. The International Advisory Committee for Carbide and Welding Technique. 8¼ in. × 11¼ in. Pp. xvi + 80, illustrated. [1934.] London: The Acetylene and Welding Consulting Bureau, Ltd., 637-638 Grand Buildings, Trafalgar Sq., W.C.2. (10s.)

Volumes I and II of this Encyclopædia were reviewed in J. Inst. Metals, 1933. 53, 430. The third volume is similarly arranged, a preliminary discussion on technique being followed by illustrations of welded plant, with brief descriptions in English, French, German, Italian, and Spunin. The illustrations are excellent, and give impressive evidence of the scope of non-ferrous welding. The scape of non-ferrous welding. The scape of non-ferrous welding is the book is of great value. To one or two points, however, exception must be taken. The statement made in the foreword: "Oxy-acetylene welding is at present the one and only process by means of which non-ferrous metals can be joined homogeneously . . . . . . The development of oxy-acetylene welding is hindered rather than helped by such statements. The metallurgy of modern copper welds, are consequently very significant. On p. 61 Elektron is described as an aluminium alloy. —H. W. G. HIGNETT.

Electric Arc and Oxy-Acetylene Welding. By E. Arthur Atkins. A Practical Handbook for Works Managers, Welding Operators and Students. Second edition. Cr. 8vo. Pp. vii + 350, with 151 illustrations. 1934. London: Sir Isaac Pitman & Sons, Ltd. (7s. 6d. net.)

After a preliminary chapter comparing the various methods of jointing metals, five chapters are devoted to are and five to acetylene welding. Further chapters deal with welding gases; cutting; expansion and contraction; weld testing; filler rods, electrodes, and fluxes; metallography of steel; welding wrought iron, cast iron, copper, and aluminium; and the testing of welders. Finally, the composition and properties of metals and alloys are tabulated, safety regulations and standard specifications are abstracted, and selected examination papers are reprinted. Considering the price and size of the book, one can expect only a brief account of each item, and there is clearly no room for wordiness, or repetition, or such vague recommendations as "hammer at a good heat" (p. 56). The space devoted to purely metallographic matters might have been reduced, with advantage, in favour of more adequate treatment of weld testing and the non-ferrous metals. The latter are almost ignored : the welding of copper is discussed without mention of the deoxidized material! Of aluminium, we are merely told that it " can, of course, be perfectly welded by a welder who is blessed with sufficient intelligence and experience " (p. 218). Much information is given about obsolete plant and methods, but none is forthcoming concerning such processes as atomic hydrogen welding, or recent advances in the technique of blowpipe welding. That " Cyc-Are " welding is " perhaps the most recent of all methods of welding " (p. 218) is an astonishing statement in a 1034 publication. —H. W. C. HIGNETT.

#### The Thermodynamics of Electrical Phenomena in Metals. By P. W. Bridgman. Med. 8vo. Pp. vi + 200, with 33 illustrations. 1934. New York: The Macmillan Company (\$3.75.); London: Macmillan and Co. (16s. net).

Professor Bridgman's name is perhaps more familiar as an investigator of the properties of materials under extremely high pressures than as a physicist concerned with the electrical properties of metals. During the last ten years he has contributed, principally to the Physical Review, a number of papers dealing with inter-relations of a thermodynamic character between various electrical properties of metals. These papers are here consolidated into a coherent whole, and some extensions and new relations are added. Professor Bridgman is sufficiently prominent a physicist to be able to admit that one of the relations deduced between the four transverse galvanomagnetic effects turns out to be erroneous. The subjects treated may be briefly indicated. They comprise thermoelectric and thermionic phenomena, the Volta effect, transverse galvanomagnetic and thermomagnetic effects, electron theory, and the photo-electric properties of metals. The treatment is necessarily mathematical in character, but does not make inordinate demands on the reader's mathematical equipment. A knowledge of thermodynamics and partial differentiation to about pass B.Sc. standard is necessary. Dr. Bridgman's treatment is logical, critical, and extremely careful. Nothing is accepted without full inquiry, He is doubtful concerning the existence of the Benedicks homogeneous thermoelectric effect. which, so far as my opinion may be worth anything, I saw beautifully and unequivocally demonstrated by Professor Benedicks at the May Lecture of the Institute of Metals in 1920 (J. Inst. Metals, 1920, 24, 7-55). A very brief account of Professor Bridgman's work on this subject is given, for the first time, as a footnote on p. 40. The book is nicely printed on good paper; it is provided with a brief bibliography and an index; it will appeal principally to the specialist. Its price is quite reasonable.-J. S. G. THOMAS.

