### ABSTRA METALLURGICAL

(GENERAL AND NON-FERROUS)

1933

# MAY

Part 5

# I.—PROPERTIES OF METALS

(Continued from pp. 177-180.)

Recrystallization and Hardening of Aluminium due to Plastic Torsion. A. E. van Arkel and M. G. van Bruggen (Z. Physik, 1933, 80, 763-791) .--Torsion of fine-grained aluminium rods is found to be, in part, a reversible phenomenon, successive torsion in opposite directions being characterized by the development of a maximum crystal grain-size, dependent on the degree of untwisting effected in the rod. The axis of this maximum recrystallization effect corresponds with the axis of torsion, along which minimum hardening occurs. An elastic after-effect (Nachwirkung) is exhibited by polycrystalline aluminium rods, and, in general, by single crystals subjected to torsion. Some single crystals, however, exhibit an after-effect only when the torsion has been reversed. The difference in the two cases is possibly associated with crystal orientation. Whether the crystal size is greater or smaller after reversal of the torsion than prior to such reversal depends on the relative magnitudes of the torsions in opposite directions.—J. S. G. T. Relation between Hardening and Recrystallization Properties Associated

with the Plastic Deformation of Metals. IV.—Recrystallization of Aluminium Single-Crystals. W. G. Burgers, assisted in the experimental work by J. J. A. Ploos van Amstel (Z. Physik, 1933, 81, 43-65).-In continuation of previous work (see this J., 1931, 47, 276), it is found that the power of recrystallization, exhibited by a stretched single-crystal of aluminium and expressed in terms of the number of crystallites formed after annealing, is less, for the same total slip, the greater the number of slip planes partaking in the deformation. On the basis of this result, an attempt is made to interpret consistently the apparently contradictory deductions made by different observers concerning the relation between hardening and recrystallization in aluminium singlecrystals. The results also enable an explanation to be given of the occurrence of a preferential orientation of crystallization in the production of singlecrystals of aluminium by the slight extension of polycrystalline material.

J. S. G. T.

Beryllium. Anon. (Bull. Assoc. Tech. Fonderie, 1931, 5, 93-94).-From Found. Trade J., 1930, 42, 202. See this J., 1930, 43, 397.-W. A. C. N.

Commercial Possibilities of the Alloys of Beryllium. Alfred Stock (Technique moderne, 1932, 24, 767).—Abstract of a paper read before the Electro-chemical Society. See this J., 1932, 50, 337.—H. W. G. H. The Effect of Tension on the Electrical Resistance of Single Bismuth

Crystals. Mildred Allen (Phys. Rev., 1932, [ii], 42, 848-857) .- The effect of tension, within the elastic limit, on the electrical resistance of single-crystals of bismuth has been studied, using cylindrical specimens with the current and tension parallel to the axis of the cylinder. The orientation of the crystal may be expressed by means of 2 angles  $\theta$  and  $\phi$ , where  $\theta$  is the angle between the normal to the principal cleavage plane and the longitudinal cylindrical axis of the crystal,  $\phi$  is the angle between the projection on the principal cleavage plane of the normal to the secondary cleavage plane, and the major axis of the elliptical section of the principal cleavage plane, where the secondary cleavage plane considered is that one the normal of which makes an angle of 71° with that of the principal cleavage plane. The change of resistance  $\Delta R/R$  is directly proportional to the applied tension, and is independent of the current strength, but depends on both 0 and  $\phi$ . For  $0 = 0^{\circ}$ ,

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and  $0 = 90^{\circ}$ , the tension coeff. of resistance is very little affected by variations in  $\phi$ , whereas for  $0 = 60^{\circ}$ , the variation with  $\phi$  is a maximum. This variation involves a change of sign as well as of magnitude, so that for some orientations the coeff. is positive and not, as usually, negative. This accounts for discrepancies between the results of previous investigators on polycrystalline metal.—W. H.-R.

The Effect of Oxygen on the Properties of Copper. W. Broniewski and S. Jaslan (Compt. rend., 1933, 196, 174-177).—Oxygen was introduced into cast electrolytic copper in the form of CuO, the resultant alloys were rolled (cold up to 3% Cu<sub>2</sub>O, hot above this) and annealed at  $450^{\circ}$  C. for 1 hr., and a number of the physical properties of the alloys determined. The thermo-electric force and the e.m.f. of solution did not appear to be affected by oxidation, but the variation of e.m.f. and the elastic limit showed a change of direction above 0.8% Cu<sub>2</sub>O. The electrical conductivity is slightly reduced by oxidation, although the variation of electrical resistance increases to a flat maximum. The Brinell hardness increases by 30% up to the cutecie composition and then slowly decreases, and the plasticity behaves similarly. Both the tensile strength and the elongation are the most affected by oxidation. It is considered as established that up to 1% Cu<sub>2</sub>O does have an appreciable effect on the mechanical and electrical properties of copper.—J. H. W.

Influence of Deformation and Annealing on the Coefficient of Thermal Expansion of Copper. H. Sieglerschmidt (Z. Metallkunde, 1933, 25, 38–42, 64).—The coeff. of thermal expansion of copper increases considerably after 5-22% deformation by stretching or compression, but is decreased again by annealing at temperatures above  $150^{\circ}$  C., the "normal" figure being obtained after annealing at 300° C. The increase in the coeff. is attributed to the elastic stress caused by the cold-work. For annealed, cold-rolled copper sheets in which the crystallites are so oriented that the cubic plane lies in the rolling plane the coeff. is practically the same in all directions in the sheet.—M. H.

Recrystallization Phenomena on Synthetic Metal Bodies. W. Trzebiatowski (*Naturwiss.*, 1933, 21, 205).—A short preliminary report on cold- and hotpressing tests on very pure copper powder and the hardening and recrystallization phenomena associated therewith.—J. W.

The Phenomenon of Passivity by the Solution of Copper in a Mixture of Potassium Nitrate and Sulphuric Acid. Artur Kutzelnigg (Z. Elektrochem., 1933, 39, 67-73).—Copper becomes passive in a few seconds in a mixture of potassium nitrate (sp. gr. 1·4) and sulphuric acid (sp. gr. 1·84) at 30° C., owing to the formation of a layer of  $CuSO_4.5H_5O$ . Passivity occurs when 70-80%of the dissolved metal is precipitated as a strongly adherent, fine-grained layer, and is hastened by raising the temperature. Adding a little water retards the passivity, but further dilution increases it. The proportion of potassium nitrate to sulphuric acid content. Small amounts of hydrochlorie acid do not affect it, but larger amounts retard it.—J. H. W.

Mexican and Ecuadorian Copper and Bronze Axes. Anon. (Nature, 1933, 131, 279).—Comments on a paper by M. A. Clement (J. Soc. Américanistes Paris, [N.S.], 24, 1). Hardness tests have been made on the butt, the middle, and the cutting edge of axes of copper and bronze from pre-Columbian Mexico and Ecuador. The Ecuadorian axes were of pure copper. The Brinell values obtained were : butt 67–112, middle 59–103, edge 72–121. The Mexican axes contained 1.8–3.8% of tin. The Brinell values were : butt 48–56, middle 49–53, edge 50–56. In both the Ecuadorian and Mexican axes some process had been employed to harden the cutting edge of the instruments. There is no evidence against the hypothesis that the hardening was effected by hammering.—E. S. H.

On the Mechanical Properties of Lead. First Report. Masujirō Nakahara (J. Soc. Mech. Eng. Tokyo, 1928, 31, 391-408; Japanese J. Eng. Abs., 1932, 8, 10).—[In Japanese.] See this J., 1930, 43, 405.—S. G.

Thermal Expansion of Lead. Peter Hidnert and W. T. Sweeney (Met. Ind. (Lond.), 1933, 42, 177-178).—Abstract of U.S. Bur. Stand. J. Research, 1932, 9, 703-709. See J., this volume, p. 2.—J. H. W.

Effect of Small Percentages of Certain Metals upon the Compressibility of Lead at an Elevated Temperature. Lyall Zickrick (*Trans. Amer. Inst. Min. Met. Eng.*, 1932, 99, (Inst. Metals Div.), 345-358).—See this J., 1932, 50, 466.—S. G.

The Sublimation of Magnesium in Vacuo and its Casting in an Atmosphere of Argon. J. Hérenguel and G. Chaudron (*Génie civil*, 1933, 102, 42).—Previous work by H. and C. (see this J., 1932, 50, 67, 530) has shown that it is possible to purify magnesium by sublimation *in vacuo*. They now describe a method of obtaining cast ingots of the pure sublimed metal. The sublimed magnesium is melted in argon in a closed vessel to which is fitted a syphon leading to a mould in which the metal is to be cast. By raising the pressure of the argon the syphon is filled with molten magnesium, which is then transferred to the mould. Magnesium thus obtained is very malleable; its Brinell hardness is 29.—W. P. R.

Molybdenum. Alice V. Petar (Burn's Eng. Mag., 1932, 26, 432).—From U.S. Bur. Mines Economic Paper No. 15, 1932. See this J., 1932, 50, 763. —P. M. C. R.

The Changes in the Magnetic Resistance of Nickel After Transverse Magnetization at Various Temperatures. Angelo Drigo (Atti R. Istituto Veneto Sci. Venezia, 1032, 91, II, 173-214; Chem. Zentr., 1933, 104, I, 27-28).—The changes in the resistance of nickel wires magnetized perpendicular to the longitudinal axis at temperatures between 20° and 420° C. in fields up to 1600 gauss have been measured, and the results are discussed with reference to Gerlach's ideas of the mechanism of longitudinal magnetization.—A. R. P.

The Chemical and Physical Characteristics of the Photoelectrically-Active Hydrogen Content of Platinum and Palladium. G. Bethe (Z. Physik, 1933, 80, 701-725).—The dependence of the photoelectric effect exhibited by either platinum or palladium containing adsorbed hydrogen on the purity of the gas is investigated experimentally.—J. S. G. T.

Precise Determination of the Magnetic Moments of Potassium and Lithium in Relation to their Magnetic Nuclear Moment. W. Meissner and H. Scheffers (*Physikal. Z.*, 1933, 34, 48–53).—Read at the VIII Deutsche Physikertag, Sept., 1932. The molecular magnetic moment of potassium and lithium, and accordingly the value of the Bohr magneton, is found to be 0-916  $\times 10^{-20}$  gauss with a possible error of about 5 parts per 1000. The nuclear moment of lithium is at most 0.5–5% of a Bohr magneton. The values of the heats of dissociation of these metals, deduced from these results, agree to within about 5% with those given by Lewis.—J. S. G. T.

On the Possibility of Following the Recrystallization of Silver by Surface Colouring with Ferric Chloride. Ernst Beutel and Artur Kutzelnigg (Monatsk., 1932, 61, 189–193).—On treating silver which has been melted and allowed to cool with ferric chloride solution it becomes covered with a dirty reddish-white film of silver chloride; the corresponding film on hard-rolled silver and on worked silver which has been annealed at a high temperature is chocolatecoloured. Intermediate coloured films are obtained at intermediate annealing temperatures, a maximum of brightness being obtained after annealing at  $300^\circ$ -400° C. and a minimum after annealing at  $600^\circ$ -650° C. With increasing annealing temperatures above 500° C. there is a rapid decrease in the rate of modifies the colour of the film obtained by a subsequent etching with ferric chloride. There appears to be some relationship between the etch colours produced by ferric chloride and the grain-size and crystallographic orientation of the crystals.—A. R. P.

On the Diffusion of Silver and Copper into Glass. Joseph Halberstadt (Z. anorg. Chem., 1933, 211, 185–194).—According to Nernst's law of distribution, metals dissolve in glass in the monatomic state. The diffusion constants (average values) of silver in glass are  $1\cdot14 \times 10^{-8}$ ,  $1\cdot31 \times 10^{-8}$ , and  $1\cdot58 \times 10^{-8}$  cm.<sup>2</sup>/second at 565°, 590°, and 615° C, respectively, and that of copper 2.07 ×  $10^{-9}$  cm.<sup>2</sup>/second at 650° C. The application of Stokes-Einstein's formula shows that the diffusion coeffs. are anomalously high, from which it is concluded that silver and copper are solvated in glass.—M. H.

Colloidal Solutions in Metals. E. Podszus (Kolloid-Z., 1933, 62, 346-347). —The following method gives rise to tungsten filaments, containing thorium dioxide in solid colloidal solution. A concentrated solution of ammonium tungstate is prepared, and thorium nitrate is added until the content of thorium dioxide is about 1.5%. Acid is added, the mixture dialysed, then evaporated to dryness, and the glass-like residue is reduced to metal by means of hydrogen and then ground to a fine powder. The filaments obtained by the usual means from this powder have little rigidity, but those obtained at temperatures above 1200° C. have a higher resistance and less tendency to sinter than those produced by the usual methods.—E. S. H.

Some Theoretical and Practical Aspects of Gases in Metals. Jack H. Scaff and Earle E. Schumacher (*Metals and Alloys*, 1933, 4, 7–12).—The effects of temperature and pressure on the solubility of gases in metals are discussed with especial reference to the solubility of oxygen in silver, and methods are described for the determination of the gas content of metals. Recent work on vacuum melting of metals is reviewed.—A. R. P.

The Force of Adhesion Accompanying Solidification. A. Sellerio (*Physikal.* Z., 1933, 34, 180–181).—Determinations of the force necessary to detach ice frozen in contact with a metal plate indicate that the metals used and their molecular attractions are in the following order of magnitude: brass, 1; copper, 1·25; zinc, 1·33; aluminium, 1·38; iron, 1·49. It is suggested that solidification of a liquid is, in part, an electrical phenomenon. The force of adhesion of sulphur to aluminium is nil at the melting point of sulphur (114° C.) and increases, at first rapidly and then more slowly, to a limiting value of about 55 kg./cm.<sup>2</sup> at 0° C. as the temperature is decreased.—J. S. G. T.

On the Rate of Softening of Cold-Deformed Metals by Crystal Recovery and Recrystallization. F. Sauerwald and W. Globig (Z. Metallkunde, 1933, 25, 33-38).-Cf. this J., 1932, 50, 6, 110. Coarse-grained, fully-annealed copper cylinders (Brinell hardness 38) were compressed by a drop hammer at 200°-420° C., then annealed for different periods at various temperatures and quenched. No recrystallization occurred in 24 hrs. at 375° C. after a reduction of 19% under the hammer in the case of copper with an initial average grainsize (g) of  $170 \mu$ , but the Brinell hardness (H) gradually fell from 72 to 61, *i.e.* only crystal recovery with partial softening had taken place. With g = $122~\mu,~H$  for metal compressed 20% at 420°C. and then annealed at this temperature fell from 74 to 65, 62, 52, 45, and 44 after 20, 40, 60, 90, and 120 minutes, respectively. Recrystallization became evident after 60-70 minutes and was almost completed after 90 minutes. The value of g has a large influence on the course of the isothermal softening, thus whereas with  $g = 170 \,\mu$ recrystallization is not apparent at 375° C. within 24 hrs., with  $g = 140 \,\mu$  it becomes visible after 3 hrs., and with  $g = 115 \mu$  it is complete in 3 hrs. Iron behaves similarly. It is concluded that there are 3 temperature ranges in which the relation of softening by crystal recovery to softening by recrystallization is very different. At low temperatures only crystal recovery occurs, and this never results in complete softening even after very long periods.

At the highest temperatures recrystallization is rapid and softening is soon completed. In the middle range crystal recovery is followed by softening by recrystallization which is only slightly affected by the relatively small number of nuclei which grow slowly; the rate of softening increases only after prolonged annealing when recrystallization is almost complete. This effect is characterized by an inflexion in the Brinell hardness-annealing time curve. In the middle range softening can be incomplete in spite of crystal growth.

-M. H.

Theories of Strength. A. Nadai (Amer. Soc. Mech. Eng. Preprint, 1932, (Dec.), 1-13).—A mathematical treatment is given of the problem of determining the conditions under which yielding starts in metals subjected to stress. —W. P. R.

Plasticity and Elasticity. A. Nadai (*Electric J.*, 1932, 29, 510-512).—A general account of methods developed for studying the elastic behaviour and plastic flow of structures and machine parts.—J. C. C.

Measurements of the Pressure-Flow of Metals at Low Temperatures. R. Holm and W. Meissner (*Wiss. Abhandl. Physikal.-Tech. Reichsanst.*, 1932, 16, 24–27).—From Z. Physik, 1932, 74, 736–739; see J., 1932, 50, 291.—M. H.

The Production of Specific Tensions by Stretching. V. Caglioti and G. Sachs (Mitt. Material., Sonderheft 21, 1933, 49-52).—See this J., 1932, 50, 291.—J. W.

Recovery [of Metals] from the Effects of Cold-Work. G. Tammann (Light Metals Research, 1932, 2, (18), 9-11).—A translation of extracts from Z. Metallkunde, 1932, 24, 220-222. See this J., 1932, 50, 725.—J. C. C.

The Formation of Localized Slip Layers in Metals. C. W. MacGregor (Metals and Alloys, 1933, 4, 19-22).—The effect of previous cold-work on the formation of flow layers in aluminium has been investigated in compression tests in which the specimens were provided with conical indentations on their ends fitting a pair of conical compression plates so that the "barrel effect" was eliminated. The cone angle for aluminium is about 14.6° to the horizontal. The results indicate that the more cold-deformation within certain limits that is done on a soft and ductile metal like aluminium the more pronounced will be the flow layers if it is again stressed to the plastic limit.

-A. R. P.

The Tenacity of Polycrystalline Materials. W. Kuntze (Z. Physik, 1933, 81, 80-81).—Tensile and tenacity tests of irregular-shaped test-pieces exhibit the difference between polycrystalline and single-crystal materials. It is concluded that the property of separation-cohesion is equally important with that of tenacity in the discussion of the properties of polycrystalline elastic bodies.—J. S. G. T.

The Fatigue of Metals—Its Nature and Significance. H. F. Moore (Amer. Soc. Mech. Eng. Preprint, 1932, (Dec.), 1-3).—The essential feature of fatigue failure is a spreading crack. Studies of fatigue failure in single crystals of metal indicate that such cracks frequently start by slip along planes of atomic weakness. Whilst a ductile metal does not resist repeated stress better than a brittle material, a ductile metal does withstand occasional higher stresses without crack formation, and under such conditions it is better suited to withstand repeated stresses than is a brittle metal.—W. P. R.

Report of Research Committee [of A.S.T.M.] on Fatigue of Metals. H. F. Moore (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (I), 138).—See this J., 1932, 50, 469.—S. G.

Summary of Present-Day Knowledge of Fatigue Phenomena of Metals. Corrosion-Fatigue of Metals. T. S. Fuller, P. F. Mumma, and H. F. Moore (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (I), 139–142).—Appendix to Report of Research Committee on Fatigue of Metals. See preceding abstract and this J., 1932, 50, 469.—S. G. The Significance and Limitations of Fatigue Test Results. R. E. Peterson and H. F. Moore (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (I), 142-147).— Appendix to Report of Research Committee on Fatigue of Metals. See abstracts above and this J., 1932, 50, 469.—S. G.

Investigations on the Fatigue of Metals. R. Cazaud (Usine, 1931, 40, (21), 37).—Cf. this J., 1932, 50, 530. Abstract of a brochure published by Aéronautique.—H. W. G. H.

On the Dependence of the Endurance Strength on the Crystal Orientation. W. Fahrenhorst, K. Matthaes, and E. Schmid (*Mitt. Material., Sonderheft* 21, 1933, 58-60).—See J., this volume, p. 5.—J. W.

Increasing the Hardness of Metals by the Action of Rotating Magnetic Fields. E. G. Herbert (*Usine*, 1931, 40, (34), 29).—See this J., 1931, 47, 196.—H. W. G. H.

Use of Metals at Elevated Temperatures [in the Ceramic Industry]. Clyde E. Williams (*Brick Clay Record*, 1932, 80, 195-197).—See this J., 1932, 50, 532.—S. G.

Third Report of the Atomic Weights Commission of the International Union for Chemistry. G. P. Baxter, Mme. P. Curie, O. Hönigschnid, P. Lebeau, R. J. Meyer (*Ber. deut. chem. Ges.*, 1933, [A], **66**, 21-30).—The Commission accepts revised values for the following atomic weights : iodine 126.92, lanthanum 135.92. A complete table of atomic weights, referred to that of oxygen as 16, is given, and recent work on the subject is reviewed.—P. M. C. R.

The Chemical Elements and Atomic Types from the Standpoint of the Investigation of Isotopes. Otto Hahn (*Ber. deut. chem. Ges.*, 1933, [A], 66, 1-14).—The International Commission for Atomic Weights proposes to retain the "chemical" standard, O = 16, but recognizes the adoption of a correction based on the Mecke-Childs value  $O_{18}: O_{16} = 1:630$  in physical calculations involving isotopic oxygen. The demonstration of isotopes by spectroscopic methods, with the necessary revision of atomic weights, is recorded in the cases of lithium, oxygen, neon, scandium, zinc, selenium, strontium, niobium, tellurium, barium, tantalum, thallium, lead, eka-cæsium, hydrogen, boron, nitrogen, chlorine. Authenticated cases of isotopy are tabulated, with available relevant details.—P. M. C. R.

The Effect of Pressure on the Electrical Resistance of Fifteen Metals Down to Liquid Oxygen Temperatures. P. W. Bridgman (*Phys. Rev.*, 1932, [ii], 42, 587).—Abstact of a paper read before the American Physical Society. Measurements made 15 years ago on the pressure coeff. of a number of metals between 0° and 100° C. have been extended to  $-78^{\circ}$  C. (solid carbon dioxide) and  $-183^{\circ}$  C. (liquid oxygen). In order to avoid freezing of the transmitting medium, pressure must be transmitted with gaseous helium. This introduces a number of difficulties of technique, which have been so far overcome that routine measurements have been made to 7000 kg./cm.<sup>2</sup> at  $-183^{\circ}$  C. Over this range no very striking results have been found. Resistance decreases nearly linearly with pressure, perhaps even more linearly than at room temperatures. There is in almost all cases a numerical increase in the coeff. at low temperatures, but the increase is not usually large, the largest effect being a doubling of the coeff. of aluminium, and there is no simple correlation with other properties of the metal.—S. G.

The Effect of Homogeneous Mechanical Stress on the Electrical Resistance of Crystals. P. W. Bridgman (*Phys. Rev.*, 1932, [ii], 42, 858-863).—Theoretical. The general methods of Voigt (*Lehrbuch der Kristallphysik*) are used to express the effect of mechanical stress on the electrical resistance of a conducting crystal. Symmetry considerations show that the effect can be expressed in terms of a set of constants, the number of which is equal to the number of elastic moduli, and connect the change of resistance by equations resembling those connecting strain with stress. The equations agree with the results of Allen (J.), this volume, p. 225) for bismuth crystals. They suggest that if tension is applied to a monocrystalline rod carrying a current, a transverse e.m.f. may be produced analogous to the Hall effect caused by a magnetic field.—W. H.-R.

Some Thermal Conductivities. L. C. Bailey (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 173-175).—A summary of a paper by B. in *Proc. Roy. Soc.*, 1931, [A], 134, 57-76. See this J., 1932, 50, 4.—R. G.

New Methods for the Determination of the Heat Conductivity of Metals. F. Gabler (Anz. Akad. Wiss. Wien, 1931, 68, 142).—See this J., 1932, 50, 293. —W. A. C. N.

Measurements Employing Liquid Helium. XIII.—Contact Resistance between Super- and Non-Super-Conductors. R. Holm and W. Meissner (*Wiss. Abhandl. Physikal.-Tech. Reichsanst.*, 1932, 16, 1-21).—Reprint from Z. *Physik*, 1932, 74, 715-735; see this J., 1932, 50, 344.—M. H.

The Effect of Plastic Deformation on the Superconductivity of Dia- and Paramagnetic Metals. A. Kussmann and H. F. Scemann (Wiss. Abhandl. Physikal.-Tech. Reichsanst., 1932, 16, 261-274).—Reprint from Z. Physik, 1932, 77, 567-580; see this J., 1932, 50, 660.—M. H.

On the Stress-Elongation Diagram of Ferromagnetic Materials under Very Small Loads. H. Kühlewein (Z. tech. Physik, 1932, 13, 539-541).—The elastic behaviour of wires of copper, nickel, and a 50:50 nickel-iron alloy under small deformations such as correspond with the stresses produced by magnetostriction have been investigated by delicate measurements during loading and unloading. The observed elastic after-effects after rapid removal of load have been compared with the simultaneous changes in permeability, and a very close relationship has been established.—J. W.

Some Properties of Homogeneously Distorted Cubic Ferromagnetic Lattices. Francis Bitter (*Phys. Rev.*, 1932, [ii], 42, 697–708).—Theoretical. The work of Becker and Kersten (this *J.*, 1930, 44, 456) on the magnetic properties of distorted lattices is extended in such a way that the assumption of an isotropic medium is avoided, and the problem treated with special reference to the crystallographic symmetry. The theoretical results are in qualitative agreement with data for the magnetostriction and magnetization of nickel, iron, and nickel-iron alloys under tension and compression.—W. H.-R.

The Theory of the Ferromagnetic Anisotropy of Single Crystals. Richard M. Bozorth (*Phys. Rev.*, 1932, [ii], 42, 882–892).—The method of Heisenberg (see this J., 1931, 47, 374) is extended so as to permit the calculation of the magnitude and direction of magnetization in a single crystal corresponding with selected values of the component of magnetization in the field direction. These may be calculated for any direction of the field with respect to the crystal axes. Diagrams are given for a number of directions, and the results are in fair agreement with the observations of Honda and Kaya (*Sci. Rep. Tohoku Imp. Univ.*, 1926, [i], 15, 72) for crystals of iron.—W. H.-R.

The Electron Theory and Magnetism. F. W. Constant (*Trans. Electrochem.* Soc., 1932, 61, 275–279).—The electrons in a metal are classed as (1) free, (2) bound, and (3) partly bound, and the magnetic contributions of each type are discussed. It is first shown that the partly-bound electrons are responsible for the structure sensitiveness of the magnetic properties, and then that other structure sensitive properties in general may be attributed to these electrons. As the effect of these electrons depends on the orderliness of their distribution, such properties are crystalline rather than atomic ones. In the discussion, in which J. Schulein, P. H. Brace, C. G. Fink, and F. W. Brooke took part, it was stated that certain silver-aluminium-magnesium alloys display greater magnetic hardness than Honda's steel. With reference to the temperature effects on magnetism, when the former is raised thermal agitation commences and thus any orderly arrangement of the atoms and electrons is broken up. This appears to induce an increase in paramagnetism and a decrease in diamagnetism and ferromagnetism.—W. A. C. N.

Optical and Photoelectric Investigations Relating to Thin Metal Sheets. Rudolf Schulze (*Physikal. Z.*, 1933, 34, 24–37).—An investigation of the photoelectric and optical characteristics of thin gold foil is detailed. The refractive index and extinction coeff. of thin sheets of this metal appear to be constant up to a thickness of 2 mµ. A bibliography comprising references to 72 papers referred to in the text is appended.—J. S. G. T.

The Emission of Positive Ions from Heated Metals. Le Roy L. Barnes (*Phys. Rev.*, 1932, [ii], 42, 487–492).—Cf. this J., 1932, 50, 726. When a metal is heated to a high temperature, two kinds of positive ions may be emitted, namely, (1) positive ions of impurities, usually alkali metals, which may be reduced to zero by sufficient heating, and (2) positive ions of the metal itself. By analyzing the positive-ion emission in a mass spectrograph, B. shows that iron, nickel, copper, rhodium, and columbium emit singly-charged ions of their own metals, as well as those of impurities. In agreement with the results of Wahlin (this J., 1932, 50, 219) no positive ions of uranium or thorium were detected with these metals.—W. H.-R.

The Temperature Variation of the Positive Ion Emission from Molybdenum. Le Roy L. Barnes (*Phys. Rev.*, 1932, [ii], 42, 492–497).—Cf. preceding abstract. The temperature variation of the positive-ion emission from molybdenum after thorough outgassing and heat-treatment has been measured in two different types of tube. The mean values of the positive-ion work function determined in the two tubes were 8·14 and 8·20 v., respectively. The reflection coeff. indicates that about one ion out of ten striking the surface is condensed. The results are in better agreement with the theory of L. P. Smith (this J., 1930, 44, 462) than were the earlier data which Smith obtained.—W. H.-R.

## **II.**—**PROPERTIES OF ALLOYS**

#### (Continued from pp. 181-187.)

An Interesting Destruction Phenomenon Observed in an Aluminium Alloy. O. Greger (*Mitt. Staatl. tech. Versuchsamtes* (*Wien*), 1931, **20**, 36–39; *Chim. et Ind.*, 1932, **28**, 1339–1340; *C. Abs.*, 1933, **27**, 1306).—The alloy contained aluminium 55. zinc 45%, traces of lead, and was free from antimony, tin, and copper. A 33-mm. cube was compressed until the edge had decreased 38%; the free faces were bulged, whilst the faces in contact with the plattens of the press remained plane. A rolled sheet 1.6 mm. of the same alloy was fairly strong, although flexible. At the end of 9 years the originally flat faces were concave (deflection of 3.2 mm.), and numerous fissures disintegrated the cube; the surface of the metal sheet flaked off and only the central portion retained some of its original properties. These swelling phenomena are doubtless due to a progressive separation of crystallites composed of aluminium and zinc and to a repulsion of the crystals formed in the course of years.—S. G.

Compression Stressing of Rolled Light Alloys. G. Guidi (*Alluminio*, 1933, 2, 14–17).—Two alloys of the Duralumin type, having the same tensile strength and elastic limit, showed in the construction of riveted structures for seaplanes quite different behaviour in the areas which, in service, had been subjected to compression stresses. Numerous tests have shown a difference of 12–15% in the compression strength of "17 ST" and Alclad as compared with Dürener A.-G. Duralumin.—G. G.

Developments in Aluminium Alloys in Relation to Economies in Aircraft Construction. C. F. Nagel and G. O. Hoglund (*Amer. Soc. Mech. Eng. Preprint*, 1932).—The mechanical properties and corrosion resistance of aluminium-alloy structural material are reviewed.—W. P. R. Researches on the Aluminium-Rich Binary Alloys of Aluminium and Manganese. M. Bosshard (*Alluminio*, 1932, 1, 361-367).—A lengthy account of a paper already abstracted. See J., this volume, p. 10.—G. G.

of a paper already abstracted. See J., this volume, p. 10.—G. G. Static and Dynamic Properties of Sand-Cast Light Alloys. W. Saran (Alluminio, 1932, 1, 368-376).—From Z. Metallkunde, 1932, 24, 181-184, 207-210. See this J., 1932, 50, 726.—G. G.

A Review of Recently-Introduced Aluminium Alloys. W. C. Devereux (J. Inst. Production Eng., 1930, 9, 169–185).—See this J., 1931, 47, 649. —J. C. C.

The Equilibrium Diagram of the Chromium-Carbon System. Kazue Hatsuta (*Tech. Rep. Tóhoku Imp. Univ.*, 1932, 10, 186–194).—[In English.] See this J., 1931, 47, 337.—A. R. P.

On Polynary Systems with Iron. V.—X-Ray Supplements on the Systems Chromium-Carbon and Iron-Silicon-Phosphorus. F. Sauerwald, W. Teske, and G. Lempert (Z. anorg. Chem., 1933, 210, 21-25).—Cf. this J., 1932, 50, 728. X-ray analysis has confirmed the existence of a stable system and a metastable system with relatively large stability in the chromium-rich chromium-carbon alloys. The stable cutectic with 4.2% carbon consists of practically carbon-free chromium and the cubic carbide  $Cr_4C$ , the metastable cutectic with 4.5% carbon consists of chromium and a hexagonal carbide the formula of which is  $Cr_2C_3$ , according to Westgren and Phragmén. In the metastable state alloys with 6.4–8.5% carbon consist of Cr and  $Cr_2C_3$ , on annealing this structure transforms into  $Cr_4C$  and  $Cr_2C_3$ .—M. H.

The Binary Systems Cobalt-Tungsten and Cobalt-Molybdenum. W. Köster and W. Tonn (Z. Metallkunde, 1932, 24, 296-299).-The transformations in the solid state of alloys of cobalt with up to 40% tungsten or molybdenum have been studied by dilatometric, magnetic, and micrographic investigations. (1) The solid solubility of tungsten in cobalt decreases from 39% at  $1480^{\circ}$  C. (cutectic temperature) to about 14% at  $400^{\circ}$  C. With increasing tungsten content the temperature of the  $\varepsilon \rightleftharpoons \gamma$  transformation of cobalt is raised from 400° C. to 1040° C. (at which temperature the y-solid solution (28.5% tungsten), the  $\varepsilon$ -solid solution (about 30% tungsten) and the compound CoW are in equilibrium), and the magnetic transformation point is lowered gradually from 1140° C. to about 700° C. when it occurs simultaneously with the  $\varepsilon \Longrightarrow \gamma$ transformation. The  $\epsilon$ -phase saturated with tungsten has a magnetic transformation point at 825° C. Alloys quenched at 1300° C. show a large increase in hardness and coercive force on subsequent ageing at temperatures between 600° and 1000° C. (2) The constitution and behaviour of the cobalt-molybdenum alloys are analogous. The solid solubility of molybdenum decreases from 27.5% at 1325° C. (eutectic temperature) to about 8% at 400° C. The temperature of the  $\varepsilon \equiv \gamma$ -transformation is increased up to 920° C., where the  $\gamma$ -solid solution (20% molybdenum), the  $\varepsilon$ -solid solution (22% molybdenum) and the compound CoMo are in equilibrium. Molybdenum lowers the magnctic transformation point of cobalt gradually to about 700° C. where it coincides with the  $\varepsilon = \gamma$ -transformation. The  $\varepsilon$ -phase saturated with molybdenum has a magnetic transformation point at about 750° C.-M. H.

Aluminium-Bronze: Influence of Iron on the Dimensions of the Crystals. C. Vickers (Bull. Assoc. Tech. Fonderie, 1932, 6, 161-162).—From Foundry, 1931, 59, (9), 55-57; cf. this J., 1931, 47, 517.—W. A. C. N.

Cast "Aluminium-Bronzes." W. Claus and F. Goederitz (Bull. Assoc. Tech. Fonderie, 1932, 6, 154-160).—From Giesserei, 1930, 17, 153-155; 182-186; 1017-1023; 1931, 18, 319-326. Cf. this J., 1930, 43, 456; 1931, 47, 408; 1932, 50, 13.—W. A. C. N.

Beryllium-Copper—Cast Condition. Anon. (Machinist (Eur. Edn.), 1933, 77, 25E).—The use of beryllium-copper in the cast condition, precipitation hardened, is based on the increase in hardness and tensile strength with the

beryllium content. The heat-treatment and working and the advantages of these alloys are described. In addition to favourable mechanical properties, these alloys, owing to deoxidizing effects of the beryllium, have a high electrical conductivity, and the beryllium does not cause detrimental surface defects on the castings.—J. H. W.

Atomic Arrangement and Magnetic Properties in the Systems Copper-Gold, Copper-Palladium, and Copper-Platinum. H. F. Seemann (Z. Metallkunde, 1932, 24, 299-301).—The composition-atomic magnetic susceptibility curve of copper-gold alloys quenched from just below the solidus (in which state the atoms are irregularly distributed in the crystal lattice) is slightly convex to the axis of composition, *i.e.* in the direction of stronger diamagnetism. If the alloys corresponding with the composition  $Cu_3Au$  and CuAu are subsequently annealed at 300°-400° C. the atomic distribution becomes regular, and the diamagnetism increases by about 20% for  $Cu_3Au$  and decreases by about 20% for CuAu. The alloys corresponding with the composition  $Cu_3Pt$  and  $Cu_3Pd$ are also diamagnetic in the quenched state (in spite of the addition of paramagnetic platinum and palladium) and behave similarly to  $Cu_3Au$  on annealing, the increases in diamagnetism being about 25% and 50%, respectively.—M. H.

The [Magnetic] Susceptibility and Electrical Conductivity of Copper-Manganese Alloys. S. Valentiner and G. Becker (Z. Physik, 1933, 80, 735-754).— Cf. J., this volume, p. 71. The magnetic susceptibilities and electrical conductivities of the complete series of copper-manganese alloys have been determined between room temperature and — 192° C. The alloy containing 1 atom of manganese and 3 atoms of copper is characterized by a maximum susceptibility at all temperatures. The Curie-Weiss law for the dependence of susceptibility on temperature is obeyed by all the alloys down to a little below — 60° C. At no temperature do the alloys exhibit ferromagnetic properties. The specific electrical resistance at room temperature increases with increasing manganese content from 0.31 × 10<sup>-4</sup> ohm.cm. in the case of the alloys containing 10% (atomic) of manganese. The ratio  $R_{-185'}/R_{20}$  in the case of alloys containing 10-70% of manganese is 0.92; the corresponding temperature coeff. of resistance is about 0.0004. The specific resistance of pure manganese at 20° C. is approximately 0.28 × 10<sup>-4</sup> ohm.cm.; the corresponding temperature coeff. is 0.0039.—J. S. G. T.

On the Thermal Expansion of Manganin. A. Schulze (Z. tech. Physik, 1933, 14, 89-90).—Between 20° and 500° C. the thermal expansion of Manganin (copper 86, manganese 12, and nickel 2%) is given by the expression  $\Delta l = 1.776\tau + 0.0355\tau^2$ , where  $\tau =$  temperature in °C. × 10<sup>-2</sup> and  $\Delta l =$  change in length in mm. of 1 m. Slight variations in the composition have little effect.—J. W.

Copper-Tin Alloys. I.—Bronzes. Anon. (*Tin*, 1933, Feb., 15-18).—The composition, principal properties, and applications are given of true bronzes, bearing bronzes, and phosphor-bronzes and silicon-bronzes.—J. H. W.

Directional Properties in Cold-Rolled and Annealed Commercial Bronze. Arthur Phillips and Carl H. Samans (*Metal Stampings*, 1932, 5, 598).—Short abstract of a paper read before the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers. See this J., 1932, 50, 661. —J. H. W.

Heading Properties of Brass Wire. D. K. Crampton (*Metal Progress*, 1933, 23, (3), 21-24).—The alloy most used in heading contains about 65% copper, a little lead, and the remainder zinc. The aim of the present investigation is to determine the effect of variations in composition, and also the influence of initial temper in the ease of the process and on final quality. The results in the case of 16 different samples of given temper and composition are tabulated, the qualities considered being tensile strength, percentage elongation, and tendency

to buckling, folding, shearing, and surface roughening. The system of rating is explained and illustrated, and conclusions for moderately worked and for re-headed material are given. Effects of varying composition are graphically recorded.—P. M. C. R.

High-Strength Brass. O. W. Ellis (Bull. Assoc. Tech. Fonderie, 1932, 6, 83-88).—From Trans. Bull. Amer. Found. Assoc., 1930, 1, (4), 65-83. Cf. this J., 1930, 43, 468.—W. A. C. N.

A Simplified Method of Making Special [Nickel- and Manganese-] Brasses.
A. Le Thomas (Mech. World, 1932, 92, 334).—Abstract from Rev. Mét., 1931, 28, 518-523. See this J., 1932, 50, 15.—F. J.
Nickel in High Tension Brasses [Turbadium]. Anon. (Nickel Bulletin, Nickel in High Tension Brasses [Turbadium].

Nickel in High Tension Brasses [Turbadium]. Anon. (Nickel Bulletin, 1933, 6, 18).—Turbadium contains copper 50, zinc 45, nickel  $2-2\cdot25$ , iron  $0\cdot8-1\cdot0$ , tin  $0\cdot5$ , and manganese  $1\cdot5-2\cdot0\%$ . The use of the nickel is to increase the resistance to erosion, and thus to render the alloy especially suitable for the manufacture of ships' propellers.—J. H. W.

the manufacture of ships' propellers.—J. H. W. Nickel in Foundry Brasses and Bronzes. Anon. (Met. Ind. (N.Y.), 1932, 30, 466–467).—The tensile strength, resistance to compression, and yieldpoint of 11% tin-bronze, 85:5:5:5 red brass, yellow brass with 1% tin and 2% lead, G-bronze with 8% tin and 4% zinc, 80:10:10 lead bearing bronze, and 6:20:74 tin-lead bronze are considerably improved by addition of 0.5-3% nickel. As little as 0.5% nickel in bronze widens the casting range, increases the fluidity, reduces the intercrystalline shrinkage pores, increases the density, and reduces the porosity.—A. R. P.

**Precious Metal Alloys.** R. C. Brumfield (*Trans. Amer. Soc. Steel Treat.*, 1932, 19, 333-355; discussion, 355-367).—The composition and properties of dental alloys and solders are discussed and an account is given of the effect of heat-treatment in improving the strength and hardness. Apparatus and methods for testing the hardness, tensile strength, and torsion properties are also described, and a bibliography of recent papers on gold alloys is included. No new results are recorded.—A. R. P.

The Alloys of Gold with Antimony. A. T. Grigoriev (Z. anorg. Chem., 1932, 209, 289-294).—See abstract from Izvestia Platinago Instituta (Ann. Inst. Platine), 1929, (7), 45-51; see this J., 1930 44, 502.—M. H.

On the System Gold-Manganese. H. Moser, E. Raub, and E. Vincke (*Mitt. Forschungsinst. Edelmetalle*, 1933, 6, 109-113, 129-136).—An account of work the results of which have been published in Z. anorg. Chem., 1933, 210, 67; see J., this volume, p. 124.—A. R. P.

Contribution to the Knowledge of the Electrolytic Potential and the Constitution of Gold Amalgams. Robert Kremann and Robert Baum [with Ludwig Lämmermayr, Jr.] (*Monatsh.*, 1932, 61, 315-329).—Up to 75% gold the gold amalgams have the same potential as mercury, and hence all compounds which contain more mercury than corresponds with  $Au_3Hg$  must be considered as non-resistant compounds from the point of view of Tammann's rule. Alloys with more than 75% gold have practically the same potential as pure gold.—A. R. P.

Measurements Employing Liquid Helium. XIX.—Researches on Alloys of the Lead-Thallium and Lead-Bismuth Series with Respect to Superconductivity. W. Meissner, H. Franz, and H. Westerhoff (*Wiss. Abhandl. Physikal.-Tech. Reichsanst.*, 1932, 16, 201-218).—Reprint from *Ann. Physik*, 1932, [v], 13, 967-984; see this J., 1932, 50, 604.—M. H.

X-Ray Determination of the Solubility of Manganese in Magnesium. E. Schmid and G. Siebel (*Mitt. Material., Sonderheft* 21, 1933, 21-23).—See this J., 1932, 50, 155.—J. W.

On the Equilibrium Diagram of the Magnesium-Zinc Alloys. A. A. Botchvar and I. P. Welitschko (Z. anorg. Chem., 1933, 210, 164-165).—The diagram proposed is based on the work of Chadwick (this J., 1928, 39, 285) and Hume-Rothery and Rounsefell (this J., 1929, 41, 119), and on B. and W.'s microscopic examination of alloys with 33-42 atomic % magnesium; it shows the existence of the compounds MgZn<sub>2</sub>, MgZn<sub>2</sub>, and MgZn, but contrary to the work of H.-R. and R., but in accordance with that of C., MgZn<sub>2</sub> is shown as forming solid solutions with zine and especially magnesium.—M. H.

Influence of Carbon on the "Annealing-Brittleness" of Nickel and Its Alloys. Tokushichi Mishima (J. Min. Inst. Japan, 1928, (518), 417-446; Japanese J. Eng. Abs., 1932, 8, 83).—[In Japanese.] See this J., 1931, 47, 76, 269.—S. G.

Heat-Resistant Special Alloys of the Nickel-Chromium-Iron Group. Wilhelm Herrmann (*Feuerungstechnik*, 1932, 20, 114-116; *Chem. Zentr.*, 1933, 104, I, 666).—The brittleness of nickel-chromium alloys in hot gases containing sulphur compounds is reduced by addition of 10-20% iron. Their technological properties are improved by 0.4-0.5% carbon, but if magnesium is used as deoxidizer not more than 0.1% carbon must be present. The best mechanical working properties are obtained with less than 0.05% carbon. The mechanical properties of numerous binary and ternary alloys of this type at temperatures up to  $500^{\circ}$  C. are tabulated, and the effects of small amounts of other metals on the heat-resisting properties are discussed. Silicon improves the resistance to scaling at high temperatures, but molybdenum and tungsten have a bad effect when the chromium content is less than 10% and a good effect when the chromium exceeds 20%.—A. R. P.

The Properties of Monel Metal. With Special Reference to Power Plant Equipment. Anon. (Monel Metal (published by Henry Wiggin and Co., Ltd.), 1933, 1-8).—The physical and mechanical properties of Monel metal in various states of annealing and working are tabulated and its applications to power plant equipment are illustrated.—J. H. W.

Technical Materials of High Magnetic Softness. F. Stāblein (Z. tech. Physik, 1932, 13, 532-534).—A rapid and accurate method of measuring very small coercivities with the ballistic galvanometer is described. The properties of some technical nickel-iron alloys with low coercivity are discussed.—J. W.

"After-Effect Losses" in Ferromagnetic Materials in Weak Alternating Fields. R. Goldschmidt (Z. tech. Physik, 1932, 13, 534-539).—Besides losses due to eddy currents and hysteresis, additional losses ("after-effect losses") occur in alternating fields; these can be observed particularly well in weak fields, and in many materials they are the predominating losses. This applies especially to iron-nickel alloys in the middle composition ranges; the effect of temperature and frequency in these cases has been investigated.—J. W.

Propagation of Large Barkhausen Discontinuities [in Nickel-Iron Alloys]. III.-Effect of a Circular Field with Torsion. L. Tonks and K. J. Sixtus (Phys. Rev., 1933, [ii], 43, 70-80).—Cf. previous note, Phys. Rev., 1932, [ii], 41, 539; see this J., 1932, 50, 664. The propagation of large Barkhausen discontinuities in wires has been studied under conditions in which the main field, H, was supplemented by a transverse field,  $H_t$ , produced by passing a current through the wire, which could be subjected to combined torsion and tension. Critical field characteristics were obtained from which relations were found between the strain and the critical field. These show that the component of the applied field along the direction of maximum extension is almost solely effective in causing the large Barkhausen jump. The component perpendicular to the principal strain axis along which the extension is a maximum has no effect on the reversal of magnetization. This shows that the principal strain axis is a direction of preferred orientation of magnetization, in agreement with R. Becker's theory relating direction of magnetization to strain. The departures from the simple ideal case are discussed in detail.-W. H.-R.

The Alloys of Palladium with Antimony. A. T. Grigoriev (Z. anorg. Chem., 1932, 209, 308-320).—See abstract from Izvestia Platinago Instituta (Ann. Inst. Platine), 1929, (7), 32-44; this J., 1930, 44, 511.—M. H.

On the Magnetic Susceptibility of Ferro-Silicons Rich in Silicon. C. H. Bedel (Compt. rend., 1933, 196, 262-264).—The magnetic susceptibility of ferro-silicons containing more than 30% silicon and its variation with different kinds of heat-treatment have been investigated. There is a marked maximum of this property at about 50% silicon, which confirms the existence of the silicide, FeSi<sub>2</sub>, found by other methods.—J. H. W.

On the Behaviour of Phosphorus to Copper and Silver.—I. K. W. Fröhlich (Mitt. Forschungsinst. Edelmetalle, 1932, 6, 69-74).—A lengthy summary of a paper in Z. anorg. Chem., 1932, 208, 225; see this J., 1932, 50, 734.—A. R. P.

Cemented Tantalum Carbide Tools. Floyd C. Kelley (*Trans. Amer. Soc. Steel Treat.*, 1932, 19, 233-243; discussion, 243-246).—See this J., 1932, 50, 81.—S. G.