The Adsorption of Gases by Solids. By S. J. Gregg. Fcap. 8vo. Pp. viii + 120, with 15 illustrations. 1934. London : Methuen & Co., Ltd. (2s. 6d. net.)

This handy little pocket-book reviews briefly and efficiently the whole field of the adsorption of gases on solids. What is meant by adsorption? Briefly, as stated in the opening words of this booklet, "wherever we have an interface between a solid and a gas or vapour, the concentration of the gas is higher in the immediate vicinity of the solid than it is in the recespace beyond. The gas is said to be adsorbed on the solid." That, I think, puts the matter very clearly. Is the subject of importance to metallurgists? Most assuredly it is. Gases are adsorbed by metals, and the phenomenon in these cases is complicated by questions of solubility. Thus, by way of example, to quote from p. 15: hydrogen is taken up by copper (above 400° C.), itself (above 200° C.), platinum (slight at 580° C., appreciable above 1340° C.), tungsten (1500° C.). Can this little booklet be recommended to metallurgists? Yes, unreservelly to those interested more especially in the theoretical aspects of the subjects. Here they will find references to all important papers on this subject.—J. S. G. THOMAS.

- (1) Elements of Industrial Heat. By John A. Randall and J. Warren Gillon. Volume I. Med. 8vo. Pp. vii + 261 with 94 illustrations in the text and 1 folding diagram. 1933. New York: John Wiley & Sons, Inc. (\$2.75.); London: Chapman and Hall, Ltd. (18s. 6d. net).
- (2) Industrial Heat Transfer. By Alfred Schack. Translated from the German by Hans Goldschmidt and Everett P. Partridge. Med. 8vo. Pp. xxii + 371, with 40 illustrations. 1933. New York : John Wiley & Sons, Inc. (\$5.00); London : Chapman & Hall, Ltd. (31s. net).

These two books can be very well reviewed together, as each is concerned with what is termed "industrial heat," and let me at once confess that after reading many works on so-called "industrial heat," the significance of the expression has quite escaped me. In recent years the stream of books dealing with "industrial heat" has been in full spate, and my acquaintance with them will amply justify my contention that, with one exception only, they will render very little assistance to those concerned with the *practical* aspects of industrial heating. The books are altogether to theoretical in character to serve this purpose. If it be contended that the practical man concerned with industrial heating needs a fair modicum of theory in his make-up, T will agree, provided that it be understood that this theory is to be provided in a thorough manner by a systematic course of study devised with no special professional application in view. The books on industrial heat to which I have referred attempt to teach the essentially practical man the theory of his job where it is too late. I am certain that such procedure is foredoomed to failure. Let us consider the first of these books. It contains practically nothing of a practical character. Its contents comprise calorimetry, expansion, the three states of matter, conduction, convection and radiation, fuels and combustion, properties of air and its moisture content, energy diagrams. None of these matters is treated even theoretically with the precision that characterizes a course of study in heat for, say, the Inter B.Sc. examination of an English University. I could illustrate this from almost any page of the book. Let one or two examples, taken haphazard, suffice. On pp. 52, 53 we read, "A vacuum is said to exist in a container when no gas particles are present : thus if the pressure in a container is reduced from atmospheric pressure to 0 lb. per sq. in. a *perfect vacuum* is said to exist." On p. 209 there commences a series of questions. The itrst reads, "How many Centigrade degrees are there between the freezing and boiling points?" I put this question to ten practical men who had attended courses in theory of the type outlined in this book. Each answered, " One hundred degrees ' not one spotted that the question was meaningless without reference to the material concerned. On p. 241 we find " $\pi = 3.1416 = 22/7 = \text{circumference/diameter."}$  No reference is made to a circle. My complaint about this kind of book is that it contains too much information of this type which, for lack of a better term, may be called "Zip-fastener" information. This, I think, is characteristic of these post-war years.