On the Thermo-Electric Forces in the Systems Tellurium-Sulphur and Tellurium-Selenium. A. Petrikaln and Konst. Jacoby (Z. anorg. Chem., 1933, 210, 195-202).—(1) The thermo-electric force (e.m.f.) against silver has been determined of the systems tellurium-sulphur between 0 and 23% sulphur and tellurium-selenium between 0 and 40% selenium. Addition of sulphur to tellurium increases the e.m.f. considerably up to a maximum at 1.5-1.6%sulphur (limit of solid solubility), then gradually decreases it. The e.m.f. of the system tellurium-selenium increases rapidly up to 5% selenium, then more slowly. Two specimens of "Kahlbaum" tellurium gave an e.m.f. against silver of 430 and 550 microvolts/° C., respectively, whereas distilled tellurium gave 300-370. The high e.m.f. given by one of the "Kahlbaum" specimens is due to the presence of selenium and sulphur. The e.m.f. of this specimen was not so much influenced by different rates of cooling as was that of distilled tellurium.—M. H.

On the Recrystallization of Tin-Rich Solid Solutions. A. A. Botchvar and N. E. Merkurjew (Z. anorg. Chem., 1933, 210, 161-162).—The recrystallization at 180° C. of tin containing 0.5-1.5% antimony, lead, bismuth, copper, and aluminium was investigated after cold-deformation in the Brinell machine. The recrystallization power of tin is decreased on alloying, the decrease being smallest for antimony and largest for aluminium in the order given above. The specific influence of the added metal is the larger the smaller the solid solubility in tin (with the exception of bismuth). In this respect the effect of soluble additions on the recrystallization power is similar to that on hardness and electrical conductivity.—M. H.

Properties of Zamak Alloys Used for Die-Castings. Anon. (Machinery (N.Y.), 1933, 39, 376A).—Tabulated physical data.—J. C. C.

Nitriding of Metals. Daikichi Saito and Hataji Okawa (Suiyokai-shi, 1932, 7, 23-49; C. Abs., 1933, 27, 1301).—[In Japanese.] Manganese, chromium, aluminium, iron, nickel, and cobalt powders were nitrided for 5 hrs. in a stream of  $NH_3$  at a temperature of  $100^{\circ}-1000^{\circ}$  C. Iron, manganese, and chromium were easily nitrided at  $500^{\circ}-700^{\circ}$  C., but the nitrides formed were decomposed above these temperatures; nitriding of chromium began at about  $500^{\circ}$  C., and it proceeded with increase of temperature. Aluminium was a little more difficult to nitride, and its nitride was unstable at higher temperatures. It was also difficult to nitride cobalt and nickel, and their nitrides were very unstable.—S. G.

On Transformations in Eutectoid Alloys. N. Ageew and G. Kurdjumov (*Physik. Z. Sovietunion*, 1932, 2, 146–148; *Chem. Zentr.*, 1933, 104, I, 559).— Investigations on the copper-aluminium eutectoid show that in the transformation of the  $\beta$ -phase reactions occur similar to those in the austenite transformation in steel. With insufficiently rapid cooling the  $\beta$  decomposes into  $\alpha + \gamma$ , but with rapid cooling  $\beta$  is converted into  $\beta'$ , which has an acicular structure resembling martensite and the  $\beta'$ -crystals are regularly oriented with respect to the original  $\beta$ . From pole figures and X-ray photographs it appears that the  $\beta'$ -lattice deviates only slightly from a cubic lattice and can be considered, like the tetragonal martensite lattice, as a distorted cubic lattice. The symmetry of this distortion has not yet been determined. It is concluded that the  $\beta'$ -phase is an unstable, supersaturated solid solution of aluminium in copper which is produced by deformation of the lattice without diffusion.

-A. R. P.

Average Strength Data for Non-Ferrous Metals.—III. Anon. (Machinery (N.Y.), 1933, 39, 376A).—Average tensile data for copper and magnesium alloys, copper, and lead are tabulated.—J. C. C.

Influence of Composition of Bearing Alloys. C. Upthegrove (Bull. Assoc. Tech. Fonderie, (Suppt.), 1932, 6, 88-89).—From Foundry, 1931, 59, 72-74; cf. this J., 1932, 50, 734.—W. A. C. N.

Effect of Temperature upon the Charpy Impact Strength of Die-Casting Alloys. Bert E. Sandell (*Trans. Amer. Inst. Min. Met. Eng.*, 1932, 99, (Inst. Metals Div.), 359-362).—See this J., 1932, 50, 477.—S. G.

Metals Div.), 359-362).—See this J., 1932, 50, 477.—S. G.
The Age-Hardening of Metals. Paul D. Merica (Acters speciaux, 1933, 8, 19-30).—Read before the American Institute of Mining and Metallurgical Engineers. See J., this volume, p. 74.—J. H. W.

On the Theory of Formation of Segregate Structures in Alloys. C. H. Mathewson and D. W. Smith (*Trans. Amer. Inst. Min. Met. Eng.*, 1932, 99, (Inst. Metals Div.), 264-271; discussion, 271-273).—See this J., 1932, 50, 478.—S. G.

**Tensile Properties of Rods and Wires at Low Temperatures.** F. Pester (*Mech. World*, 1932, 92, 534).—Abstract of paper in Z. *Metallkunde*, 1932, 24, 67–70, 115–119; see this J., 1932, 50, 431.—F. J.

Influence of Electromagnetic Waves on the Resistivity and Hardness of Metals and Alloys. G. Mahoux (*Technique moderne*, 1931, 23, 642–643).—A note presented to the Académie des Sciences. See this J., 1931, 47, 228; J., this volume, p. 74.—H. W. G. H.

### III.-STRUCTURE

(Metallography; Macrography; Crystal Structure.)

#### (Continued from pp. 187-193.)

Etching Characteristics of Constituents in Aluminium Alloys. Anon. (Metal Progress, 1933, 23, (2), facing p. 45).—A tabulated summary of etching methods, with approximate times and temperatures; the characteristic behaviour of 20 common micro-constituents of light alloys is given for etches with 0.5% hydrofluoric acid, 1% caustic soda, 20% sulphurie acid, 25% nitrie acid, 10% caustic soda, and a mixture of 0.5% hydrofluoric acid, 1.5% hydroehloric acid, 1.5

On the Structure of Hyper- and Hypo-Eutectic Alloys. A. A. Botchvar and K. W. Gorew (Z. anorg. Chem., 1933, 210, 166–167).—In a microscopic study of binary hyper- and hypo-eutectic alloys of antimony, lead, bismuth, cadmium, and tin (systems not specified) formation of envelopes (halos) of the second constituent around primary crystals of the other constituent was observed in all the systems, but it occurred in a particular system either only in hyper-eutectic or only in hypo-eutectic alloys, more especially around sharply limited primary crystals, e.g., of bismuth or antimony. In the following list any metal forms a halo about any of those preceding it, but not about those following it : bismuth, antimony, cadmium, lead, tim.—M. H.

On the Structure of Some Ternary Eutectics. A. A. Botchvar and K. W. Gorew (Z. anorg. Chem., 1933, 210, 171-172).—Microscopic examination of

the structures of the ternary eutectics cadmium-lead-bismuth, cadmiumlead-tin, cadmium-tin-bismuth has shown that the three constituents are not irregularly distributed. In the cadmium-lead-bismuth eutectic cadmium needles are surrounded by lead crystals, and these by a ground-mass of bismuth. It is concluded that the order of crystallization is determined by the number of crystallization centres, that component having the largest number crystallizing first.—M. H.

Veining or Sub-Boundary Structures. L. Northcott (J. Iron Steel Inst., 1932, 126, 267-280; discussion, 281-287) .- For abstract of the paper see this J., 1932, 50, 614. J. Gorschkov stated that when hydrogen was evolved from molten copper in vacuo, ingots with a double structure resulted, light etching revealing a veined structure and deeper etching a crystalline one. The explanation given by N. could not apply, as there was almost certainly no cuprous oxide present in these ingots, owing to their being saturated with hydrogen. He considered that the veining was due to a solid solution of hydrogen in copper, the network representing a solution highly saturated with hydrogen. W. D. Jones doubted if veining was invariably due to oxide inclusions, and stated that it had previously been shown that mild quenching obliterated the structure and that veining could be produced in nickel and 67:33 copper-tin after etching in acidified ferric chloride. H. O'Neill confirmed N.'s conclusions and outlined a third method of removing veining in an X-ray vacuum after cold-working. F.S. Tritton thought that N. had been misled by his etching conditions and had reached wrong conclusions. He considered that specimens were usually not polished sufficiently well to show true crystal sub-boundaries on etching. In reply, N. agreed with G.'s explanation, but thought that the term veining should not be applied to that particular network as well as to ordinary crystal structure. He was not convinced by J.'s doubts as to the causative effects of oxygen, and completely disagreed with T.'s views as to the causes of veining .- J. H. W.

Grain Boundary of Aggregates of Metallic Crystallites. Keiji Yamaguchi (J. Soc. Mech. Eng. Tokyo, 1928, 31, (136), 409-419; Japanese J. Eng. Abs., 1932, 8, 89).—[In Japanese.]—S. G.

The Lattice Spacings of Iron-Aluminium Alloys. A. J. Bradley and A. H. Jay (J. Iron Steel Inst., 1932, 125, 339-357; discussion, 358-361).—For abstract of the paper see this J., 1932, 50, 308. In the discussion C. Sykes stated that dilatometer curves of iron-aluminium alloys containing 11-17% of aluminium exhibited a change in direction at about 560° C., but without any definite discontinuity. Cooling curves also showed a slight evolution of heat at 560° C. A striking point is that the resistivity of these alloys is a function of the heat-treatment, although this property is independent of heat-treatment in alloys containing less than 11% of aluminium. The maximum effect is observed at about 14% of aluminium, and the phenomenon is completely reversible. A similar change is observed in the lattice-spacing curve when the aluminium content is about 14%. E. W. Colbeck said that an alloy containing aluminium 14, carbon 0.05, silicon 0.15%, and the remainder iron showed a very definite break in the resistivity-temperature curve at about 490° C. On quenching this alloy in water from 500° to 800° C. a decrease in hardness of 4 or 5 points on the Rockwell B scale was observed, which was particularly marked after very prolonged annealing at  $550^{\circ}$  C. The authors stated, in reply, that probably in the region 10-17% of aluminium a contraction due to the electronic interaction between iron and aluminium exactly compensated the expansion caused by substituting the smaller iron atoms by the larger aluminium atoms.--E. S. H.

Effect of Deformation (Pulverization) on the Superstructure Lines and Lattice Constants of an Iron-Aluminium Alloy. K. Schäfer (Naturwiss., 1933, 21, 207).—Pulverized specimens of the regularly-oriented mixed phase (FeAl) of iron-aluminium with a grain-size of  $10^{-4}$  cm. show no distinct superstructure lines; its lattice constant is 0.7% greater than in the massive state, but returns to normal after annealing.—J. W.

Single Crystals of the Intermediate Compound Antimony-Tin. H. S. van Klooster and M. D. Debacher (*Metals and Alloys*, 1933, 4, 23-24).—A single crystal of SnSb has been obtained by cooling the equiatomic alloy from 480° to 300° C. over a period of 15 hrs., using the apparatus of Obreimov and Schubnikov (Z. Physik, 1924, 25, 31). The compound has a simple cubic lattice of the NaCl type with 4 antimony and 4 tin atoms at the corners of the unit cell. The atomic distance is 3.061 A., which gives a calculated density of 6.918 compared with an observed density of 6.9104  $\pm$  0.005 at 20° C.

-A. R. P.

On the Transformation of Single Crystals of Cobalt. U. Dehlinger, E. Osswald, and H. Bumm (Z. Metallkunde, 1933, 25, 62–63).—The transformation of rod-shaped single crystals of cobalt from the face-centred cubic into the hexagonal form takes place in such a way that the angle between the rod axis and that octahedron plane along which slip occurs and which becomes the hexagonal base plane is smaller than any of the angles between the rod axis and the other octahedron planes of the cubic crystal. On heating above the transformation point and cooling, the crystal remains intact, the orientation being unchanged.—M. H.

Lattice Constants and Grain-Size in the Gold-Silver Alloys. P. Wiest (Z. Physik, 1933, 81, 121-128).—The lattice constants of gold-silver alloys, both polycrystalline and single-crystal, are investigated by X-ray analysis. The lattice constant of the polycrystalline material differs more and more from that of the single-crystal with increasing gold content, the difference attaining a maximum value in the case of the alloy containing 75% (atomic) of gold. The lattice constant of recrystallization grains alters only very slightly when the material is subjected to a subsequent very considerable increase of grain-size. Cast grains down to a size of about 0.5 mm.<sup>2</sup> have the same lattice constants as single crystals of like concentration.—J. S. G. T.

Lattice Structure of Indium. E. Zintl and S. Neumayr (Z. Elektrochem., 1933, 39, 81-84).—Goniometric measurements of a crystal of indium confirm face-centred tetragonal structure derived by Hull and Davey from the powder diagram. Accurate measurements of the interference of pure indium in a mixture with sodium chloride as a reference gave:  $a = 4.583 \pm 0.002 \text{ A}$ ,  $c = 4.936 \pm 0.002 \text{ A}$ .,  $c/a = 1.077 \pm 0.001$ . Hence with indium = 114.8, it follows that the density is 7.308 (cf. 7.314 by the pyknometric method).

-J. H. W.

**Crystal Structure of**  $\beta$ -Lanthanum. E. Zintl and S. Neumayr (Z. Elektrochem., 1933, 39, 84-86).—The  $\beta$ -modification of lanthanum, stable at higher temperatures, gives the constants :  $a_{\text{Lo}} = 5.296 \pm 0.002$  A., density = 6.17, and atomic radius in the duodecimal system,  $r_{\text{Lo}}^{\text{res}} = 1.872$  A.—J. H. W.

and atomic radius in the duodecimal system,  $r_{La}^{(12)} = 1.872 \text{ A.} -J. \text{ H. W.}$ On the Alloy Phases of the Type NaPb<sub>3</sub>. E. Zintl and S. Neumayr (Z. Elektrochem., 1933, 39, 86–97). -The crystal and lattice structure of the following compounds has been investigated: CuPb<sub>3</sub> (cubic, a = 4.891 A.), SrPb<sub>3</sub> (tetragonal, a = 4.955 A., c = 5.025 A., c/a = 1.014), CePb<sub>3</sub> (cubic, a = 4.891 A.), CaPb<sub>3</sub> (cubic, a = 4.891 A.), CaSh<sub>3</sub> (cubic, a = 4.732 A.), CeSh<sub>3</sub> (cubic, a = 4.711 A.).-J. H. W.

Structure and Chemical Composition of Some Metallic Alloys. [Manganese-Zine and Cobalt-Zine,] N. Parravano and V. Caglioti (Mem. R. Accad. Italia. Classe: Chimica, 1932, 3, (3), 1-21; C. Abs., 1933, 27, 1307).—In the system manganese-zine the  $\varepsilon$ -phase is hexagonal close-packed and analogous to the  $\varepsilon$ -phase of the bronzes. It is stable at ordinary temperature between 24.5 and 33% manganese and at temperatures above 293° C. between 24 and 12.5%

manganese. There are 2 atoms in the elementary cell. The lattice constant a, varies from 2.754 to 2.764 A. between 33 and 12.5% manganese. The y-phase has a body-centred cubic structure and contains 52 atoms per elementary cell. The lattice constant  $a_0$  varies between 9.11 and 9.13 A. This phase, which is analogous to the  $\gamma$ -phase of the bronzes, exists between 22.2 and 8.1% manganese at room temperature only. The alloys between 11.1 and 8.1% manganese contain in addition to the  $\gamma$ -phase another phase  $\gamma'$  or  $\beta'$  which could not be accurately identified on account of the insufficient crystallization of these alloys. The n-phase, consisting of a solid solution of 1-2% manganese in zinc, is unstable and changes on ageing to a cutectic of zinc and  $\gamma'$  or  $\beta'$  or  $\gamma + (\gamma' + \beta')$ . The formation of this phase is connected with Westgren's theory regarding the ratio of the number of valence electrons to the total number of atoms which express the chemical formula. Assuming a valence of -1 for manganese, the authors arrive at a formula of Mn<sub>5</sub>Zn<sub>34</sub> for the compound in the y-phase (ratio 21:13) and of MnZn11 for the compound in the  $\varepsilon$ -phase (ratio 7:4). The system cobalt-zine was studied between the limits of 17 and 24% cobalt, and showed the existence in this interval of a  $\gamma$ -phase in which might be present a compound  $\text{Co}_8\text{Zn}_{31}$  (ratio 21 : 13).—S. G.

On the Capacity of the Élements to Form Negative Ions. E. Zintl and H. Kaiser (Z. anorg. Chem., 1933, 211, 113-131).—Inter alia, the crystal structures of the following compounds have been determined: Mg<sub>2</sub>Sn, Mg<sub>2</sub>Pb, and Mg<sub>2</sub>Ge have a fluorite structure;  $a = 6.765 \pm 0.002$  A.,  $6.836 \pm 0.002$  A., and  $6.378 \pm 0.003$  A., respectively. Mg<sub>2</sub>Tl, however, has a structure of still unknown nature. PtBi and PtPb have the NiAs structure; the structure of PtTl is still unknown.—M. H.

Lattice Forces and X-Ray Spectrum. R. Glocker (*Naturwiss.*, 1933, 21, 27).—Amplification of earlier work (see J., this volume, p. 18).—J. W.

On Precision Measurements of Lattice Constants by the Debye-Scherrer Method. K. Moeller (*Naturwiss.*, 1933, 21, 61-62).—The influence of deviations from Bragg's simple reflection law of X-rays on the precision measurement of lattice constants has been calculated for some substances on the assumption of symmetrical reflection for various lattice planes. With unsymmetrical reflections very great deviations can occur according to the orientation of the lattice plane to the surface of the crystallite; these cannot be eliminated by calibration and have been investigated experimentally for finely-crystallized substances. The results will be given in a paper shortly to be published.—J. W.

A Suitable Standard Substance for the Precision Measurement of Lattice Constants by the Debye-Scherrer Method. K. Moeller (*Naturwiss.*, 1933, 21, 223).—Thallous chloride best fulfils all practical requirements.—J. W.

### IV.-CORROSION

#### (Continued from pp. 193-194.)

The Behaviour of a Single Crystal of Aluminium Subjected to Stressless Corrosion in a Stream of Tap Water Followed by Test to Destruction in Air, under Alternating Torsional Stresses. H. J. Gough and G. Forrest (*Aeronaut. Res. Cttee. R. and M.* No. 1476, 1932, 1-11).—To determine whether the general pitting attack observed in some corrosion-fatigue experiments is influenced by the applied stress, observations have been made of the changes in microstructure of a single crystal of aluminium produced by slow oscillations (400/minute) in a slow stream of tap water without the application of straining forces. Comparison of the results with those obtained with a similar crystal subjected to cyclic stresses in running tap water shows that stress alone has little, if any, effect in promoting corrosion during corrosion-fatigue action; and that the fatigue strength is not appreciably affected by the corrosion which occurs during the stressless-corrosion stage.—A. R. P.

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On the Action on Aluminium and its Alloys of Fuels Containing Alcohol. O. Bauer and G. Schikorr (Automobiltech. Zeit., 1932, 35, 583-589; and (abstract) Z. Metallkunde, 1933, 25, 44).—The fuels investigated contained from 10 to 20% of alcohol of about 99.7% purity, the use of fuels of this alcohol contont having recently been legalized in Germany. The metals and alloys tested were: half-hard aluminium sheet, Anticorodal AW 15 and Pantal sheet: also a perforated sample of aluminium sheet, coated by the Bauer-Vogel process. Mechanical properties and chemical composition are tabulated, as are some relevant properties of the selected fuels. The preparation of the samples, which were exposed for either 60 or 30 days to the corrosive action of fuels containing stated proportions of alcohol, with or without added water, is described, and the exposure apparatus is illustrated. The results are thus summarized: addition of alcohol up to 20% causes little attack unless more than 0.5% of water is present; attack becomes more marked, especially with the 20% alcoholic fuels, as the proportion of water rises. This applies to the alloys investigated as well as to aluminium. The MBV (Modified Bauer-Vogel) protective process affords complete protection.—P. M. C. R.

Investigations on Stress-Corrosion Cracks of Light Metals. P. Brenner (Jahrb. deut. Versuchsanst. Luftfahrt, 1932, V65-71).—Reprinted from Z. Metallkunde, 1932, 24, 145-151; see this J., 1932, 50, 738.—B. Bl.

[Corrosion-Resistance of a New Dental Alloy.] "Chrogo U42." H. Choulant (Met. Ind. (Lond.), 1932, 41, 612).—Short abstract of an article from Z. Metallkunde, 1932, 24, 263-264. See this J., 1932, 50, 739.—J. H. W. Corrosion of Lead by Cement Mortar. Anon. (Architect, 1932, 132, 215).—

Corrosion of Lead by Cement Mortar. Anon. (Architect, 1932, 132, 215).— A case of mortar-corrosion is briefly considered, with reference to Dept. Sci. Indust. Res., Building Res. Bull. No. 6, 1930, 1-4, "The Prevention of Corrosion of Lead in Buildings"; see this J., 1930, 43, 497.—P. M. C. R.

Effect of  $p_{\rm H}$  on Corrosion of Tin. J. M. Bryan (Food Manuf., 1932, 7, 82). —Abstracted from Trans. Faraday Soc., 1931, 27, 606; see this J., 1932, 50, 26.—E. S. H.

Exposure Tests on Plated Metals. Joint Committee of American Electroplaters' Society for Testing Materials and the Burcau of Standards (*Met. Ind.* (*N.Y.*), 1932, 30, 226-227, 270-271).—Abstracted from the *Monthly Rev. Amer. Electroplaters' Soc.*, 1932, 19, (5), 6-15. See this J., 1932, 50, 609-610.—I. M.

Corrosion-Fatigue of Metals. T. S. Fuller, P. F. Mumma, and H. F. Moore (*Mech. World*, 1932, 92, 341-342).—Abstract from Report of Research Committee on Fatigue of Metals, American Society for Testing Materials. See this J., 1932, 50, 469.—F. J.

The Mechanics of Fluids and Ship Propulsion (Section on Cavitation). E. G. Barillon (Science et Industrie, 1933, 17, (228), 5–9).—A summary of the conclusions reached by the first International Conference on the Mechanics of Fluids and Ship Propulsion, held at Hamburg, May 1932. The present state of knowledge as regards cavitation is far more practical than theoretical, and the work of the section was devoted to reviewing such aspects of the problem as its effects on performance, its connection with corrosion, its local incidence in tubing, and in blading of various types, and the nature of the resultant grooving.—P. M. C. R.

The Cause of the Corrosion of Vehicle Parts by Lubricants. — Wawrzinick (Automobiltech. Zeit. (Mitt. Inst. Kraftfahrwesen Sächs. Tech. Hochschule, Dresden), 1932, 35, 428–430).—A series of conductivity determinations on 70 samples of commercial lubricating oils and greases shows that although the permissible limits of fatty acid content are not exceeded, and in most cases are not reached, local electrolytic action may be the cause of severe corrosion. This may be reinforced by stray currents due to defective insulation. It is advisable, therefore, to specify high electrical resistance and low fatty acid content for lubricants. Cf. following abstract.—P. M. C. R.

Attack by Lubricating Oil. — Steinitz. Paul Nettmann. Curt Ehlers. — Wawrziniok (*Automobiltech. Zeit.*, 1932, 35, 600–603).—Correspondence on an article by Wawrziniok (cf. preceding abstract), and replies to S. by W. and others.—P. M. C. R.

Foods. G. D. Elsdon (Ann. Rep. Prog. Applied Chem., 1932, 17, 528-546).—References are given to papers dealing with the solubility of such metals as copper and aluminium in milk, and with the corrosion-resistance of metals, including nickel and nickel-chromium alloys, to milk.—H. F. G.

Intercrystalline Embrittlement of Metals. G. B. O'Malley (Commonwealth Eng., 1932, 19, 375–378).—Read before the Melbourne University Metallurgical Society. Describes the phenomenon of season- or corrosion-cracking due to intergranular failure of metals under the action of certain solvents. Embrittling agents may be gases, liquids, or molten metals. The embrittlement of steel by molten brass, the properties of crystal boundaries, and the relation of boundary structures to intercrystalline embrittlement are discussed. —J. H. W.

A Study of the Method of Corrosion and Susceptibility to Corrosion of Metals by Diffused Light. François Canac (Compt. rend., 1933, 196, 51-53).-Metal specimens are immersed in a succession of corrosive baths and, after washing and brushing the surface, the intensity of a pencil of light diffused through an angle of 15° is measured in a Blondel photometer, the angle of incidence being 30°. It is found that the intensity of the diffused light-time curves fall into 2 classes : (1) an exponential curve, concave downwards, of the form  $s = S(1 - l^{-kt})$ , where S is the surface area, s the portion of the surface attacked, and t the time; (2) a parabola, concave upwards, of the form :  $\left(1-\frac{s}{S}\right)^{N}=\left(1-n\frac{s}{N}\right)^{N}$ , where N is the number of points attacked and  $n=\frac{N}{S}$ . In the first case, corrosion takes place at several points, but does not spread round them, and in the second, it occurs at an invariable number of points and spreads round. Stainless steels treated in sulphuric acid gave examples of the first type of corrosion, light alloys treated in soda baths gave examples of the second. The classification of metals and alloys by this method agrees very well with those of longer and less precise methods, such as loss in weight.

-J. H. W.

Results Obtained in Counteracting the Corrosion of Ferrous Metals. R. Arzens (Bull. Assoc. Tech. Fonderie, 1932, 6, 147–154).—The electrochemical theory of corrosion is briefly summarized. Steps taken against the inroads of corrosion include the production of intrinsically more resistant materials, the employment of non-ferrous in place of ferrous metals in certain cases where they are more effective, and the protection of the surface of iron and steel. In the last class are metallic coatings, oxide coatings, enamels, and painted coverings. The methods by which these various coatings are applied are indicated. Tests, slow and accelerated, for the evaluation of corrosion-resistance properties are described. In the discussion of the results obtained various illustrations of plant parts which have been subjected to attack under normal working conditions are included.—W. A. C. N.

The Deterioration of Boiler Metal. H. E. Wallsom (*Fuel Economist*, 1933, 8, 377-378).—The phenomenon of boiler-metal corrosion under stress is briefly referred to, and sources of corrosion occurring in the feed-water are briefly discussed.—J. S. G. T.

Results of Corrosion Research and New Methods of Testing Materials for Stability Against Corrosion and Erosion. Walter Denecke (*Giesserei*, 1933, 20, 89–93).—A review of recent work on the causes of corrosion and of new methods of testing the resistance of metals to corrosion and erosion in electrolytes and non-electrolytes.—A. R. P.

Corrosion of Metals and Alloys. J. Jacquart (Science et Industrie, 1932, 16, 449-458; 517-521; 1933, 17, 13-15).--(I.--) Some important economic and industrial results of corrosion are enumerated, with its more obvious effects on certain common materials. The principal corrosive agents are classified, and their operating conditions outlined. The importance of internal structure is emphasized. A summary is given of the acid, peroxide, colloidal, pellicular, bacteriological, and electrochemical theories of corrosion; the last of these receives special consideration. Methods of corrosion testing are reviewed, and modifications introducing acceleration are described for each type of test. (II.--) Methods of combating corrosion are classified. A table of relative corrodibilities of many ferrous and non-ferrous metals and alloys in hydrochloric, sulphuric, and nitric acids, a second table giving penetration data for steels in water of different types, and a third comparing mild and alloy steels, cast iron and Monel metal as regards atmospheric, aqueous, alkaline, and saline corrosion, are accompanied by brief notes on the peculiarities and special applications of each material. Protective coatings are classified, with brief descriptions of the method employed. The main headings are : metallic coatings, sprayed or painted coatings, thicker coverings (concrete, asphalt, bitumastic, &c.), and surface treatments (oxidation, Parkerizing). (III.-) Corrosion may be localized by the introduction of easily replaced sections of corrodible material, which to a great extent protect the remainder of the fabric. This method may be combined, as in the Cumberland process, with electrolytic protection. Feed-water treatments are classified; the type adopted must depend on the purpose for which the water is intended. Chemical, de-acrating, and "de-activating" processes are out-lined. The treatment of boiler feed-water is discussed. Soil electrolysis may be prevented by careful construction and placing of conductors, so far as the latter is possible; where electric leakage is unavoidable, effective protection may be given by suitable coatings (which should afford electrical as well as chemical insulation), the use of non-conducting material for jointing at suitable intervals, and the provision of electric "drainage areas" with return conductors to the power-station-the dangerous character of this method, however, prevents its general adoption .- P. M. C. R.

Corrosion Apparatus Aids Study of Welds. Anon. (*Electric J.*, 1932, 29, 149).—A short, illustrated description of an intermittent-immersion corrosion apparatus in which specimens are rapidly immersed and withdrawn at predetermined intervals. The time during which the specimens are moving can be made only a small fraction of the complete cycle.—J. C. C.

Eliminating Guesswork in Materials of Construction. Hugh Miller (Chem. and Met. Eng., 1932, 39, 646–650).—The testing of metallic materials for chemical equipment is a more complicated procedure than the testing of non-metallic materials. The selection, preparation for testing, and laboratory testing of metals are discussed in brief. The most suitable material having been indicated as the result of laboratory tests, a test should be made, using the material as part of the plant equipment, e.g., as part or whole of an agitator, as bolts or as a piece of pipe in a hose line. Proper selection of a material from several giving similar results, importance of tests under operating conditions, and the designing of semi-plant equipment are also discussed.—F. J.

German Corrosion Congress. G. Masing and O. Bauer (*Technique moderne*, 1932, 24, 480).—Abstracts of papers presented at Berlin, October 1931. See *J.*, this volume, pp. 131, 132, 133, 134.—H. W. G. H.

### V.-PROTECTION

### (Other than Electrodeposition.)

#### (Continued from pp. 194-197.)

Electrochemical Corrosion and Its Prevention. Kurt Nied (Oberflächentechnik, 1932, 9, 253-255).—The patent literature is reviewed with especial reference to new methods of galvanizing and tinning metals, of protecting condenser tubes from corrosion, and of insulating joints of two dissimilar metals from the action of corrosive fluids.—A. R. P.

The Alumilite Process. For Decorating and Protecting Aluminium Products. H. Bengston and R. E. Pettit (*Machinist* (*Eur. Edn.*), 1933, 77, 76-79). —The Alumilite process is a method for protecting aluminium surfaces by anodic oxidation with sulphuric acid. The preparation of the surface is very important to the appearance of the final surface. Colouring is effected by immersing the coated articles in suitable aniline dye baths. Still tanks are usually used, but mechanical processes are being developed. The coating is essentially  $Al_2O_3$ , and is remarkably resistant to salt spray and to atmospheric and chemical corrosion. Scaling the surface with inert compounds such as oils and wax increases the resistance to corrosion. The applications of the process to articles for various purposes are described.—J. H. W.

**Dyeing Gives Aluminium a Colour Finish.** Anon. (*Iron Age*, 1933, 131, 357).—The process of colouring aluminium surfaces protected by anodic oxidation (the Alumilite process) is described (see preceding abstract).—J. H. W.

**Depositing Oxide Film on Aluminium.** A. Eyles (*Met. Ind.* (*N.Y.*), 1933. 31, 17).—Flexible strong adherent oxide films with a breakdown voltage of more than 300 v. have been produced on aluminium wire by anodie oxidation in hot organic acid solutions using also a superimposed alternating current. Such wires have found extensive application in the Russian electrical industry. —A. R. P.

The Anodic Oxidation of Aluminium. H. Schmitt (Alluminio, 1933, 2, (1), 18-31).—A descriptive article, similar to that published in Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium, 1932, 4, 78-94. See J., this volume, p. 84).—G. G.

Protection of Light Alloys against Corrosion. — Pubellier (Usine, 1931, 40, (47), 27).—Abstract of a paper presented to the Salon Nautique. See J., 1932, 50, 162, 304.—H. W. G. H.

How Cadmium Resists Aqueous Solutions. B. E. Roetheli, C. J. Franz, and B. L. McKusick (*Met. Ind.* (*N.Y.*), 1932, 30, 361-363).—In solutions of  $p_{\rm H}$  lower than 5-29 the rate of corrosion of cadmium is approximately inversely proportional to the  $p_{\rm H}$  value when the composition of the solution remains constant and it is uniformly agitated with air. At higher  $p_{\rm H}$  grey to bluish films are formed, but no further attack takes place. It is recommended that cadmium should not be used as a protective plate when the  $p_{\rm H}$  of the corroding solution is less than 6.—A. R. P.

The Determination of the Porosity of Tin Coatings on Steel. D. J. Macnaughtan, S. G. Clarke, and J. C. Prytherch (J. Iron Steel Inst., 1932, 125, 159–174; discussion, 175–189).—For abstract of the paper, see this J., 1932, 50, 356. In the discussion T. Turner expressed the view that the pinholes in tinplate are caused by the presence of dirt, either as particles of scale on the sheet or acquired from the grease or oil in which the plates are immersed. Careful elimination of dirt and the use of a slightly thicker tin coating should extend the use of tinplate. II. S. Thomas referred to the comparative absence of perforations in the Welsh tinplate industry and in the British canning industry, in relation to experience in the U.S.A., and suggested that apart from the presence of dirt it was possible that steel in some particular form (pearlite,

austenite, &c.) does not take the tin coating. U. Williams suggested that in the tinplate works' atmosphere small particles of iron-bearing materials might fall on the tinned surface and, without penetrating to the steel, give the test indicating porosity. In general, he thought that the porosity of the tin coating depended more on the way it was put on than on its thickness. W.L. Knowle agreed that the ferrioyanide-gelatin test was unsatisfactory, and suggested that when tinplates had been tested for porosity by the new method they should be made into cans and their service compared with the porosity data. G. E. Tregoning confirmed the diminution of the number of perforations as the thickness of the tin coating is increased, and referred to experience in the canning of meat in the Argentine, where black spots were prevented by using a 6-lb. coating. In their reply the authors suggested that other causes besides the presence of dirt contributed to the formation of pinholes, and referred to the possible influence of minute bubbles of hydrogen retained after the pickling process. Similar holes are found in electrodeposited tin. They regarded the test described as indicating almost exclusively actual breaks in the tin coating. The greater frequency of perforations of cans in the U.S.A. is probably due to the higher average temperature.-E. S. H.

Resistance to Sea-Water of Electro-Deposited Coatings on Iron and Light Metals. Erich K. O. Schmidt (Jahrb. deut. Versuchsanst. Laftfahrt, 1931, 525-531).—Reprinted from Z. Flug. u. Motor., 1931, 22, 141-147. Cf. this J., 1932, 50, 742.—B. Bl.

Corrosion-Resistance of Aircraft Bracing Cables with Different End-Connections. Martin Abraham (Jahrb. deut. Versuchsanst. Luftfahrt, 1931, 532– 536).—Cf. Wire and Wire Products, 1931, 6, 283–289; see this J., 1932, 50, 742. —B. Bl.

Protection of Steel at High Temperature by Aluminium. [A.] Hauttmann (Usine, 1931, 40, (32), 39).—Abstract from Stahl u. Eisen, 1931, 51, 65-67. See this J., 1931, 47, 533.—H. W. G. H.

New Developments in Galvanizing. W. H. Spowers, Jr. (*Iron Age*, 1933, 131, 270-273).—The principal developments introduced into the galvanizing process during the past year are the perfection of a neutral flux to reduce dross formation, the preparation of a special flux, and a continuous process for galvanizing wire. Improvements in the course of development are the perfection of an automatic wipe for galvanizing wire, a more permanent container for zinc, and a bright coat on galvanized products. The application of the diffusion flame for heating galvanized kettles is described.—J. H. W.

Cadmium Additions to Galvanizing Baths. Wallace G. Imhoff (*Heat-Treat. and Forging*, 1932, 18, 692-694, 698).—The resistance of cadmium coats to corrosion compares very favourably with that of other metals, and the coat can be appreciably thinner. The addition of cadmium to the galvanizing bath, however, lowers the working temperature and tends to thin the bath; it increases the weight of the coating required and lowers the bending properties. The amount permissible varies greatly and is a matter of considerable contention. One of its advantages is the production of a bright spangled effect in the coating.—J. H. W.

A Note for Galvanizers (Hot-Zincing). James Brinn (Met. Ind. (N.Y.), 1932, 30, 277).—It is pointed out that incomplete washing of iron or steel after treatment in the pickling solution may lead to serious contamination of the zinc in subsequent hot-zincing, as the ferrous chloride on the metal reacts readily with zine at 460° C., producing oxide dross and introducing iron into the zinc bath.—A. R. P.

Report of Sub-Committee VI [of Committee A-5 of A.S.T.M.] on Specifications for Metallic-Coated Products. F. F. Farnsworth (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (I), 110–115).—See this J., 1932, 50, 549.—S. G. Report of Sub-Committee VIII [of Committee A-5 of A.S.T.M.] on Field Tests of Metallic Coatings. R. F. Passano (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (I), 116–123).—See this J., 1932, 50, 550.—S. G.

Report of Committee A-5 [of A.S.T.M.] on Corrosion of Iron and Steel. J. H. Gibboney and James Aston (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (I), 100-104).—See this J., 1932, 50, 549.—S. G.

Report of Sub-Committee X [of Committee A-5 of A.S.T.M.] on Embrittlement Investigation. V. F. Hammel and C. S. Trewin (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (I), 124–125). Embrittlement of Hot-Galvanized Structural Steel. Samuel Epstein (*ibid.*, 1932, 32, (II), 293–374; discussion, 375–379; and (abstracts) *Mech. World*, 1932, 92, 478, and *Iron Steel Canada*, 1932, 15, 142–143).—See this J., 1932, 50, 550.—S. G.

Effect of Zinc Coatings on Steel. W. H. Swanger and R. D. France (Power Plant Eng., 1932, 36, 597).—Abstract of paper read before the American Society for Testing Materials. See this J., 1932, 50, 481, 670.—P. M. C. R.

Report of Sectional Committee [of A.S.T.M.] on Zinc Coating of Iron and Steel. J. A. Capp and A. B. Campbell (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (I), 126–128).—See this J., 1932, 50, 482.—S. G.

Coating Metals with Zinc or Cadmium. Anon. (*Technique moderne*, 1931, 23, 509-510).—From *Chem.-Zeit.*, 1931, 55, 225; see J., 1932, 50, 360.—H. H.

Thomas Coated Strip Steels. Anon. (Automotive Ind., 1933, 28, 358).— Soft, ductile, plated coatings of zinc, copper, or tin can now be applied to steel intended for deep stamping, forming, or drawing. The coatings are said to help rather than hinder the working processes, and to be less porous, and consequently more resistant to corrosion, than hot-dipped coatings. Zinc-plated steel is found to be particularly satisfactory in usc.—P. M. C. R.

Recent Progress in Metallic Cementation. J. Laissus (Bull. Assoc. Tech. Fonderie, 1932, 6, 365-375).—A discussion of modern developments in the cementation of metals—principally iron and steel. Especial attention is given to the conditions that are necessary for the production of good resistant coatings. Cementation with chromium, tungsten, boron, tantalum, molybdenum, and cobalt is fully dealt with.—W. A. C. N.

The Characteristics of Sprayed Metal Coatings.—I. H. Reininger (Z. Metallkunde, 1933, 25, 42–44).—Sprayed metal coatings on metals, wood, and other materials adhere merely by surface tension, *i.e.*, no alloying takes place with a metallic surface. Sprayed coatings can be produced with aluminium, lead, iron, copper, nickel, zine, tin, bronze, brass, cast iron, &c. Before spraying, the surface of smooth articles (sheets, die-castings) should be increased as much as possible by sand-blasting or etching with dilute acids, other wise the coating does not adhere if the article is heat-treated. Articles with a natural rough surface (cast iron, sand-castings, unsized paper, pasteboard, ceramic masses, wood) need not be roughened further.—M. H.

On the Diffusion of Sprayed-On Metal Coatings into Solid Iron. P. Bardenheuer and R. Müller (Mitt. K.-W. Inst. Eisenforschung, 1932, 14, 295-305).— The tests were made with (a) nickel, (b) chromium, (c) mixtures of chromium and nickel, (d) mixtures of chromium and aluminium, (c) mixtures of nickel and aluminium, (f) mixtures of nickel and silicon, (g) chromium-silicon alloys, (h) chromium-nickel-aluminium alloys, and (i) chromium-aluminium alloys. The metals were sprayed in the form of powder from a "Versa" pistol (Schori, German Patent No. 477,505) on to rotating cylinders of soft iron which were then heated in vacuo at 900°-1350° C., and the degree of diffusion was determined chemically and metallographically. Good diffusion is obtained with b, c, f, g, and poor with a. Aluminium alone diffused rapidly up to a small aluminium content in the diffusion layer, but it prevents diffusion of other metals. The unavoidable oxide content of the sprayed film interferes seriously with diffusion, and, as nickel and chromium react differently with the oxidie inclusions in the iron, their rates of diffusion are adversely affected in different degrees. Volatilization of the sprayed metal and the iron base has an appreciable effect on the diffusion phenomena; under the conditions of the test the diffusion in all cases appeared to proceed through the vapour phase. The process does not seem to be capable of mathematical expression.—J. W.

Recent Developments of the Schoop Spraying Process. A. Karsten (Werkzeug (Suppt. to Maschinenkonstrukteur), 1933, 9, 28-29).—An electricallyoperated spraying pistol adapted for the Schoop process is described and illustrated. The metal to be applied is automatically fed into the instrument in the form of wires, which carry a current (a.c. or d.c.). The ends of the wires, by approximating, cause a short-circuit, and the small are produced melts the metal, which is expelled by compressed air. Greatly increased output is claimed for this type of pistol, which has the further advantage of being applicable to chromium, tungsten, molybdenum, and other metals and alloys of high melting point, the estimated temperature of the are being above  $3000^{\circ}$  C.—P. M. C. R.

The Electric Metal Spraying Process. Anon. (*Elektrotech. Z.*, 1932, 53, 1178; and (translation) *Electrician*, 1933, 110, 70).—Whereas in the Schoop process the metal is melted by its passage through a high-pressure gas flame, in the electric process an arc is played between two wires of the metal, and the resulting liquid is thrown out of the arc by a stream of compressed air. The temperature at the melting zone is above 4000° C., so that molybdenum, chromium, tungsten, and their alloys can be readily sprayed by this process on to any desired surface.—B. Bl.

The Spraying of Metals. Anon. (Met. Ind. (Lond.), 1933, 42, 255).—A description is given of the apparatus and method of spraying metals with zine, aluminium, and tin.—J. H. W.

Developments in Metal Lacquers. L. M. Hayden (Quarterly Rev. Amer. Electroplaters' Soc., 1933, 19, (9), 30-38).—To determine the value of a lacquer as a means for preventing tarnishing of metals a polished strip of silver sheet is coated with the lacquer, air-dried for 30 minutes, baked for 30 minutes at 150° F. (66° C.), aged at room temperature for 24 hrs., and then kept in an atmosphere of hydrogen sulphide under slight pressure until tarnishing develops. The rate of tarnishing is an indication of the value of the lacquer. To determine the tendency to "crystal spotting" small copper-plated strips of iron are given an "oxidized" finish and then buffed in parts until bright copper is exposed; the lacquer is then applied and after storing for 3 days the plates are placed in a desiccator and covered with a filter paper which has been sprinkled with flowers of sulphur. The development of black crystalline spots occurs in a few days with some lacquers but not at all with others.—A. R. P.

Recent Developments in Metal Lacquers. Kenneth R. Longnecker (Met. Ind. (N.Y.), 1932, 30, 475–476).—Abstracted from Quarterly Rev. Amer. Electroplaters' Soc., 1932, 19, (8), 31–36. See this J., 1932, 50, 743.—I. M.

**Evaluating Lacquer Finishes.** J. A. Reinhardt and E. A. Woelfel (Monthly Rev. Amer. Electroplaters' Soc., 1932, **19**, (4), 12–19; and (abstract) Met. Ind. (N.Y.), 1932, **30**, 192–194).—Tests are applied for film building and hiding power, drying qualities, colour and lustre, resistance to perspiration, flexibility, adhesion and ageing, resistance to moisture, hardness, and resistance to abrasion. A good lacquer should hide water-marks produced by drying after plating, should fail to print the pattern of a coarse cloth pressed into it under 1 lb./in.<sup>2</sup> for 1–2 minutes, should withstand continuous handling at 140° F. (60° C.) for 2 hrs. without becoming soft enough to scratch with the finger-nail, should withstand 6 cycles of alternating storage for I day at 150° F. (66° C.) and 1 day at 0° F. (– 18° C.) without cracking when the metal is subsequently bent, should show no signs of cracking or peeling after 2 weeks in air saturated with moisture at  $110^{\circ}$  F. (43° C.), and should give good resistance to wear in the emery test.—A. R. P.

Paints and Pigments. A. Hancock (Ann. Rep. Prog. Applied Chem., 1932, 17, 376-391).—References are given to papers published during 1932 relating to the physical properties of paint films; the relation between the corrosion of metals and protective materials; experiments on methods of protecting metallic aeroplane parts, particularly those constructed of Duralumin; the indication of corrosion, before it becomes visible, by changes of the tensile strength and clongation of the metal; and to the durability of paint films.

-H. F. G.

### **VI.**—ELECTRODEPOSITION

#### (Continued from pp. 197-199.)

Aluminizing Metal Surfaces in a AlCl<sub>3</sub>-NaCl Bath. W. A. Plotnikow and N. N. Graziansky (Z. Elektrochem., 1933, 39, 62-67).—Metals were aluminiumcoated in a bath consisting of  $3AlCl_3: 2NaCl$  or  $2AlCl_3: NaCl$  using an aluminium liner as the anode. The electrolysis gives a smooth, polished surface, the amount of  $AlCl_3$  remaining constant. The thickest deposit (0.08 mm.) was obtained with a current density of 1 amp./dm.<sup>2</sup> at 200° C. The resulting coat had better resistance to water vapour and sodium chloride solution than rolled Kahlbaum aluminium sheet. Tests in agar-agar proved the compactness of the coat, and metallographic examination showed that a solid solution of aluminium in iron is formed at the junction of the metals. The coat gives increased hardness to the metal and does not crack in the bending test. Coated articles are as stable at high temperatures as those not aluminized.—J. H. W.

The Control of Electrodepositing Solutions. XIV.—The Cadmium Solution. Samuel Field (*Met. Ind. (Lond.)*, 1933, 42, 309–310).—Four determinations are desirable in cadmium solutions : free cyanide, cadmium, total alkali, and carbonate. Free cyanide is determined by  $AgNO_3$ , and cadmium by precipitation and weighing as sulphide or by titrating with ferrocyanide.—J. H. W.

Some New Organic Addition Agents for Cadmium Electroplating. R. A. Claussen and H. L. Olin (*Electrochem. Soc. Preprint*, 1933, May, 45-52).—The optimum range of current density at which bright deposits of cadmium may be obtained from baths containing cadmium oxide 45, sodium cyanide 120, sodium sulphate 50, and nickel sulphate crystals 1 grm. per litre of water has been determined using various addition agents. For easein (0.4–0.66 grm./litre) the best results are obtained at 1.9 amp./dm.<sup>2</sup>, for gulae (12 grm./litre) at 3.5 amp./dm.<sup>2</sup>, for Steffen's waste (12–21 grm./litre) at 3.5–5 amp./dm.<sup>2</sup>, and for concentrated steep water, produced in the initial soaking of corn in the starch industry (12–15 grm./litre) at 3.5 amp./dm.<sup>2</sup>. The two last-named agents give the bath a much better throwing power than any of the other additions.—A. R. P.