Now with regard to the second of these books. In the translators' preface it is emphasized that the translators have kept the requirements of the engineer engaged in practical work in view. Well, I must say that I have not met many engineers who could read with profit more than a very little part of this book. It can be appreciated only by those equipped with mathematical knowledge far beyond that of the ordinary practical engineer. He will get on quite well without knowledge of the contents of this book. These include the three mechanisms of heat transfer, heat exchanges, heat transfer in industrial furnaces, equations, and physical constants for heat transfer. The translators' task has been no light one, for throughout they have converted the metric units of the original to the English system of units.

Summing up, then, I would say that each book attempts the impossible—viz. to supply the essentially practical man with a knowledge of the theory of his craft when it is too late. The store of knowledge is a vast one, but contains no bargain basement. One can ascend from ground to top floor by a slowly ascending lift. These books attempt to make a rapid descent to the non-existent bargain floor. I think that puts the matter fairly. There may be some who deem this possible; I am of the contrary opinion.

Both books are well got up, are well printed on good paper, and well bound. Neither is unreasonable in price.-J. S. G. THOMAS.

# The Design and Construction of High-Pressure Chemical Plant. By Harold Tongue. Med. 8vo. Pp. ix + 420, with 306 illustrations. 1934. London: Chapman and Hall, Ltd. (30s. net.)

Mr. Tongue has endeavoured to compress within about 400 well-illustrated pages the results and experience of hundreds of technical workers in Europe and America during the last decade. He has succeeded to a remarkable degree in compiling a book of reference of great value to all interested in this new technique of high-pressure work, which has been one of the mostoutstanding industrial developments of recent times. The author writes with authority from our National Chemical Laboratory, and is clearly well acquainted with the details of the methods developed in Great Britain, Germany, Holland, U.S.A., and elsewhere. Much of the information has not been published before, and certainly we have not seen elsewhere, between two covers, such a fund of useful and interesting information on this subject.

Members of the Institute of Metals will be most interested in the chapters on "Materials for Service in High-Pressure Plant when Exposed to High and Low Temperatures," "The Design and Construction of the Chemical Autoclave," and "Manufacture of Large Pressure Vessels for High Temperatures."

The use of published creep data is described, and there is an excellent survey of corrosion and hydrogen penetration and embrittlement of steels under stress at high temperatures. Here we should have liked a fuller account of the use of bronze, aluminium, and other non-ferrous metals as linings, and for internal fittings of H.P. converters. The limiting creep stresses for copper, nickel-copper, and nickel-chrome alloys at high temperatures are given, and some very recent work—November, 1933—on the behaviour of these and other non-ferrous metals and alloys at low temperatures is summarized.

The author raises an important question in regard to the safety of fusion and other types of welding for the construction of high-pressure vessels. As Mr. Tongue points out, this matter should now be reviewed officially in the light of the rapid development and experience which has been gained abroad with these methods of manufacture.

It is interesting to note that the early chemical pressure vessels of Papin (1680) and Frankland

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(1855) were constructed of bronze and wrought copper, respectively. Also that Mr. Tongue recommends the use of solid drawn seamless copper tube for H.P. piping up to 550 atmospheres, with bronze fittings. This is, of course, only economic for small-scale experimental plant.

The book is not complete, as it does not include treatments of some very important sections of industrial high-pressure plant, e.g., scrubbing towers and absorbers, liquid injection pumps, internal electric heaters—usually of non-ferrous metal—rotary type pumps, gas compressors and circulators and coolers. In regard to the last, we should have liked some account of the effect of coating steel tubes with non-ferrous metals to protect against corrosion.

A valuable feature of the book is the patent abstracts given at the end of each chapter.

-A. F. B.

# How to Use a Large Library. By Eric John Dingwall. Pp. 63. Second Edition. 1933. Cambridge : Bowes and Bowes. (2s. 6d.)

This useful little book is intended to aid readers to trace references in some of the great libraries in Europe and America, e.g., the British Museum Library, the Cambridge University Library, the Bodleian Library, the Bibliothèque Nationale in Paris, the Library of Congress in Washington, and the Prussian State Library in Berlin. General notes are given on the methods of cataloguing books and periodicals in these libraries, together with hints on the best way of consulting these catalogues with reference to specific examples. Having found the reference, details are given of the procedure to be adopted in obtaining access to the book or periodical required. Another useful feature of the book is a list of bibliographies in various languages, which is particularly valuable for tracing very old books. To all who are unacquainted with the use of large libraries this work should prove indispensable.—A. R. PowELL.