The Electrodeposition of Ternary Alloys of Cadmium, Zinc, and Antimony. Lawrence E. Stout and Leonard Goldstein (*Electrochem. Soc. Preprint*, 1983, May, 17–37).—Ternary alloys can be deposited from alkaline cyanide solutions containing zinc and cadmium as complex cyanides and antimony as potassium antimonyl tartrate; the zinc and antimony, however, are more readily deposited than cadmium, hence a large cadmium concentration is required to obtain deposits containing an appreciable amount of this metal. The ratio of the metals in the deposits is a function of the ratio of their concentration in the electrolyte, the current density, and the temperature. When the zinc and cadmium concentrations of the electrolyte are low, increase in current density or temperature increases the antimony content of the deposit, but when the zinc and cadmium concentrations are high, changes in the operating conditions reduce the antimony content of the deposit. Increase in current density at 20° C. reduces slightly the amount of zinc deposited, but increases the amount of cadmium. Deposits with a high cadmium content have a good resistance to corrosion, but antimonial alloys are slightly less resistant than pure cadmium.—A. R. P.

The Electrodeposition of Cadmium from Cadmium Sulphate Solutions.—I. S. Wernick (*Met. Ind. (Lond.)*, 1932, 41, 500).—Abstract of a paper read before the Electrochemical Society. See this J., 1932, 50, 562.—J. H. W.

On the Action of Hydrogen Peroxide in the Chromium-Plating Bath. E. Raub and K. Bihlmaier (Mitt. Forschungsinst. Edelmetalle, 1932, 6, 85) .--Addition of hydrogen peroxide to the chromium-plating bath results in the reduction of the equivalent quantity of chromic acid to chromium sesquioxide, which remains in the bath as chromium chromate. With increasing amounts of this compound up to a maximum, which varies with the composition of the bath, the current density range at which bright plates can be obtained is broadened, but the limiting concentration range of sulphuric acid is narrowed. The throwing power of baths with a relatively high content of chromic oxide is improved by increasing the sulphuric acid content of the bath to  $1.5-2.22_{0}^{\prime\prime}$ ; conversely, the throwing power of a too-acid bath may be improved by addition of tervalent chromium, i.e. by addition of hydrogen peroxide. The current yields are increased by addition of tervalent chromium to an amount not exceeding  $10^{0/}_{0}$  of the chromic acid present; this addition has no effect on the resistance of the bath, but larger quantities increase the resistance and reduce the current efficiency.-A. R. P.

Chromium Electroplating with Aqueous Solutions of Chromic Acid Containing Hydrofluoric Acid. Erich Müller and Otto Rossow (Z. Elektrochem., 1932, 38, 883-884).—The effects of the current density (2-16 amp./dm.<sup>2</sup>), temperature, mixture of fluorides, and current strength on the deposit in chromium plating in chromic acid solutions have been investigated.—J. H. W.

Researches on the Electrochemistry of Chromium. III.—Nature of Deposits from Tervalent Solutions. A. W. Pamfilov and O. S. Fedorov (Zhurnal Obschtchey Khimii (Journal of General Chemistry), 1932, [A], 2(64), (2) 208– 216).—[In Russian.] Cf. this J., 1932, 50, 630. Earlier work on the current efficiency and nature of the deposits obtained from tervalent chromium solutions are summarized and further results obtained from numerous similar solutions are tabulated. Satisfactory deposits on relatively large surfaces were not obtained from tervalent chromium solutions except in the case of Liebreich's solutions (Z. Elektrochem., 1921, 27, 109), which are really of the chromite type, the chromium being present as a complex anion similar to the hexavalent form. In general, deposits from tervalent chromium baths differ sharply in character from those obtained from hexavalent baths, and are very porous and non-adherent.—M. Z.

The Electrodeposition of Chromium from Tervalent Chromium Salt Solutions. II.—Chromium Acetate, Oxalate and Tartrate Baths. H. T. S. Britton and O. B. Westcott (*Met. Ind.* (*Lond.*), 1933, 42, 155–158).—Read at a joint meeting of the Faraday Society and the Electroplaters' and Depositors' Technical Society. See this J., 1932, 50, 758.—J. H. W.

The Correction of the Sulphate Content of Chromium Baths. E. Raub (Oberflächentechnik, 1932, 9, 299-212).—See J., this volume, p. 28.—A. R. P. Chromium Plating of Light Alloys. K. Altmannsberger (Technique moderne,

Chromium Plating of Light Alloys. K. Altmannsberger (*Technique moderne*, 1932, 24, 507).—From Chem. Zeit., 1932, 56, 247. See this J., 1932, 50, 449. —H. W. G. H.

Chromium Plating Applied to Steel Mill Rolls. N. H. McKay (*Mech. World*, 1932, 92, 266).—Abstracted from *Iron Age*, 1932, 130, 2–3. See this *J.*, 1932, 50, 563.—F. J.

On the Use of Chromium-Plated Screws in the Chemical Industry. Carl Hütter (Chem. Fabrik, 1932, 5, 59-60).---By plating steel screws directly with chromium at a low current density a soft but non-porous coating is obtained which is highly resistant to nitric acid.—A. R. P.

Chromium-Plated Gauges. Anon. (*Machinery* (Lond.), 1932, 40, 316).— Chromium-plated gauges have five times the life of hardened steel gauges, and are now available in this country.—J. C. C.

Nickel-Chromium Plating and Its Defects. Hans Hornauer (*Emaille-technische Monats-Blätter*, 1931, 7, 66, 75-78; *Ceram. Abs.*, 1932, 11, 497).— The modern process of chromium plating is briefly discussed and some of the causes for defective plating are enumerated, including improper bath composition, dirty or oxidized surfaces to be plated, careless and unskilled labourers, &c. Some of the different places in which chrome plating is finding application are enumerated. Complete detailed information regarding the process used in matte chrome plating is given, pointing out its difference from the ordinary bright plating process.—S. G.

Nickel-Chromium Processes. Hans Hornauer (*Emailletechnische Monats-Blätter*, 1931, 7, 96-97, 103-105; *Ceram. Abs.*, 1932, 11, 497).—Some of the processes used in nickel-chromium plating development are described in detail.—S. G.

Nickel-Chromium [Plating]. Hans Hornauer (*Emailletechnische Monats-Blätter*, 1932, 8, 27-28; Ceram. Abs., 1932, 11, 497).—Some of the defects of chromium plating are discussed and developments in processes to correct them are described.—S. G.

Theory of Chromium Plating. Anon. (Automotive Ind., 1932, 67, 618).— A brief account of the results of recent investigations by the U.S. Bureau of Standards.—P. M. C. R.

The Importance of Current Density in Chromium Plating. Herbert Kurrein (Oberflächentechnik, 1932, 9, 165–166).—The effects of current density and temperature on the nature of the chromium deposits and on the current efficiency are described.—A. R. P.

When is Iron Dangerous in the Chromium-Plating Bath? K. Schuch (Metallwaren-Ind. u. Galvano-Tech., 1932, 30, 419).—Some of the troubles attributed to high iron content are really due to incorrect sulphate content.

-A. R. P.

Modern Chromium-Plating. W. Birett (Metallwaren-Ind. u. Galvano-Tech., 1932, 30, 358-360).—Cf. J., this volume, p. 136. The value of chromium plating in modern technology is briefly discussed.—A. R. P.

Chromium Plating Electrolytes. Anon. (Oberflächentechnik, 1932, 9, 199-201).—The behaviour of numerous types of chromium-plating baths under different conditions of temperature and current density is described.—A. R. P.

Anodes in Chromium-Plating Baths. H. Rüttermann (Oberflächentechnik, 1932, 9, 168).—Cf. J., this volume, p. 29. The use of "Ibo-Aktiv" steel anodes is recommended.—A. R. P.

Information on Chromium Bath Anodes. Karl Gebauer (Metallwaren-Ind. u. Galvano-Tech., 1932, 30, 360-361).—Polemical against H. Rüttermann (cf. J., this volume, p. 29, and preceding abstract). No iron anode will remain inert in a chromium-plating bath, hence the use of these anodes results in accumulation of iron in the bath and deterioration of the plate.—A. R. P.

New Anodes for Chromium [Plating] Baths. G. Elssner (Metallwaren-Ind. u. Galvano-Tech., 1932, 30, 355-358, and Ober/lächentechnik, 1932, 9, 181-183). --The use of steel anodes of any description rapidly leads to serious contamination of chromium-plating baths with iron, and consequent rapid deterioration of the plates obtained therefrom. The so-called "Ibo-Aktiv" anodes, which consist of a ferrous alloy, are just as dangerous as steel anodes.--A. R. P.

Chromium Anodes "Ibo-Aktiv." Rudolf Stamm (Metallwaren-Ind. u. Galvano-Tech., 1932, 30, 398-399, and Oberflächentechnik, 1932, 9, 201).— Contrary to the statement of Elssner (cf. preceding abstract) these anodes behave well in the large boths used in grantical glating. The experiments were made in 3-5 litre tanks.-A. R. P.

Land and Land-Animony Anades for Chromium Plating. E. M. Baker and P. J. Merkus (Cohem. 1932, (5), 2(+23), "Translated from Trans. Electrorhom. Soc., 1932, 61, 327-333. See this J., 1982, 51, 35, 568. — R. S. H.

Ihronium Flating Light Meaks, Especially Aluminium and Aluminium Aloys. Georg Buchner (*lice/likelinicem.il.*, 1982, 9, 118).—An obstract and discussion of a gaper by A. F. comp (see this J., 1982, 56, 45).—A. F. F.

Use of thue in Polishing Wheels for Freparation of Surfaces for Unromium Plaine. 3: A. Biersol (Metal Chaming and Finishing, 1932, 4, 505-596; C. Mos., 3933, 37, 1276).—A discussion of the scientific control of glue and its correct application in the graduation of pulsibility wheels for the preparation of much surfaces for abronium plating.—S. G.

Scientifit Achievements in the Field of Discrimination. L. Zahivaev (Costal Metallopromisidemosti (Messenger of the Metal Industry), 1921, (4), 62– 88).— In Russian.] The instellation and mechade used in auromium-plating precision instruments and measuring appliances in the Informatory and works of the Precision Machineys Trust, are described.—T), N.S.

The Realth of Abronium-Plaing Workers. H. F. Tranper (J. State Med., 1933, 40, 696-501; C. Mos., DSC, 37, D277).—No real times to health at life is to be antisingled if proper regulations are observed.—S. G.

Hygiene in Chronnium Plating Francise. Janua. ((herflöckentechnik: 1932, 5, 239-240).—Frequentions to evoid dauger to the health of the workmen are detailed.—J. R. T.

The Electrodeposition of Iron-Robilt Elloys.—I. S. (Hasstone and J. G. Speakmar (MR, Jud., 1993), 1933, 42, 205-206).—Head at a joint meeting of the Eloraday Society and the Electroplaters' and Depositors' Technical Society. Sec. J., this volume, p. 29,—J. H. W.

The Electrodeposition of Dran-Tobalt Alloys.—II. S. Glasstone and J. G. Speakman (*Mit. Ind. (Deal.)*, D83, 42, 250-260).—G. J., this walture, p. 29. Theoremits a comparison of the alloys deposited from bulkered solutions containing various proportions of the alloys deposited from bulkered solutions containing various proportions of decrous and cobal sulphates was studied, showing that the composition tends towards a constant value as the correct decay, increased, this value height for the hydrogenion constant of the alloys discussed of the hydrogenion consecutation of the electrolyte. A comparison is made of the inter-cobalt, from-mixed, and cobalt-mixed series.—J. H. W.

3. Oyanide-Bree Bailt for the Deposition of Romar on Steel. Golin G. Finkand Guash Y. Wong (Electronican, Non. Preprint 1925, May, 83-99).—By adding a concentrated copper sulphate solution to a hor solution of scaling mainter until a faint turbidity appears, then adding a slight excess of the oxalate and cooling. The sale disodium disperioral accountriate. No. 1001 (1994). Sportstee on cooling as deep blue crystals. If has a solubility of 20 gran, fliure at 200 G, and all ords a solution having an exceedingly low concentration of copper lions, hence this solution provides a satisfactory electrolyte for producing a copper "strike" on iron and steel, and has the advantage over the cyanode bath of hence more stable unitanuel less poisonors. The fest results are obtained from a saturated solution of the salt to which here a affect by gran, fliure a saturated solution of the salt to which here a affect by gran. Jitre of sedium sulphate and 20 gran, fliure of here, acid; the steel is

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plated for 1 minute at 10 amp./ft.<sup>2</sup> in this bath, then transferred to the ordinary acid bath to obtain a dense, thick plate.—A. R. P.

The Electrodeposition of Ternary Alloys of Copper, Cadmium and Zinc from Cyanide Baths. R. C. Ernst and C. A. Mann (*Trans. Electrochem. Soc.*, 1932, 61, 363-394; discussion, 394-395).—See J., this volume, p. 247.—S. G.

On the Correction of Acid Copper and Silver Baths. A. Wogrinz (Metallwaren-Ind. u. Galvano-Tech., 1932, 30, 475-477).—Mathematical.—A. R. P.

Analysis of Free Cyanide in Brass Plating Baths. L. C. Pan (Met. Ind. (N.Y.), 1932, 30, 402-404, 438-439).—Comparative tests have been made of the following four methods: (a) titration with silver nitrate without an indicator, (b) as (a) but with a small quantity of potassium iodide as indicator (c) as (b) but with a large quantity of iodide, (d) titration with copper sulphate. Method (a) gives consistent results very close to the theoretical, but the endpoint is not sharp; addition of a little potassium iodide gives a sharp endpoint, but causes deviations from the theoretical, but addition of a large amount (4-5 grm./70 c.c.) of iodide gives a sharp end-point and theoretical results which are only slightly affected by the presence of ammonia, carbonate, and zinc. Method (d) gives results close to the theoretical with a sharp endpoint 15-20 seconds after addition of the reagent.—A. R. P.

Electrolytic Gold Baths. A. Wogrinz (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, 30, 495-496).—Methods of determining gold in cyanide baths are discussed.—A. R. P.

Indium in Electroplating. — Altmannsberger (Metallwaren-Ind. u. Galvano-Tech., 1932, 30, 477-478; and Oberflächentechnik, 1932, 9, 223-224). —Indium has been suggested for use in plating silver as a protection against tarnishing, but the metal is extremely scarce and much more costly than platinum.—A. R. P.

How to Handle Nickel Solutions. E. Schor (*Met. Ind.* (N.Y.), 1932, 30, 187-188).—Practical plating hints on the maintenance of good nickel-plating solutions emphasizing the need for cleanliness and for avoiding contamination of the electrolyte with impurities of any kind.—A. R. P.

of the electrolyte with impurities of any kind.—A. R. P. Peeling of Electrodeposited Nickel. E. A. Vueillenmier (Quarterly Rev. Amer. Electroplaters' Soc., 1933, 19, (9), 10–14; and (summary) Met. Ind. (N.Y.), 1933, 31, 130–131).—The tendency to peel of nickel deposits from a given bath may be ascertained by plating on a thin sheet cathode and measuring the amount of curling caused by the stress in the deposited metal. The presence of iron salts in the plating bath increases these stresses very considerably, and hence induces an increased tendency of the plate obtained from such baths to peel when deposited on thick metal which cannot bend to relieve the stresses. Shiny deposits always have a greater tendency to peel than relatively coarse deposits, but this tendency can be overcome to a great extent by improving the adherence of the deposits, e.g. by thoroughly cleaning the metal surface prior to plating.—A. R. P.

Nickel Baths and Lead Vats. Anon. (*Oberflächentechnik*, 1932, 9, 166-167). —Emphasizes the need for proper protection of sides of the vat to avoid shortcircuiting with the anodes.—A. R. P.

Nickel in the Printing Industry. Victor Clough (Met. Ind. (Lond.), 1933, 42, 158).—Short note from a paper, read at Stationers' Hall, describing the use of nickel plating in the Oscar Kohn method for producing an intagliooffset plate for printing.—J. H. W.

Modern Procedure in Nickel- and Chromium-Plating. H. Kurrein (*Technique moderne*, 1932, 24, 572).—From *Chem. Zeit.*, 1932, 56, 93, 114. See this J., 1932, 50, 450.—H. W. G. H.

Investigations on De-Nickelling Baths. H. Krause (Oberflächentechnik, 1932, 9, 179–180, 191–193).—See this J., 1932, 50, 682.—A. R. P.

De-Nickelling Baths. H. Krause (Metallwaren-Ind. u. Galvano-Tech., 1932, 30, 515–516).—Electrolytic stripping in sulphuric acid, d 1 583, is recommended for removing old or faulty nickel plate from iron or brass; the acid should be free from arsenic.—A. R. P.

On the Electrochemical Behaviour of Platinum. III.—The Electrodeposition of Platinum. G. Grube and D. Beischer (Z. Elektrochem., 1933, 39, 38-45).—Plating details are given for the electrodeposition of platinum in alkaliplatinum phosphate baths, in baths of alkali-platinum salts of organic acids, of platinum salts of organic and inorganic acids, and in baths of other compositions. The best deposits were given with sodium-ammonium phosphate and ammoniacal dinitrodiamminoplatinum solutions. The deposition of the metal is accompanied by considerable evolution of hydrogen, even with low current densities. In a solution of potassium platinum cyanide, with all the cathodes investigated except mercury, only hydrogen was liberated and no metal was deposited. With a mercury cathode, a reduction process takes place which does not give a platinum deposit but another reduction product of the divalent platinum salt.—J. H. W.

Platinum Plating. Anon. (Sci. American, 1933, 148, 54).—A new technique for platinum plating is being developed, and it is suggested that platinumplated cutlery will soon be available.—W. P. R.

On the Determination of Output in Electroplating Practice with Special Reference to Silver. Paul Friedrich Wintersberger (*Oberflächentechnik*, 1932, 9, 135-136).—Costing methods are discussed.—A. R. P.

Electro-Tin Plating. R. E. Maeder (*Met. Ind.* (*N.Y.*), 1932, 30, 323-324). --Abstracted from the *Monthly Rev. Amer. Electroplaters' Soc.*, 1932, 19, (7), 12-16; see this J., 1932, 50, 760.—I. M. The Electrodeposition of Tungsten from Aqueous Alkaline Solutions. M.

The Electrodeposition of Tungsten from Aqueous Alkaline Solutions. M. Leslie Holt and Louis Kahlenberg (Quarterly Rev. Amer. Electroplaters' Soc., 1933, 19, (9), 41-52; and (summary) Met. Ind. (N.Y.), 1933, 31, 94-97).—After a review of earlier work on tungsten plating, the results of attempts to prepare a more efficient plating solution are described. All the tests were made on tungstic acid or sodium tungstate dissolved in solutions of various alkali salts, but satisfactory results were obtained only with solutions of tungstic acid in trisodium phosphate. Bright silvery deposits may be produced from a solution containing 30 grm. of tungsten trioxide and 100 grm. of Na<sub>3</sub>PO<sub>4</sub>, 12H<sub>2</sub>O in 150 c.c. of water using 10 amp./dm.<sup>2</sup> at 90° C., but the current efficiency is less than 1%, and the bath plates only so long as it retains its original yellow colour, and apparently cannot be regenerated.—A. R. P.

Electroplating Zinc on Aluminium. Harold K. Work (Quarterly Rev. Amer. Electroplaters' Soc., 1933, 19, (9), 26-30).—A review of recent work.

-A. R. P.

The Effect of Mercury in Zinc Cyanide Plating Solutions. E. E. Halls (*Met. Ind. (Lond.)*, 1933, 42, 261).—The behaviour of amalgamated zinc anodes in a bath consisting of water 1 gall, zinc cyanide (54-55% zinc) 6 oz., sodium cyanide (97% pure) 4 oz., and caustic soda 5 oz., without agitation and at ordinary temperatures was studied, and the resistance of the resulting coat to the salt-spray test was investigated. The process affords specific advantages, but the darkness of the coat may sometimes be an objection, and additional care in operating control is required.—J. H. W.

Zinc or Cadmium Plating. H. Figour and P. Jacquet (Galvano, 1932, (2), 20-21).—Abstracted from Compt. rend., 1932, 194, 1493-1495. See this J., 1932, 50, 450.—E. S. H.

Cadmium and Zinc Plating of Aluminium and Duralumin. G. A. Mario Gambioli (Z. Flug. u. Motor., 1932, 23, (21), 650).—Detailed abstract from Aerotecnica, 1932, 12, 314–320. See this J., 1932, 50, 669.—P. M. C. R.

Modern Electrodeposition of Metals. S. Cowper-Coles (J. Inst. Production Eng., 1933, 12, 79-86; discussion, 86-90).—Copper sheet can be produced with straight edges and of any thickness by electrodepositing at 200-500 amp./ft.<sup>2</sup> on a rotating drum of welded sheet steel and stripping the deposit. Energy

consumption is 1000 kw.-hr./ton. Sheet sufficiently hard to serve in place of phosphor bronze for electrical spring contacts can be produced by consolidating the deposit by floating rollers. Copper wire can be made by depositing on a cylindrical mandrel having a shallow spiral V-groove cut on its face. The crystals in the deposit grow out at right angles to the surface, and a line of weakness is formed where they meet above the centre of the depressions. A square wire with 2 small fins can then be unwound and drawn to a circular section in one final operation. The flashing of boiler tubes with zinc, the production of parabolic reflectors, the automatic plating of steel sheet, and the deposition of iron, lead, nickel, chromium, and cadmium are briefly reviewed.

-J. C. C.

Protective Value of Electroplated Metal Coatings on Steel. Progress Report. Joint Inspection Committee of the A.E.S., A.S.T.M., and Bureau of Standards (Quarterly Rev. Amer. Electroplaters' Soc., 1933, 19, (9), 3-10; and Met. Ind. (N.Y.), 1933, 31, 58-60).-Conclusions reached from examination of the nickel and chromium coatings on steel after 6-8 months' exposure are as follows : good protection is afforded by nickel or nickel-copper-nickel coatings only when the total thickness is at least 0.001 in. Coatings containing a middle copper layer are less protective than pure nickel coatings of the same thickness, but are about as efficient as a nickel coating of the thickness of the nickel in the composite coating. An outer film of chromium 0.00002 in. thick deposited at 113° F. (45° C.) and 150 amp./ft.<sup>2</sup> slightly decreases the protective value of all-nickel deposits except very thick ones, but increases that of composite copper-nickel deposits. The conditions under which copper or nickel is deposited have no marked effects on the protective value. Deposition of a cadmium or zinc layer before the nickel sometimes increases the protective value, but causes white stains and blisters to develop under severe conditions of exposure.-A. R. P.

Theories of Addition Agent Action [in Electrodeposition of Metals]. Robert Taft (*Electrochem. Soc. Preprint*, 1933, May, 53-60).—The action of addition agents in electrolytes may be of two distinct types: (a) the addition agent is actually adsorbed by the metal as it is deposited; this is the case with gelatin and other colloids in copper electrolytes; (b) the addition agent is reduced simultaneously with the deposition of the metal and is not included in the deposit; this is the case with ammonium nitrate in acid copper electrolytes. —A, R, P.

Electroplating Solution Control. L.E. Stout (Metal Cleaning and Finishing, 1932, 4, 607-610; C. Abs., 1932, 27, 1277).—A procedure is outlined for the determination of copper, free and total cyanide and carbonate in a cyanide copper bath.—S. G.

Calculation of Ampère-Minutes in Plating. Charles H. Eldridge (Met. Ind. (N.Y.), 1932, 30, 111-112).—Tables are given showing the number of ampèreminutes per ft.<sup>2</sup> required to deposit thicknesses of 0.0001-0.0010 in. of copper, cadmium, and nickel assuming current efficiencies of 40-100%.—A. R. P.

The Preparation of Metals for Electroplating. Anon. (Met. Ind. (N.Y.), 1932, 30, 359-360, 400-401, 440-441).—Pickling, degreasing, and bright dipping methods of removing dirt and grease from metals prior to electroplating are described.—A. R. P.

The X-Ray Analysis of Electrodeposited Alloys. Charles W. Stillwell (*Met. Ind.* (N.Y.), 1933, 31, 47–50).—The value of X-rays in determining the crystal structure, grain-size, alloying between deposit and base metal, and the constitution of alloy deposits is discussed with reference to cadmium-silver plate.

-A. R. P.

Recent Foreign Original Research in Electroplating. M. de Kay Thompson (Quarterly Rev. Amer. Electroplaters' Soc., 1933, 19, (9), 15-25).—Recent work on chromium, cadmium, and copper plating is briefly reviewed.—A. R. P. A Kodel Mate: Onsting Research Laboratory. E.F. Berry (Met. Ind. (N.J.), 1932, 30, 229-230. An illustrated description of the testing and research laboratory and large contract plating words. — A. R. P.

Platting at Gast Aluminium and Jointee Aluminium Parts. E. Smith and C. A. Velarde (Metallimetric) Ind. Galvano-Tech., 1932, 20, 438-437 - A translation of an article in Met. Ind. (Lond.), 1932, 41, 15. See this J., 1932, 50, 633. A. R.P.

Preparation a Dine and Dine Alloy Surfaces for Doaling. H. A. Nelson and W. W. Killardherger (Indust and Dug. Chun., 1983,25,27-32, and tabstract) Met. 1nd. (Land.), 1983, 42, 147-149 — A paper read before the Division of Paint and Varnish Chunnerty of the American Chemical Society. Beethis.J., 1982, 80, 743---, 31, W.

The Manufacture of Phonograph Reports. R. A. Dimon (Met. Ind. (N.T.), 1822 40, 165-117; Haunssin, 7). Abstracted from the Monthly Rev. Amer. Programmer, No., 1922 19, (1), 7-16. See this J., 1922, 50, 451.-I.M.

# WH. BEESTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodemosition and Electro-Refining.)

#### (Christman Trans 189.)

The Dotation of Petro-Manuanese and of Petro-Chrominin Anodes (at Differen Corran Densitie and Hudrat Concentrations. M. de Rev Thompson and R. T. Marrisse (Primes, Detrock, Not., 1922, 52, 131-138).—The electrod contentials of form-imagenese and ferro-electronium anodes were measured as different control densities and different concentrations of alkali hydroxide solutions in which they, were electrolyzed, and it was found that though the output density-electroide potential correction the different reactions taking phase wary in position with the hydrate concentration, the unroader the sum of the different reactions runnains constant over considerable range of concentration.—S. G.

Guillandie Films h. Electrolytic Condensors. John VV. Guilesv. Jr. (Electrowhen See Prysmin 1982 May, --- The computer of electrolytic condensors firmed to agreens a construction shown not to be inversely proportional to the termatial voltage as the lower framation voltages naing either direct or afternating ourman. Frankting of the condensors proceeds regularly as the altermisting outwohlis increased until a certain critical value is reached, showe which is present to the maximum voltage of the anodes. With a high alternating Tipor voltage, film home time may re our at the aluminium eatinds of aluminium file remularizes, and the radius, the effective energity of the condenser. Appendix operation of the film formed is assumed to be inversely properturnal to the formation voltage, no formation can near until a critical voltage is "reached, when the estired, will develop a film that increases in thickness until the effective monoir of the emplement momes inversely proparitional to the hummand willing. The Bisarced film formation at the estimates for " sultains boldy in civitize ] sulties accounted for by the deviation of the film Constant of the the transforment on the rate, -A. R. T.

The Communication of the Relation of the Relation of the Relation in Communic Duplication of the Relation in Communic Duplication Startage. (F.H. Present, Jr. and A. K.H. & Communication (F. 45). Formation (F. 45). Formati

# Refining

oxygen and free cæsium on the light sensitivity are discussed and it is shown that the active surface of the cathode is probably a film of free cæsium of atomic dimensions adsorbed on a matrix of cæsia and silver containing free cæsium and a little silver oxide. Cf. the work of F. H. Constable.—A. R. P.

# VIII. - REFINING (Including Electro-Refining.)

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### (Continued from p. 199.)

Liquation as a Metallurgical Operation and Its Aids. Max Moldenhauer (Metall u. Erz, 1933, 30, 81-84, 103-109; discussion, 109-112).—The theory and practice of refining metals and alloys by liquation processes are discussed with special reference to the working-up of lead-tin bearing metals, the removal of iron from zinc and of bismuth from lead, and the desilverizing of lead.

-A. R. P.

Electrolytic Metals. III.—Refining Cast Aluminium. Anon. (J. Four Elect., 1933, 42, 18–19).—The refining of cast aluminium at a temperature between 675° and 735° C. (not above 780° C.) in carefully controlled gas furnaces, as carried out by the Aluminum Company of America, is briefly described and illustrated.—J. H. W.

The Production of Zinc by Electrolysis of Zinc Sulphate Solutions. H. Hey (*Proc. Roy. Soc. New South Wales*, 1932, 65, M1-M48; *Eng. Abs.*, 1932, (53), 57).—Briefly reviews the history of electrolytic zinc production since 1914 and describes the main processes involved in the treatment of ore, purification of electrolyte, winning of zinc, and recovery of by-products.—S. G.

## IX.-ANALYSIS

#### (Continued from pp. 200-201.)

[Report on] Analytical Chemistry. B. A. Ellis and J. J. Fox (Ann. Rep. Prog. Chem., 1933, 29, 220-238).—A survey of recent advances in the detection and determination of non-ferrous metals is given, with particular reference to the quantitative separation of hydroxides, conductometric titrations, and the use of organic reagents for metals.—E. S. H.

The Rôle of Emission Spectrographic Analysis in the Metal Industry. G. Scheibe (*Mitt. Forschungsanst. G.H.H. Konzern*, 1931, 1, 123–127; and (short abstract) *Iron Age*, 1932, 129, 832).—A review of the value of spectrography in the analysis of metals and alloys with especial references to steels.—A. R. P.

A New Photometer for the Spectral Lines in the Visible Region for the Rapid Analysis of Alloys. G. Scheibe and G. Limmer (*Mitt. Forschungsanst. G.H.H. Konzern*, 1932, 2, 35–42).—A new polarization spectrophotometer is described and the mathematical principles of its construction are explained. Illustrations are given of its value in determining spectrographically various alloying elements in steel.—A. R. P.

Remarks on the Question of Optical Spectrum Analysis. O. Feussner (Z. tech. Physik, 1932, 13, 573-575).—The apparatus for obtaining reproducible electrical discharges in spectrographic analysis is described.—J. W.

Spectrographic Analysis. G. Heidhausen (Mitt. Forschungsanst. G.H.H. Konzern, 1932, 2, 62-78).—Apparatus and methods are described and a brief account is given of their application to metal analysis.—A. R. P.

Application of Solid Cadmium Amalgam in Volumetric Analysis. Sciji Kaneko and Chujiro Nemoto ( $K \bar{o} gy \bar{o} K wagaku Zasshi (J. Soc. Chem. Ind.,$ Japan), 1932, 35, (5); C. Abs., 1932, 26, 4006).—[In Japanese, with Englishsummary in supplemental binding, p. 185.] Experiments with Fe and MoO<sub>4</sub>solutions have shown that reduction, prior to titration with KMnO<sub>4</sub>, can be

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accomplished by means of Cd-Hg containing 15% Cd as follows: To 25 c.c. of solution in a 300-c.c. Erlenmeyer flask, add 10 c.c. of 18N-H<sub>s</sub>SO<sub>4</sub> and 20 grm. of the solid amalgam. Add a little Na CO<sub>3</sub> to expel air, stopper loosely, and heat carefully to melt the amalgam. Shake and allow the reduction to proceed for 5-6 minutes. Then insert a Pt wire, allow the amalgam to solidify, forming around the wire on cooling, remove it, and titrate in the usual manner.—S. G.

Sampling of Secondary White Metals and Residues, with Special Consideration of American Methods. E. Richard Thews (*Metallbörse*, 1931, 21, 675-676, 723-724, 771-772; *C. Abs.*, 1931, 25, 3930).—The methods applied on the various materials commonly found in the secondary metal trade are described.—S. G.

Analysis of White Metals and Their Smelter Products. Hans Neubert (Indust. and Eng. Chem. (Analyt. Edn.), 1933, 5, 60–61).—Dissolution of the sample in HCl and the minimum amount of NaClO<sub>3</sub> is preferable to the use of HNO<sub>3</sub>. If much Cu is present, FeCl<sub>3</sub> is added, followed by NH<sub>4</sub>OH, to separate the Sn and Sb from the greater part of the Cu; the precipitate is redissolved in HCl, the solution reduced, and the SnCl titrated with I<sub>4</sub>. Pb and Cu are separate from Sb and Sn in a separate portion by boiling with Na<sub>4</sub>S and S, the Pb being eventually determined volumetrically as PbCrO<sub>4</sub> and the Cu with I<sub>4</sub>. In the Na<sub>4</sub>S filtrate As is removed by H<sub>2</sub>S in 1:1 HCl, the Sb filtrate evaporated with NaClO<sub>3</sub> almost to dryness, diluted to 100 c.c. with H<sub>4</sub>O, and treated with KI, and the liberated I<sub>4</sub> titrated with Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.—A. R. P.

Studies of Various Methods for the Separation of the Common Elements into Groups. III.—A New Method for the Separation of Zinc, Cobalt, Nickel, and Iron from Aluminium, Chromium, and Manganese. Ernest H. Swift, R. C. Barton, and H. S. Backus (J. Amer. Chem. Soc., 1932, 54, 4161–4172).—Many of the individual separations by present methods are liable to be incomplete. The improved method evolved consists in precipitation of Zn, Ni. Co, and Fe with H.S in controlled excess of NaOH. Sufficient oxalate is added to prevent precipitation of Al or Cr. The precipitates are readily coagulated and filtered. —R. G.

Precipitation of the Hydroxides of Iron, Aluminium, and Chromium in a Pure, Dense, and Easily Filtered Form. Friedrich L. Hahn (*Ber. deut. chem. Ges.*, 1932, [B], 65, 64-65).—The use of a mixture of NaNO<sub>2</sub> and sodium azide in aqueous solution is found to precipitate  $Fe(OH)_3$ ,  $Cr(OH)_3$ , and  $Al(OH)_3$ rapidly and completely from solutions of their salts; the precipitates settle quickly, and are easily filtered. Full directions for preparing the reagent and for precipitation and washing are given. The reagent is especially recommended for the separation of  $Cr(OH)_3$ .—P. M. C. R.

Microdokimastic Enrichment and Spectrographic Determination of the Precious Metals. Cl. Peters (*Metallucirtschaft*, 1933, 12, 17–19).—In obtaining a concentrate of precious metal by smelting with Pb and cupelling the button (microdokimastic enrichment) a small quantity of precious metal is lost. On the other hand, spectrographic analysis is not sufficiently delicate for very small quantities. If, however, cupellation is not carried too far, and the residual Pb is examined spectrographically, it is possible to detect as little as 0-1 grm. per ton of Ag, 0-2 grm. per ton of Kh, Pd, Pt, and Au, 0-5 grm. per ton of Ru, 5 grm. per ton of Os, and 1 grm. per ton of Ir.—v. Gr.

A New Method for the Determination of Aluming in Aluminium Alloys. Wolfgang Ehrenberg (Z. anal. Chem., 1932, 91, 1-5).—The alloy (3 grm.) is dissolved in an excess of boiling CuCl, solution so that all the Cu deposited is redissolved. The residue is collected, washed well with hot  $H_2O$ , then with  $1 = 5 \text{ HNO}_3$ , ignited, treated with HF and  $\text{HNO}_3$ , dried, again ignited, and weighed as  $ALO_3$ . In this way the  $ALO_3$  content of virgin Al was found to be  $0.049_{\odot}$ , that of remelted  $Al 0.06 - 0.09_{\odot}$ , that of Silumin 0-044 $_{\odot}$ , and that of powdered Al  $0.72_{\odot}$  (due to the large surface).—A, R. P. Volumetric Determination of Magnesium in the Presence of Free Acid and Alkali Metals. J. Clarens and J. Lacroix (*Bull. Soc. chim. France*, 1932, [iv,] 51, 667-668).—The solution is neutralized with KOH until methyl red indicator just turns yellow, an excess of  $Na_2CO_3$  is added, and the solution boiled for 10 minutes, a small quantity of powdered, dried Al(OH)<sub>3</sub> being added soon after the solution boils, to cause the precipitate to become granular so that it settles well. The excess  $Na_2CO_3$  in the boiling solution is then titrated with HCL.—A. R. P.

The Direct Titration of Magnesium and Manganous Sulphates using Fluorescein as an Adsorption Indicator and the Extension of the Method to the Direct Titration of Other Soluble Sulphates and Alums. A. W. Wellings (*Trans. Faraday Soc.*, 1932, 28, 561-564).—Neutral MgSO<sub>4</sub> and MnSO<sub>4</sub> may be titrated with Ba(OH)<sub>2</sub> using fluorescein as indicator; the end-point is indicated by the persistence of a pink colour, which changes to orange on shaking. Some other neutral sulphates may be similarly titrated if (CH<sub>3</sub>COO)<sub>2</sub>Mg is added to the solution.—A. R. P.

A Simple Electrolytic Micro-Determination of Mercury. F. Patat (*Mikrochemie*, 1932, 11, (5), 16-21).—The Hg is deposited electrolytically from 0.1N-HNO<sub>3</sub> solutions using a Au wire cathode and a Pt spiral anode with 0.015-0.08 amp./dm.<sup>2</sup> at 3 v. for 15-20 hrs.—A. R. P.

Contribution to the Microchemical Determination of Minute Quantities of Mercury. Vladimir Masjer (*Mikrochemie*, 1932, 11, (5), 21-30).—The method depends on the deposition of Hg and Cu together on an Fe wire, distillation of the Hg, and micrometric measurement of the drop. A new technique for the latter operation is described.—A. R. P.

Determination of Tellurium as Crystalline Tellurium and as Tellurium Dioxide. Otto E. Clauder (Z. anal. Chem., 1932, 89, 270-282).-Precipitation of Te in the amorphous form yields high results owing to oxidation during drying. Crystalline Te may be precipitated by adding to the Te solution containing 15-20% of free HCl, 10-20 c.e. of a 5-10% solution of  $\mathrm{KH}_2\mathrm{PO}_2$ , N2H4 H2SO4, NH2OH HCl, SO2, or TiCl3 and heating the mixture very slowly in a water-bath. Drying of the crystals at 132° C. proceeds to completion without oxidation. If Bi or Sb is present, the precipitate must be washed with N-HCl, 3N-HCl, H2O, and C2H3OH in succession. Cu docs not interfere, but if more than 0.5 grm. of PbCl<sub>2</sub> is present, the precipitate must be redissolved in HNO<sub>3</sub>, the solution evaporated twice with HCl, and the Te re-precipitated. Te may be determined as TcO2 by neutralizing the solution with NH,OH, adding 10 c.c. of N-HCl, diluting to 100 c.c., adding 1 grm. of NH<sub>4</sub>Cl, heating to 100° C., and adding drop by drop 10 c.c. of 20%  $(CH_2)_6N_4$ . The precipitate is collected in a filter crucible on the next day, washed with cold H<sub>2</sub>O, then with C<sub>2</sub>H<sub>5</sub>OH, and dried at 132° C. Se does not interfere.-A. R. P.

Estimation of Thallium after Oxidation with Bromine. Philip E. Browning (Indust. and Eng. Chem. (Analyt. Edn.), 1932, 4, 417).—The nitrate solution is oxidized with a slight excess of  $Br_2$ -water and the Tl precipitated as  $Tl_2O_3$ , aq. by addition of  $NH_4OH$  or NaOH. The washed precipitate is heated to constant weight  $(Tl_2O_3)$  at  $150^\circ-200^\circ$  C.—A. R. P.

A Rapid Method for the Determination of Small Quantities of Thallium in the Presence of Lead and Bismuth. F. Pavelka and Hermine Morth (*Mikrochemie*, 1932, 11, (5), 30-33).—The method depends on the development of a yellow colour when an excess of phosphomolybdic acid is added to a  $HNO_3$ solution of a Tl salt. The intensity of the colour is compared with that of a standard.—A. R. P.

Quantitative Estimation of the Impurities in Tin by Means of the Quartz Spectrograph. C. Stansfield Hitchen (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. 494, 1933, 1–20).—The determination of Zn, Cu, Bi, Fe, Pb, As, and Sb in Sn by the logarithmic sector method is described, and suitable line-pairs are given for various conditions. The method is unsuitable for amounts of As below 0.03% and Sb below 0.07%. Tables are given for the sensitivity of the most important lines in the arc and spark spectra of all the above elements.—A. R. P.

Volumetric Determination of Tin. Application to the Separation of Antimony from Tin. P. Ed. Winkler (Bull. Soc. chim. Belg., 1932, 41, 115–137).— The Sn is separated in the usual way as  $SnS_2$ , the precipitate is dissolved in NaOH, and the Sn reduced to metal by treatment of the solution with HCl and Zn. The Sn together with excess of Zn is dissolved in HCl in a flask fitted with a valve, the H<sub>2</sub> evolved preventing oxidation of the SnCl<sub>2</sub> to SnCl<sub>4</sub>. The SnCl<sub>2</sub> solution is titrated with I<sub>2</sub> in the usual way. When Sb has been separated from Sn by means of H<sub>2</sub>S in H<sub>2</sub>C<sub>2</sub>O<sub>4</sub> solution, the latter may be destroyed by boiling with NaClO<sub>3</sub> and HCl, but there is always a small loss of Sn, which may be allowed for by the use of an empirical factor. —A. R. P.

On the Colorimetry of Titanium.—II. (A Contribution to the General Method of Colorimetry.) H. Ginsberg (Z. anorg. Chem., 1932, 209, 105-112).—M. H.

Volumetric Determination of Vanadium and Molybdenum. G. Scagliarini and P. Pratesi (*Atti R. Accad. Nazion. Lincei. Rendiconti Classe Scienze Fisiche*, 1932, 15, 99–103).— $V_2O_5$  and  $MoO_3$  are reduced by Cu in solutions free from  $SO_4^{\prime\prime}$ , whereas Ti<sup>1V</sup> and Cr<sup>111</sup> are unaffected.—G. G.

Determination of Small Quantities of Zinc in Aluminium. M. I. Choubine (Zvetnye Metally (The Non-Ferrous Metals), 1932, 7, 147-162; and (abstract) Chim. et Ind., 1932, 28, 1344).—[In Russian.] After dissolving in caustic soda and separating the Zn by means of sodium hydrosulphide, the ZnS is dissolved in  $H_2SO_4$  and the  $H_2S$  removed by boiling. Oxygenated water is added and the solution neutralized with ammonia while hot. After filtering, excess of ammonia is added and the solution is electrolyzed in the normal way.

-W. A. C. N.

Determination of Zinc in Brass and Red Brass or Other Zinciferous Alloys by the Oxalate-Permanganate Method. E. Knoppick (*Chem.-Zeit.*, 1932, 56, 663).—The sample is dissolved as usual and the other metals are separated from the Zn by  $H_2S$  and  $NH_4OH$ . The ammoniacal Zn solution is then treated with  $H_2C_2O_4$  and strongly acidified with  $CH_3$ ·COOH; on heating to  $70^\circ$ -S0° C. the powdery precipitate is converted into crystalline  $ZnC_2O_4$ , which is collected, washed, dissolved in  $H_2SO_4$ , and titrated with  $KMnO_4$ . Mn is co-precipitated with the Zn, but may be determined colorimetrically in a separate portion and due allowance made in calculating the Zn.—A. R. P.

Volumetric Determination of Zinc. André Hecquet (Ann. chim. analyt., 1933, [ii], 15, 10-11).—Modifications of the  $K_4$ Fe(CN)<sub>6</sub> method are described for use when the solution contains large amounts of sulphate and organic matter.—A. R. P.

Electrolytic Deposition of Zinc from Acid Solutions. Hisashi Kiyota (Mem. Coll. Sci. Kyötö Imp. Univ., 1932, [A], 15, 301-310).—[In English.] Quantitative results are not obtained in the electrolysis of the usual Zn solutions, using a Pt basin as cathode. In the presence of 0.15-0.33N-acetic acid (for 0.5-0.1 grm. Zn) a satisfactory deposit is formed and the procedure is suitable for quantitative electro-analysis. Sodium or ammonium sulphate should not be present at a concentration greater than 0.15N; nitrates and chlorides should be absent. The Zn deposit is obtained as a smooth coating, and the electrode may be used directly for the next electro-analytical determination.—E. S. H. Laboratory Apparatus, Instruments, &c.

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

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

#### (Continued from p. 202.)

An Inexpensive and Easily-Made Lining for Fireclay Crucibles for Laboratory Use. A. H. Jay (J. Iron Steel Inst., 1932, 125, 427–428).—Alumina is mixed with 7% by weight of dry, powdered fluorspar, a concentrated gum solution is added to form a paste, which is spread over the inside of the crucible to a thickness of  $\frac{1}{3}$  in. The lining is first dried in a hot-air oven and then fired in two stages : (a) by slowly heating in a plentiful supply of air up to 700° C., (b) by heating more rapidly to about 1300° C., at which the temperature is maintained for about 2 hrs. The crucible is then allowed to cool in the furnace. The linings are devoid of cracks. Aluminium-manganese alloys, which were melted in them, showed no foreign matter when examined by the X-ray method. The linings can withstand fairly high temperatures and have proved useful in preparing iron-aluminium alloys of high iron content, having melting points of 1200°-1400° C.—E. S. H.

On a Heating Device for X-Ray Specimens. G. Wassermann (Mitt. Material., Sonderheft 21, 1933, 69).—See this J., 1932, 50, 246.—J. W.

A Method for Preparing Crystals for [X-Ray] Rotation Photographs. H. Kersten and W. Lange (*Rev. Sci. Instruments*, 1932, 3, 790-791).—Apparatus comprising a flexible shaft dental drill equipped with an emery-paper disc with which crystals can easily be ground to diameters of less than 1 mm. without disturbing the necessary spectrographic adjustments of the crystal, is described.—J. S. G. T.

A New X-Ray-Interference Method [for the Investigation of Multi-Crystalline, more especially Rolled and Fibrous, Materials]. (Object between Two Slits.) H. Seemann (*Physikal. Z.*, 1932, 33, 755-762).—A form of X-ray interference method, suitable for the investigation, more especially of the crystalline structures of rolled and fibrous materials, is described. Results obtained with copper, aluminium, and nickel sheet and foil are illustrated.

-J. S. G. T.

Two New X-Ray Spectrometers. Anon. (Instruments, 1932, 5, 272).—Brief descriptions of the Allison and Compton X-ray spectrometers.—J. C. C.

Metal X-Ray Tube for Characteristic Radiation. C. J. Ksanda (*Rev. Sci. Instruments*, 1932, 3, 531–534).—An X-ray tube, constructed of stainless steel and having aluminium "windows" is described.—J. S. G. T.

Measuring Movements of 0.000001 Inch. Anon. (Electric J., 1932, 29, 380-382).—The principles of a magnetic strain-gauge are outlined and some applications described. Movements of an armature are recorded by changes in the reluctance of two magnetic circuits. In conjunction with an oscillograph, the gauge has been used to measure strain in locomotive driving rods and in railway tracks.—J. C. C.

An Apparatus for the Purification of Mercury. W. Burstyn (Z. tech. Physik, 1932, 13, 505).—Air is drawn by means of a water-pump through mercury contaminated with base metal impurities whereby they become oxidized and collect as a seum on the surface of the metal.—J. W.

Laboratory Equipment for Dental Casting. T. C. Trigger (Oral Health, 1932, 21, (5); and (reprinted) Brit. J. Dental Sci.—Prosthetics Section, 1932, 76, 181–183).—General notes on the use of gas for heating and melting.—J. C. C.

The Hard Metal Widia in the Hands of the Chemist. Curt Agte (Chem. Fabrik, 1933, 6, 5-6).—The use of Widia tools for cutting and grinding in the laboratory and for working glass is described.—A. R. P.

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

#### (Continued from pp. 202-203.)

Report of Committee E-1 [of A.S.T.M.] on Methods of Testing. W. H. Fulweiler and R. E. Hess (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (I), 498-506). —See this J., 1932, 50, 557.—S. G.

-See this J., 1932, 50, 557.—S. G. Technical Methods of Photo-Elastic Research. R. V. Baud (Schweiz. Bauzeitung, 1932, 100, 1-4, 15-20).—The development, principles of calculation, and technical applications of photo-elastic investigations are described at length and a new graphical and photographic method is given which depends on the sharp changes of colour at phase differences in the region of  $0.55\mu$ and  $1.1\mu$ .—J. W.

Studying How Machine Parts Act Under Stress. A. M. Wahl (*Electric J.*, 1932, 29, 464–465, 467).—Photo-elastic tests on celluloid or bakelite models, and strain, deflection, and buckling tests on models or full-sized machine parts are briefly reviewed.—J. C. C.

Photographic and Kinematographic Study of Photo-Elasticity. Zirō Tuzi (J. Soc. Mech. Eng. Tokyo, 1928, 31, (136), 334-349; Japanese J. Eng. Abs., 1932, 8, 10).—[In Japanese.] Cf. this <math>J., 1930, 44, 595. T. introduces the use of the photographic method instead of the compensator for the numerical calculation of stress in photo-elastic observations. With the green ray of monochromatic light the fringes are photographed by an orthochromatic plate. By this method personal errors can be completely eliminated, but the method fails when a uniform stress exists at any part of the specimen.—S. G.

A Dial-Type Load Indicator for Testing Machines. Anon. (Machinery (Lond.), 1932, 40, 660-661).—The Olsen pendulum dial indicates directly by a pointer, the load applied by the testing machine. The position of the pointer is determined by the movement of a pendulum to which the load is transmitted by a series of levers. An autographic recorder is incorporated.—J. C. C.

Full-Load Calibration of a 600,000 lb. Testing Machine. H. F. Moore, J. C. Othus, and G. N. Krouse (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (II), 778-782). —See this J., 1932, 50, 447.—S. G.

On the Properties of the Strain Figure and Its Applications. Ichitarō Takaba and Katsumi Okuda (J. Soc. Mech. Eng. Tokyo, 1928, 31, (136), 350-365; Japanese J. Eng. Abs., 1932, 8, 10).—[In Japanese.] See Arch. Eisenhüttenwesen, 1928, 1, 511-515; this J., 1928, 39, 578.—S. G.

Notes on the General Theories of Strain and Elasticity. Chido Sunatani (J. Soc. Mech. Eng. Tokyo, 1928, 31, (136), 635-671; Japanese J. Eng. Abs., 1932, 8, 14).—[In Japanese.] See this J., 1928, 40, 608.—S. G. Applications of Creep Tests. Gleason H. MacCullough (Amer. Soc. Mech.

Applications of Creep Tests. Gleason H. MacCullough (Amer. Soc. Mech. Eng. Preprint, 1932, (Dec.), 1-11).—Mathematical analysis of four specific problems which involve creep phenomena, viz., the problem of a flanged and bolted pipe joint, under creep conditions, and the three problems of stress distribution and creep in (a) a thick-walled cylinder under internal pressure, (b) a beam subjected to pure bending, and (c) a solid circular shaft under torsion.—W. P. R.

Stress-Concentration Phenomena in Fatigue of Metals. R. E. Peterson (Amer. Soc. Mech. Eng. Preprint, 1932, (Dec.), 1-11).—Stress concentrations are invariably present in machines, owing to fillets, threads, keyways, &c., and the importance of such "stress raisers" on the endurance of metals to alternating stresses is generally recognized. The fatigue stress-concentration factor is defined as the ordinary endurance limit/endurance limit with stress concentration effect. This factor is not independent of the material, and it is doubtful whether it can be correlated with the ordinary properties of

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materials such as ductility and hardness; it has been suggested that materials having a small stress-concentration effect in fatigue are also materials which possess a large internal damping and vice versa. If material and size of a specimen are kept constant and the size of a discontinuity is varied, theoretical stress-concentration factors increase as the size decreases. Fatigue stressconcentration factors show a similar increase except for a marked decrease for very small discontinuities. The method of producing a surface discontinuity has an influence on the fatigue stress-concentration factor, since cold-working the surface increases the endurance properties of metals, and the beneficial effect of the cold-work may be greater than the reduction caused by the stressconcentration. In ordinary fatigue specimens the crack usually begins at one place and progresses across the specimen, so that the area of final rupture has a segmental appearance. If a stress-concentration effect is present, the rupture area is generally totally enclosed. The position of the rupture area within the cross section appears to vary with the stress, being centrally located for high stresses and displaced from the centre as the stress approaches the endurance limit. The presence of radial ridges-the so-called " beach marks " -on the fracture usually indicates that failure has commenced at several points.-W. P. R.

Breaking of Metal by Fatigue. Masuhiro Suzuki (Bull. Research Office, Japanese Govt. Railway, 1928, 16, (8), 1177-1201; Japanese J. Eng. Abs., 1932, 8, 18).—[In Japanese.] The fatigue limit of a material was determined by observing the changes in structure, measuring the electrical p.d. between 2 points on the specimen. The measurement was made by a differential method using an auxiliary specimen, and the change was observed clearly and accurately.—H. Y.

Fatigue Testing of Materials. P. Field Foster (*Machinery* (*Lond.*), 1932, 40, 404-407).—A general account is given of the method of determining fatigue endurance curves with the Wöhler type of machine.—J. C. C.

Dynamic Testing of Materials. R. E. Peterson (*Electric J.*, 1932, 29, 377-379).—A note. Photographs of some special fatigue testing machines in an American industrial laboratory are included.—J. C. C.

American industrial laboratory are included.—J. C. C. Breaking Specimens in Fatigue Testing Machines. L. Persoz (Aciers spéciaux, 1932, 7, 428-438).—The question of the graduation marks and shape of the test-pieces is discussed, and the relation between the resistance to alternate torsion and alternate bending is explained. A series of corrosion tests on a number of ferrous and non-ferrous alloys is described, and the significance of fatigue tests after corrosion and the methods of protecting the alloys from corrosion are discussed.—J. H. W.

Tentative Specification II of the DVM-Testing Method A 113, Endurance Bending Test. German Society for Testing Materials (Z. Metallkunde, 1933, 25, 27–28).—Specifications are given for the testing machine, test-piece, experimental procedure, and evaluation of the results.—M. H.

The Haigh Alternating Stress Testing Machine. P. Field Foster (Machinery (Lond.), 1932, 40, 621-624).—A general illustrated account of the construction, use, and method of calibration of the Haigh machine.—J. C. C.

Recent American Researches on "Fatigue of Metals."—II. Anon. (Metallurgist (Suppt. to Engineer), 1932, 8, 167–168).—A continuation of a review of recent work on the subject, including that by P. L. Irwin, Proc. Amer. Soc. Test. Mat., 1925, 25, (II), 687 (cf. this J., 1926, 35, 687), by France (ibid., 1931, 31, (II), 176), and by Gough, Aeronaut. Res. Citee., R. and M. No. 864, 1925. —R. G.

Fatigue Strength and Resistance to Slip. P. Ludwik (Met. Ind. (Lond.), 1932, 41, 613-615, 635-636).—Translation of a paper on "Schwingungsfestigkeit und Gleitwiderstand," Z. Metallkunde, 1930, 22, 374-376. See this J., 1931, 47, 102.—J. H. W. Fatigue of Metals. Methods for Determining the [Fatigue] Limit. P. Vernotte (Usine, 1931, 40, (34), 29).—Abstract of an article in Science et Industrie, 1931, 15, 223. See this J., 1932, 50, 43.—H. W. G. H.

A Proposed Method for Determining the Fatigue Limit [of Steel]. Yūji Nagasawa (J. Soc. Mech. Eng. Tokyo, 1928, 31, (135), 259-274; Japanese J. Eng. Abs., 1932, 8, 9).--[In Japanese.]-S. G.

Amsler Torsion Testing Machines. P. Field Foster (Machinery (Lond.), 1932, 39, 616-617).—Illustrated descriptions are given of the Amsler pendulumtype torsion testing machines of 1200, 2400, and 4800 lb.-ft. capacity and of the Amsler wire testing machines in which the torsion is measured by the twist of a calibrated measuring wire.—J. C. C.

Obtaining a Steady Curvature in Technical Bending Tests. M. Moser (Stahl u. Eisen, 1932, 52, 409-411).—In bending tests, especially on welded specimens, it is recommended that the mandrel about which the specimen is bent should not be semi-cylindrical, but should have a definitely flattened surface, so that the specimen is bent into a circular form when the bending angle is large. If this angle exceeds  $170^{\circ}-180^{\circ}$ , an additional apparatus in the form of a hollow wedge is used so as to avoid local nicking.—J. W.

Notched-Bar Tests. Max Moser (Amer. Soc. Mech. Eng. Preprint, 1932, 1-6).—Unlike the tensile test, the notched-bar test does not give comparable results using test-pieces the dimensions of which, although of the same proportior, are not identical, and before such tests can be of real use the relationship existing between the conditions of tests and the test results must be understood. Although the notched-bar test does not provide any practical design data, it does give an indication of the ductilities of materials. Moreover, the test does to a certain extent give an indication of whether a material can be improved or deteriorated by "ageing." Steps are being taken by the New International Association for Testing Materials to establish a standard test-specimen for the notched-bar test. Cf. this J., 1932, 50, 369.—W. P. R.

On the Relation between Stress and Strain in the Impact Test. Ryönosuké Yamada (J. Soc. Mech. Eng. Tokyo, 1928, 31, (136), 420-446; Japanese J. Eng. Abs., 1932, 8, 11).—[In Japanese.] See this J., 1930, 43, 580.—S. G.

An Automatic Autographic Extensioneter for Use in Tension Tests of Materials. R. L. Templin (Proc. Amer. Soc. Test. Mat., 1932, 32, (II), 783-792).—See this J., 1932, 50, 490.—S. G.

A Method for Studying Strain-Hardening Susceptibility and Ageing after Cold-Work Deformation. Albert Sauveur and John L. Burns (Metals and Alloys, 1933, 4, 6).—The strain-hardening susceptibility of a metal may be determined by making a depression in the metal with a 10-mm. ball in the Brinell machine using a standard load and then measuring the hardness at the bottom of the depression by the Rockwell B test. The susceptibility for a constant depth of depression may be similarly measured, and the effect of ageing in either case may be determined by suitable heat-treatment after the Brinell depression has been made. Examples of the results obtained with Armeo iron are given, but the method can be applied to any metal.—A. R. P.

Portable Hardness Testing Machine with Diamond Pyramid Indenter. S. R. M. Porter (J. Sci. Instruments, 1933, 10, 18–20).—P. describes briefly a portable hardness tester designed for use on large or fixed surfaces (e.g., the head of a railway line). A 136° diamond pyramid indenter is used with a load of 10 kg., which is supplied by hand through a spring, mounted so that a stop prevents overloading. The size of the indentation is measured by a portable microscope, and the hardness number determined from a table. The accuracy is estimated as 5% under all conditions, and greater under favourable conditions.—W. H.-R.

A Useful Micrometer [for Measuring Brinell Impressions, &c.]. Anon. (J. Sci. Instruments, 1933, 10, 20).—A note. Describes briefly a small micrometer

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mounted on a tripod, and suitable for measuring Brinell impressions, &c. The instrument contains an illuminating device, and a scale divided to 0.001 in. The standard magnification is  $\times$  25, but additional scales and objectives can be supplied by the makers.—W. H.-R.

The Hardness of Metals at High Temperatures. Anon. (*Engineering*, 1932, 134, 604-605).—Illustrated article describing a method for determining true hardness at high temperatures. See J., this volume, p. 97.—W. P. R.

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X-Ray Examination of Aero Materials by the D.V.L. Kurt Matthaes (Jahrb. deut. Versuchsanst. Luftfahrt, 1932, V59-64).—Identical with Z. Flug. u. Motor., 1932, 23, 459-464. See this J., 1932, 50, 755.—B. Bl.

Laue Diagrams with Large Diffraction Angles. W. Boas and E. Schmid (Mitt. Material., Sonderheft 21, 1933, 66–68).—See this J., 1932, 50, 165.—J. W. Measurements of Elasticity by Means of X-Rays. G. Sachs and J. Weerts (Vestnik Metallopromishlennosti (Messenger of the Metal Industry), 1931, (2–3), 90–92).—[In Russian.]—See this J., 1930, 44, 594.—D. N. S.

## XII.-PYROMETRY

#### (Continued from p. 204.)

Temperature Measurement and Control. Anon. (Engineering, 1932, 135, 67-69).—The various types of instruments and apparatus for measuring temperatures are described. A very useful and complete table is given of all types of pyrometers, ranging from mercury-in-glass thermometers to the Joly meldometer, in which temperatures are measured by observing the expansion of a platinum strip.—W. P. R.

The Naeser Colour Pyrometer. M. A. Vernon (Metallurgia, 1933, 7, 159– 160).—A description is given of a new optical pyrometer in which temperature measurements depend on variations in colour, and in which light is passed from the hot body successively through 3 filters. Filter 1 transmits 2 colours, filter 2 absorbs one of the colours in gradually increasing amounts, whilst filter 3 absorbs the second colour and transmits the first. The three filters are joined together and an eye-piece is made to slide along the compounded filter and a pointer on the eye-piece moves along a rigid scale of temperatures on the filter, so that the required temperature is read off directly. For the greatest accuracy the colours chosen must be such that as the eye-piece is moved along the wedge one component predominates, until there is a sudden change to the standard compound tint, followed immediately by a change to the other colour, and this condition is satisfied by making the colours complementary and the standard tint white. Temperatures ranging from 500° to 3000° C. can be measured, and a high degree of accuracy can be obtained.—J. W. D.

A New Thermocouple for the Determination of Temperatures up to at Least 1800° C. G. R. Fitterer (Amer. Inst. Min. Met. Eng. Preprint, 1933, Feb., 1-8).—The couple consists of a carbon tube through which is run a silicon carbide rod spaced from the walls by means of a refractory ring at the upper end and screwed into the lower end to form the hot-junction. Comparison of the readings of this couple with those given by a platinum|platinum-rhodium couple and by an optical pyrometer show that the calibration curve may be expressed by the equation: t = 50 + 3.32x, where t is the temperature required in °C., and x is the reading in millivolts. The couple is extraordinarily stable and highly resistant to chemical contamination.—A. R. P.

A Design for Precision Platinum Resistance Thermometers. J. A. Hall (J. Sci. Instruments, 1933, 10, 4-10).—Full details are given of the design and

construction of a resistance thermometer in which the platinum element is wound on a frame of fused quartz in a hermetically-scaled envelope. This type of mounting is lighter than one of porcelain, and stronger than one of mica.—W. H.-R.

Ageing of Nickel-Chromium Thermoelements. A. Grunert (*Chem. Fabrik*, 1933, 6, 39-40).—Thermocouples consisting of very pure wires of nickel and nickel-chromium alloy, both of which have been melted in a vacuum, retain their calibration at  $1280^{\circ}$  C. after 200 hrs.' continuous heating. The presence of small quantities of impurities causes rapid deterioration in this test, manganese, silicon, aluminium, and carbon being especially harmful.—A. R. P.

Maintenance of Pyrometers. J. F. Martin (*Met. Ind.* (Lond.), 1933, 42, 104, 111).—A letter commenting on a paper by F. J. Brookes on "Practical Notes on the Installation and Upkeep of Thermo-Couple Pyrometers" (see J., this volume, p. 98).—J. H. W.

Measurement of Temperature of Non-Ferrous Alloys. [H. M.] St. John (Usine, 1931, 40, (23), 31).—Abstract of a paper read before the 10e. Congrès de Fonderie. See this J., 1931, 47, 546.—H. W. G. H.

# XIII.-FOUNDRY PRACTICE AND APPLIANCES

#### (Continued from pp. 204-207.)

Oxide in Metal Castings. F. Höhne (Z. ges. Giesserei-Praxis: Das Metall, 1933, 54, 13-14, 35-36, 78-79).—The mechanism of dcoxidation of metals is discussed. The heat of combustion of the deoxidizing agent must be considerably greater than that of the metal to be deoxidized, a small excess of the deoxidizer must have no detrimental effect on the metal, and any oxide formed must be easily slagged off. The use of magnesium, aluminium, silicon, manganese, zinc, phosphorus, and carbon as dcoxidizing agents for copper and for alloys of copper with zinc, tin, nickel, aluminium, and silicon is discussed.

-J. H. W.

Factors and Faults in the Foundry. A. Portevin (Usine, 1931, 40, (43), 37).—Abstract of a paper presented to the 6e. Congrès International de Fonderie. See this J., 1932, 50, 770.—H. W. G. H.

The Contraction of Metals During Casting. [C. M. Saeger, Jr., and Eugene J. Ash] (*Technique moderne*, 1932, 24, 633).—Abstract from U.S. Bur. Stand. J. Research, 1932, 8, 37. See this J., 1932, 50, 263.—H. W. G. H.

**Pouring Castings with Large Flat Faces.** Anon. (Z. ges. Giesserei-Praxis: Das Metall, 1933, 54, 73-74).—The special precautions to be taken in making castings with large flat faces are described.—J. H. W.

Some Notes on Aluminium and Aluminium Alloy Founding. N. F. Budgen (Aluminium Broadcast, 1933, 3, (42), 4-9).—Read before the Manchester Metallurgical Society, 1932, Nov. 16. Aluminium alloys suitable for sand, permanent mould, and pressure castings are enumerated, and furnaces for melting the alloys briefly reviewed. Pinholing is well established as being caused by gases such as hydrogen derived from water vapour, or absorbed by the virgin metal when exposed to corrosive conditions. Preventive methods include pre-solidification or treatment with nitrogen or chlorine. Experiments to show the effect of melting and pouring temperatures were made by using an alloy, for which the lowest pouring temperature was 720° C., to cast a shallow dish. If the metal was heated above 760° C and then allowed to cool to 720° C. before pouring, the crystal-size and the depth and number of eutectic draws increased. These bad effects were even more pronounced if the metal was poured above 720° C. Metal which has been overheated can, however, be made to give good castings if it is allowed to solidify and carefully remelted. Reference is made to the use of agents such as boron trichloride to effect grainrefinement.—J. C. C.

Casting of Aluminium Alloys. A. Courty (Usine, 1931, 40, (2), 39).— Abstract of paper published in Compt. rend., 1930, 191, 1128. See this J., 1931, 47, 238.—H. W. G. H.

Organization of a Foundry for Varied Small Castings in Bronze and Iron. ——Castelain (Usine, 1931, 40, (43), 39).—Abstract of a paper presented to the 6e. Congrès International de Fonderie, describing the reorganization of the Chemin de Fer du Nord Foundry at Hellemmes. See this J., 1932, 50, 580.

-H. W. G. H.

Casting Bronze which Retains Fluids under High Pressure. J. E. Crown (*Industria Meccanico*, 1932, (5), 300-332).—The methods used at the U.S. Naval Gun Factory are described; see this J., 1932, 50, 123, 196.—G. G.

Casting Properties of Nickel Bronzes. N. B. Pilling and T. E. Kihlgren (Met. Ind. (Lond.), 1932, 41, 631-633; 1933, 42, 11-13).—Read before the American Foundrymen's Association; see this J., 1932, 50, 772.—J. H. W.
What is Wrong with the Brass Foundry ? William J. Reardon (Met. Ind.

What is Wrong with the Brass Foundry? William J. Reardon (Met. Ind. (N.Y.), 1933, 31, 15).—A brief outline of the present economical conditions in American brass foundries.—A. R. P.

A Specialist in the Production of Difficult Alloys. Anon. (Met. Ind. (N.Y.), 1932, 30, 310-314).—An illustrated description of an American works producing high-grade nickel-brass and phosphor-bronze.—A. R. P.

The Fundamentals of Brass Foundry Practice.—XXVIII., XXIX. R. R. Clarke (*Met. Ind.* (*N.Y.*), 1932, 30, 62–63, 280–281).—The concluding parts of an article on the basic laws which control the melting and casting of brass. The subjects discussed are fuels and fluxes for the melting of brass.—A. R. P.

The Chief Causes of Porous Brass Castings. Anon. [Z. ges. Giesserei-Praxis: Das Metall, 1933, 54, 53-54).—The chief kinds of porosity in brass castings are: (1) lack of compactness as shown by mechanical tests; (2) fine pores which show up as small black points in the polished specimens; (3) blisters under the skin which appear after the casting is turned in a lathe. These 3 forms of porosity are explained and methods of preventing their occurrence are described.—J. H. W.

Casting Small Paddle Wheels in Green-Sand. Anon. (Z. ges. Giesserei-Praxis: Das Metall, 1933, 54, 14–16).—Small paddle wheels were formerly cast in dry sand. Green-sand, however, has the advantages that the red brass and bronze usually used cast well in it and a more nearly seamless and a smoother easting can be obtained. Details of the moulding and mould-dressing are given.—J. H. W.

Fluxes for Brass. [Edmund R. Thews] (Usine, 1931, 40, (49), 39).—From Metallurgist (Suppt. to Engineer), 1931, 7, 94–96. See this J., 1931, 47, 572.

-H. W. G. H.

Phosphorus in Red Brass. R. W. Parsons (Met. Ind. (N.Y.), 1932, 30, 433-435).—Abstract of a paper read before the American Foundrymen's Association. See this J., 1932, 50, 773.—I. M.

Casting Brass in Chills under Pressure. [L. H. Morin] (Usine, 1931, 40, (33), 35).—Abstracted from Iron Age, 1931, 127, 1552. See this J., 1931, 47, 608.—H. W. G. H.

White Bearing Metals. E. Fleischmann (Metallurgist (Suppt. to Engineer), 1932, 8, 182-184).—A summary and discussion of a publication on white metals for bearings by F., in Forschungsarbeiten über Metallkunde und Röntgenmetallographie. See this J., 1932, 50, 774.—R. G.

Viscosity of Fluxes and Slags for Magnesium Melting. — Hardouin, — Cochet, and — De Fleury (*Technique moderne*, 1932, 24, 573).—Abstract of a paper presented to the Académie des Sciences. See this J., 1932, 50, 710. —H. W. G. H. Flux for Protecting, Refining, and Eliminating Chlorides in Casting Magnesium. R. do Fleury and A. Caillon (*Compt. rend.*, 1933, 196, 53-55; and J. *Four elect.*, 1933, 42, 56).—When magnesium chloride is used as a flux in casting magnesium and its alloys, all traces of chloride must be eliminated from the casting. A better method is to melt the metal under 0.5-5% by weight of a "base flux" consisting of magnesium chloride 60% + sodium chloride 40%. After melting, 20% (by weight of the base flux) of a "correcting flux," consisting of MgF<sub>2</sub> 50% + B<sub>2</sub>O<sub>3</sub> 50% or MgF<sub>2</sub> 35% + BaF<sub>2</sub> 15% + B<sub>2</sub>O<sub>3</sub> 50%, is stirred in to increase the viscosity of the flux, facilitate pouring, and eliminate the chlorides. The melt is then dusted with flowers of sulphur and NH<sub>4</sub>F + HF. A "casting flux," consisting of B<sub>2</sub>O<sub>3</sub> 15% + Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub> 85%, is added 20-25 minutes before pouring. This mixture must be accurately made up with strictly anhydrous salts. It becomes viscous at 850° C. and adequately protects the metal without entering the mould.—J. H. W.

Melting and Casting Nickel and Non-Ferrous Metals Containing Nickel. B. Trautmann (Z. ges. Giesserei-Praxis: Das Metall, 1933, 54, 11-13).—Nickel and high-nickel non-ferrous alloys are characterized by high melting points, large shrinkage, and a pronounced tendency to absorb gases, particularly oxygen, sulphurous and carbonic. In pure nickel and Monel metal, silicon can be present up to 2%, manganese up to 0.5%, and iron up to 3% without harmful effects, but carbon and sulphur must be absent. The melting, moulding, a.id pouring operations for these alloys and for copper alloys containing less nickel are described.—J. H. W.

Saving Babbitt by Covering Melting Pot. James J. Baule (Machinery (N.Y.), 1933, 39, 480).—An asbestos board cover for floating on the metal in a Babbitt melting pot is described. After 54 hrs., 78 lb. of oxide were formed in a 24-in. diam. pot fitted with such a cover, as against 232 lb. in an open pot and 198 lb. in one having a layer of charcoal.—J. C. C.

Directions for Running White Metal Bearings for Machinery and Motors. Carl Krömer (Automobiltech. Z., 1932, 35, 284–286).—For heavy duty, a bearing metal of the composition tin 75–83, antimony 12–15, copper 3–5% is suggested; no lead should be present. The selection of crucibles, the time taken in melting, treatment of excess metal, method of temperature control, preparation of the ladle, and rate of pouring are considered in detail; the avoidance of premature separation of copper-tin crystals and of included airbubbles is specially considered. The preparation and tinning of the mould are fully described, and tealls of melting furnace, pyrometers, arrangements prior to pouring, and rapid cooling of the bearing are given, together with particulars as to shrinkage.—P. M. C. R.

Widening the Scope of Aluminium Permanent Mould Castings. Harry L. Smith (*Iron Age*, 1933, 131, 312-313, 340).—Permanent mould castings lie between sand- and die-castings, and are used where accuracy, lightness, strength, and a smooth finish are required for castings with intricate shapes and complicated cores. The alloys used contain up to 10% copper,  $5\cdot5\%$  silicon,  $1\cdot5\%$  zinc, and  $0\cdot2\%$  magnesium, and have an ultimate tensile strength of between 21,000 and 33,000 lb./in.<sup>2</sup>, a minimum clongation of  $0-4\cdot5\%$  on 2 in., and a Brinell hardness of 45-125.—J. H. W.

Centrifugal Casting of Non-Ferrous Metals. ——Dubercet (*Rev. Fonderie moderne*, 1933, 27, 17-21).—General considerations in centrifugal casting and its effects on segregation are discussed, and the methods of horizontal and vertical centrifugal casting are described. The process has many advantages, but its applications are somewhat severely limited to special cases, *e.g.*, where severe friction is to be encountered by the casting.—J. H. W.

Centrifugal Casting in the American Navy. Joseph F. Crowell (Usine, 1931, 40, (22), 31).—Abstracted from *Iron Age*, 1930, 126, 994, 1047. See this J., 1931, 47, 53.—H. W. G. H.

The Production of Aluminium Die-Castings. C. R. Norwood (Machinery (Lond.), 1933, 41, 499-500).—Correspondence on C. Vaughan's paper (see J., this volume, p. 151). The use of steel and brass inserts and the effects of correct venting in gravity die-castings are illustrated.—J. C. C.

Die-Cast Silumin. Anon. (Z. ges. Giesserei-Praxis: Das Metall, 1933, 54, 55-58).—The casting and mechanical properties of Silumin (aluminium + 13% silicon), both modified and unmodified, are described and these properties are compared to those of other common die-cast aluminium alloys. For ordinary Silumin, the casting temperature is 750° C. and the mould temperature 200° C., increasing to 800° and 500° C., respectively, when special security against cracks is required. The casting of test-pieces is described and the structures of the various kinds of Silumin are explained.—J. H. W.

Mould Construction in Silumin Die-Castings. Anon. (Z. ges. Giesserei-Praxis: Das Metall, 1933, 54, 74-78).—A description of the construction of iron moulds suitable for casting Silumin and examples of such castings are given.—J. H. W.

Die-Cast Screw Threads. Anon. (*Machinery* (Lond.), 1933, 41, 529-530).— Methods of constructing dies for casting screw-threads are discussed and illustrated.—J. C. C.

Kipp Die-Casting Machines for Small Parts. Anon. (Machinery (N.Y.), 1933, 39, 483-484).—Brief descriptions of some recently introduced machines. —J. G. C.

The Luting of Joints in Moulds. Anon. (Maschinenkonstrukteur, 1933, 66, 34).—Slaked lime, mixed with water to a pasty consistency, preserves its plasticity long enough to penetrate and fill the joints; the water is very gradually given up to the moulding sand, and the lime possesses a penetrability by air equal to that of clay. Contact with molten metal causes no evolution of gases. Lime is of great use when moulds are of porous material, consisting of advantageously used in the protection of cores.—P. M. C. R.

Modern Moulding Machines. Anon. (Giesserei, 1933, 20, 94-96).—An illustrated description of the "Rekord," "Herman," "Pluto," and rotating moulding machines.—A. R. P.

A Study of Moulding and Core Sands. Marcel Girault (*Rev. Fonderie* moderne, 1933, 27, 23–26, 28–29; discussion, 29).—The chemical composition, clay content, absorption, granulation, permeability and cohesion, refractoriness and hardness required by moulding sands, and the choice of core sands with a silicious base and the selection of a good binder are described. The control of these various properties is discussed.—J. H. W.

Contribution to the Study of the Expansion of Sand Moulds and Cores. J. Varlet (Bull. Assoc. Tech. Fonderie, 1932, 6, 275-284).—Results of laboratory experiments are given confirming the expansion of moulds and cores. The influence of the composition of the sand is discussed.—W. A. C. N.

On the Testing and Evaluation of Core Sand and Core Sand Binders. Th. Klingenstein (*Mitt. Forschungsanst. G.H.H. Konzern*, 1931, 1, 175-185).— Core sand should be tested for grain-size and clay content. Binders can be tested only by making standard cores with varying quantities of binder and testing these cores for strength and permeability to gases. The optimum moisture content of the core mixture can be determined only by experiment. Methods and apparatus for carrying out these tests are described, and the results obtained on a standard sand using 30 different binders are tabulated. Recent literature on the subject is briefly reviewed and a list of 30 references is appended.—A. R. P.

Introduction to a Study of Moulding Sands. L.-F.-C. Girardet (Bull. Assoc. Tech. Fonderie, 1933, 7, 43-58).—After a survey of the prominent characteristics of sands in general G. proceeds to consider the causes which may operate in destroying a mould when once formed. Mechanically, the two main factors are erosion and excess pressure. Physically, the thermal stability of the mould and the core, the temperature of vitrification, and the expansion of the sand are important. The chemical constitution, bearing in mind the necessity for the absence of alkalis and other low temperature slagforming constituents, is equally important. The various tests which determine the value of a moulding sand are described and discussed. Among them are those for ascertaining the agglomerating power, the amount of colloid material, flocculation, and the expansion. The apparatus used in the tests is fully illustrated.—W. A. C. N.

Management and Warehousing of Foundry Sands. Metals and Materials Having Good Resistance to the Abrasive Action of Foundry Sand. J.-R. Delin (Bull. Assoc. Tech. Fonderie, 1932, 6, 109–114).—A discussion of the effects of various sands on the usual constructional materials of bins, silos, elevators, &c., in the foundry. Typical layouts of foundry plants are discussed, as well as the necessity of having a true conception of the angles of rest and frictional resistances that are likely to be present, and must be taken into account. Tests on the abrasive resistances of rubber, nickel-chrome steel, laminated steel, and cast-iron with respect to sand are described.—W. A. C. N.

Foundry Sand Control. A. A. Grubb (Met. Ind. (N.Y.), 1932, 30, 64–65, 100–101).—Abstracted from Trans. Bull. Amer. Found. Assoc., 1931, 2, (11), 8–17. See this J., 1932, 50, 510.—I. M.

Practical Tests for Sands in the Foundry. P. Aulich (Usine, 1931, 40, (43), 33).—Abstract of a paper presented to the 6e. Congrès International de Fonderie. See this J., 1932, 50, 641.—H. W. G. H.

Dust Removal from Used Sand. B. Trevis (Usine, 1931, 40, (43), 33).—An account of a paper read before the International Foundry Congress, Milan, 1931. See this J., 1932, 50, 641.—H. W. G. H.

Materials Handling in the Small Brass Foundry. D. G. Anderson and B. F. McAuley (*Met. Ind.* (*N.Y.*), 1932, 30, 349–351).—Abstract of a paper read before the American Foundrymen's Association. See J., this volume, p. 42. —I. M.

Mechanical Handling Equipment in Small Foundries. H. L. Hoefman (Mechanical Handling and Works Equipment, 1933, 20, 12, 42–43).—Abridged report of an address to the National Founders' Association, New York. The possibilities of utilizing mechanical handling systems in foundries casting as little as 25 tons per day are briefly reviewed.—J. C. C.

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

#### (Continued from p. 207.)

Metal Scrap will Provide World's Need is Predicted. Anon. (Daily Metal Reporter, 1933, 33, (19), 5).—The report of the President's Research Committee (U.S.A.) on Social Trends states that since 1911 recoveries from scrap have increased much more rapidly than has production of virgin metal. In 1926, the following percentages of the total production were derived from scrap: aluminium 38, copper 35, antimony 31, tin 28, lead 23, zince 19%. It is considered that these proportions are likely to increase until the bulk of the world's metal supply can be obtained from scrap.—P. M. C. R.

Secondary Metals. Thomas A. Wright (Met. Ind. (N.Y.), 1932, 30, 16–18).—A review of new developments during 1931 in the recovery and utilization of non-ferrous metal scrap.—A. R. P.

# XV.-FURNACES AND FUELS

#### (Continued from p. 207.

### FURNACES

Some Developments in Metal Melting and Heat Furnaces. Anon. (Metallurgia, 1933, 7, 137-142).—The increasing demand for better and cheaper products has involved considerable development in melting and heating equipment, and a number of furnaces in which progress has been made are briefly surveyed and reviewed. Types of heating furnaces considered include pulverized-fuel melting furnaces, oil-fired oscillating furnaces used for melting brass, bronze, nickel-bronze, nickel-brass, and similar alloys as well as for copper refining, and oil- and gas-fired tilting furnaces of various designs for the rapid and economical melting of copper and aluminium alloys. Recent developments in heating furnaces for rolling-mill use and for forging purposes, and in heat-treatment furnaces for the heat-treatment of aluminium alloys and the bright-annealing of copper wires and strip, are also dealt with, special reference being made to the careful selection of heating units in the case of pulverized coal, oil, and gas. The developments which have taken place in the mechanical handling of the material to be treated in furnaces are discussed.

-J. W. D.

Continuous Metal Melting. Anon. (Gas J., 1933, 201, 749).—A thermostatically-controlled continuous-melting furnace, heated by low-pressure gas or using air at 18 in. water pressure, capable of melting 600 lb. of aluminium, is described. Under test, the furnace melted 338 lb. and 652 lb. of aluminium per hr. at different gas rates, with respective efficiencies of 48.6% and 39.8%. —J. S. G. T.

The Use of Gas for Making Money at the Mint. Anon. (Gas World (Indust. Gas Suppt.), 1933, 5, (2), 16–18).—Furnaces and other equipment used for coin-making at the Royal Mint, London, are briefly described and illustrated. —J. S. G. T.

Large Scale Brass Annealing in Gas-Fired Muffles. W. Wirt Young, Jr. (Met. Ind. (N.Y.), 1932, 30, 102-104).—See J., this volume, p. 45.—I. M.

Furnace Bright-Anneals Copper Wire. J. B. Nealey (*Heat-Treat. and Forging*, 1932, 18, 599-600).—Cf. this J., 1932, 50, 582, 776, and this volume, p. 48.—J. H. W.

The Electric Furnace and the Alloy Age. John A. Mathews (*Trans. Electrochem. Soc.*, 1932, 61, 143-160).—The First Joseph W. Richards Lecture. Metallurgical developments resulting from the steady advance in electric furnace practice are historically reviewed.—P. M. C. R.

Induction Furnaces (International Congress of Electricity). P. Bunet (Science et Industrie, 1933, 17, 144–145).—Report No. 11. A historical review is followed by a consideration of induction furnaces from the points of view of metallurgy and of economical shop practice; the cooling of the primary coil, on the efficiency of which depends that of the entire plant, is of great importance. The question of safety is considered, and notes are appended on low-power furnaces, on induced currents in cylindrical conductors, and on transformers.—P. M. C. R.

Lead-Bath Furnaces. S. Z. Owen (*Electric J.*, 1932, 29, 525–526).—Leadbath furnaces are economical below 1600° F. (871° C.) and heat 2–3 times as rapidly as air furnaces. By using two-point control, with thermocouples in the bath and near the heating elements, the temperature gradient can be kept a minimum. A circular pot has least top surface and is most economical. Variations in temperature in a 17-in. pot can be kept below  $\pm 5^{\circ}$  F. ( $\pm 3^{\circ}$  C.) at 1450° F. (788° C.), at which temperature radiation losses are 25 watts/in.<sup>2</sup> or 8 kw./hr. Losses can be halved by using a cover. Curves are given showing the relation between the weight of steel parts treated and the power consumption per day.—J. C. C.

Electric Heat-Treatment Furnaces. A. G. Lobley (J. Inst. Production Eng., 1930, 9, 186-199).—See this J., 1930, 44, 717.—J. C. C.

Control of Atmosphere in Heat-Treatment Furnaces. Robert M. Keeney (*Technique moderne*, 1932, 24, 23).—From *Iron Age*, 1931, 128, 690. See this J., 1931, 47, 612.—H. W. G. H.

Induction Furnace with Ferromagnetic Muffle and Automatic Temperature Regulation. R. Perrin and V. Sorrel (*Technique moderne*, 1931, 23, 481, and *Usine*, 1931, 40, (20), 29).—Abstract of a paper read before the Académie des Sciences. See this J., 1932, 50, 270.—H. W. G. H.

### FUELS

Fuels in Heat-Treating Furnaces. H. J. Gregg (Metal Progress, 1933, 23, (3), 37-40).—The increasing importance of automatic temperature control and of continuous or cyclic operation in heat-treatment must influence the choice of fuels, especially in view of the stress now laid on furnace atmosphere and of the undesirability of expensive part-time running. The advantages and limitations of fuel oil, electricity, artificial and natural gas, "diffusion" combustion, and butane, are considered and compared.—P. M. C. R.

On Metallurgical Coke. Seiji Tanaka (*Tetsu-to-Hagane*, 1928, 14, (6), 463-477; Japanese J. Eng. Abs., 1932, 8, 79).—[In Japanese.] T. investigated the properties of metallurgical coke manufactured in Japan by measuring its relative reactivity for carbon monoxide and also the relative reactivity of coke substance. A test was finally carried out to estimate the permeability of coke to gases.—S. G.

The Use of Pulverized Coal in the Foundry. Raymond Moine (Bull. Assoc. Tech. Fonderie, 1932, 6, 75-82).—A discussion of powdered-coal firing historical, theoretical, and practical. Diagrams of crushing and storage plants, and a number of illustrations of actual plant are given. The discussion tends to bring out the essential advantages of this means of coal utilization over other earlier means.—W. A. C. N.

Distribution of Pulverized Fuel for Metal Working. Frank S. O'Neil (Power Plant Eng., 1932. 36, 162-163).—The application of a pulverized coal system to an existing metallurgical plant is described. Stress is laid on the method of automatic distribution, the adaptation of the burners to the type of work, and on the reduced fuel consumption and annealing time, improved products and saving on the operating costs of the boilers.—P. M. C. R.

Pulverized Coal for Forge Furnaces is Excellent and Cheap. C. P. Blair and C. E. Pond (*Metal Progress*, 1932, 22, (6), 24–28).—An account, illustrated by photographs and scale drawings, of an installation of heavy forge furnaces now in operation at Roanoke, Va., U.S.A. Pulverized Pocahontas coal is used as fuel, the escaping flame being utilized to maintain the preheating furnace. Much of the equipment was made locally. Systems of distribution, aeration, and feed, of capacity and of temperature range are described. It is found that a reducing atmosphere can be maintained continuously and that there is comparatively little wear on the furnace refractories, whilst the coal consumption is reduced by 25%.—P. M. C. R.

The Trend of Pulverized Fuel Practice in U.S.A. and Canada. John Rogers (*Fuel Economist*, 1932, 8, 13-18).—Recent progress in pulverized fuel technology in U.S.A. and Canada is briefly discussed. The subjects dealt with include unit and central systems of firing, mills and fuel transport systems, furnaces, boilers and boiler control, and results obtained with various plant.—J. S. G. T.

Unit Firing v. Storage System in Pulverized Fuel. Anon. (Fuel Economist. 1932, 8, 121-128).—The respective advantages of the unit and central systems of pulverized fuel supply are discussed, reliability of plant and the influence of drying the coal being amongst the subjects referred to. The two methods of firing are illustrated.—J. S. G. T.

The Grindability of Coal. Anon. (Fuel Economist, 1932, 8, 157).—A memorandum on this subject prepared by a Committee appointed by the Institution of Mining Engineers is briefly referred to.—J. S. G. T.

Furnace for the Determination of the Ash of Solid Fuels. Horst Brückner and Gert Seufert (Gas. u. Wasserfach, 1932, 75, 276-277).—Combustion of the fuel is accelerated by continuously withdrawing the gaseous products formed through a tube placed over the crucible. In the apparatus described the crucible is heated by radiation from the walls of the furnace and by preheating the air used for the combustion of the fuel.—B. Bl.

Coal Nomenclature. H. Clifford Armstrong (Fuel Economist, 1932, 8, 67–68).—Confusion in the existing classification of coals of different sizes and descriptions, and the economic and commercial necessities of standardizing coals marketed are very briefly referred to.—J. S. G. T.

Coal and Coke. Ivan A. Given (*Mineral Ind.*, 1932, 40, 74–108).—Statistical.—E. S. H.

Report of Committee D-5 [of A.S.T.M.] on Coal and Coke. A. C. Fieldner, H. C. Porter, and W. A. Selvig (*Proc. Amer Soc. Test. Mat.*, 1932, 32, (I), 436-438).—See this J., 1932, 50, 512.—S. G.

### XVI.-REFRACTORIES AND FURNACE MATERIALS

#### (Continued from pp. 208-211.)

Refractories, Refractorers, and the Non-Ferrous Metal Industry. Frank S. Russell (*Met. Ind.* (*Lond.*), 1933, 42, 57-58).—A description of the use of refractories and a discussion of the behaviour of refractorers in the non-ferrous metal industry.—J. H. W.

Refractory Materials for Melting Pure Metals. H. B. Wahlin, O. D. Fritsche, and J. F. Oesterle (*Phys. Rev.*, 1932, [ii], 42, 911).—Abstract of a paper read before the American Physical Society. A study of various refractories has shown that porcelain as well as magnesia crucibles volatilize and reduce sufficiently, when heated in a vacuum, to contaminate pure metals contained in them. Crucibles of pure, fused thorium oxide are the most satisfactory and will withstand heating in a vacuum for long periods of time. Special shapes of crucibles may be readily prepared by using moulds made of a fusible alloy which is melted off before firing. The crucibles should be fired to a temperature of 1800° C., care being taken to prevent the formation of thorium carbide, which, because of interaction with the moisture of the air, will cause the crucibles to break up.—S. G.

The Use of Unburnt Bricks for the Linings of Induction Furnaces. J. H. Chester and W. J. Rees (*Trans. Ceram. Soc.*, 1932, 31, 243-252).—A method is described whereby an induction furnace can be lined with tongued and grooved unburnt bricks, the linings being sintered, without the aid of a metal former, by the melting of the first charge. An account is given of 3 experimental trials.—S. V. W.

Sinterkorund—A New Ceramic Material. Anon. (Indust. Chemist, 1932, 8, 150-152; also Ceramic Age, 1932, 19, 28-29, 36-37; and Automobiltech. Z., 1932, 35, 133).—Sinterkorund is made by sintering precipitated alumina at about 1800° C. It is highly resistant to alkalis and acids and also to molten aluminium, ferromanganese, and other alloys. As a crucible material it shows the greatest resistance of all known substances towards blast-furnace slag, lead carbonate, lead, and other metal silicates, &c. Sinterkorund is very resistant

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to temperature changes and is impermeable to gases even at 1720° C.; the thermal conductivity is high. These properties make it useful as a refractory material for furnaces. The reaction of Nichrome heating elements with many supports and cements, forming silicates, is obviated by using Sinterkorund.

-E. S. H.

Refractories. Anon. (Refractories Bull. (John G. Stein & Co., Ltd.), 1932, Nos. 1-12).—A series of 2-page monthly Bulletins presenting some of the interesting features connected with silica and fire-clay refractories. Among the properties dealt with are refractoriness, refractoriness under load, the significance of the chemical composition of firebricks, silica volume changes, the burning of a firebrick, firebrick bonding, refractory cements, thermal expansion of firebricks, carbon monoxide disintegration, and refractories in service.—J. W. D.

Economics of the Use of Refractories. S. P. Mason (Blast Fur. and Steel Plant, 1932, 20, 512-514; Ceram. Abs., 1932, 11, 495).—The items which enter into the cost of the brick are: (1) cost of material f.o.b. manufacturer's plant; (2) freight to consumer's plant; (3) unloading into storage at consumer's plant; (4) delivering from storage to the furnace; (5) dismantling old furnace brickwork; (6) masons' labour in building new brickwork; (7) mason helpers' labour; (8) carpenters' labour on forms; (9) lumber for forms; (10) cement; (11) fuel for drying furnace to start next run, and (12) idle furnace time. Methods for calculating the unit cost of the refractory are explained. Factors entering into materials and labour costs are enumerated and discussed.—S. G.

Castable Refractory. —— (Chem. and Met. Eng., 1932, 39, 626).—" Cast-Refract," a new material, is said to be capable of being cast or moulded on the job, and also to produce a monolithic structure, air- and gas-tight, free from shrinkage, highly resistant to spalling, and of excellent refractory properties up to its temperature limit of 2,600°-2,800° F. (1427°-1548° C.).—F. J.

High-Alumina Refractory Bodies. R. Rieke (Ber. deut. keram. Ges., 1932, 13, 88-90; Ceram. Abs., 1932, 11, 493).—R. discusses the natural high-alumina refractory materials and the methods whereby the alumina content of refractories can be increased with an accompanying increase in refractoriness and an improvement of various other properties.—S. G.

Expansion Behaviour of Chassov-Yar Firebrick at High Temperatures. P. P. Budnikov and W. Müller (*Ber. deut. keram. Ges.*, 1932, 13, 153-157; *Ceram. Abs.*, 1932, 11, 493).—Firebricks made up of the different kinds of Chassov-Yar clays were studied in regard to their expansion behaviour at high temperatures.—S. G. Expansion Behaviour of the Regular and Black Silica Brick. P. P.

Expansion Behaviour of the Regular and Black Silica Brick. P. P. Budnikov and W. Müller (*Ber. deut. keram. Ges.*, 1932, 13, 28-31; *Ceram. Abs.*, 1932, 11, 492).—A comparison was made of the expansion behaviour of a regular silica brick and a black silica brick. The latter is made with a mineralizer of furnace dust and has a higher sp. gr., bulk gravity, per cent. expansion, resistance to compression, and a lower porosity and water absorption. A check also shows the black silica brick to consist of tridymite 40, cristobalite 20, and quartz 40% compared to tridymite 52, cristobalite 18, and quartz 30% for the regular silica brick.—S. G.

Chromite-Dinas Bricks. P. P. Budnikov and L. L. Mandelgrin (Zhurnal Prikladnoi Khimii (Journal Applied Chemistry), 1932, 5, (3/4), 299-302).— [In Russian, with German summary.] Attempts have been made to combine the high resistance of chromite bricks to the action of acid and basic slags with the high refractoriness and high deformation temperature of dinas bricks. Bricks made from 50:50, 70:30, and 80:20 mixtures of quartzite (silica 96.92, alumina 0.5, ferric oxide 1.35, and lime 0.73%), and chromite (silica 12.76, alumina 10.59, ferric oxide 32.68, chromic oxide 29.13, lime 0.33, and magnesia 10.80%) after heating to 2100° C. contained undissolved  $Cr_2O_3$ , showing that chromic oxide does not form a compound with silica but remains dispersed in a finely-divided state throughout the conglomerate of crystalline tridymite and cristobalite and amorphous cement. Addition of chromite reduces the refractoriness and deformation temperature of dinas bricks owing to the high iron content, so that with a purer chromite, higher values for these properties should result. On the basis of the experiments it is recommended that chromite-dinas bricks be produced from chromite containing a minimum of ferric oxide and their resistance to acid and basic slags carefully studied.

-M. Z.

**Properties of Refractory Materials.** Anon. (*Eng. Rev.*, 1932, 46, 297–298).— Expansion, spalling, erosion, and chemical attack are briefly reviewed as possible sources of failure in refractories. British, American, and Continental methods of testing are summarized. The chemical constitution of firebrick is considered and the influence of certain ingredients pointed out. A table of melting-points for various compositions of brick is given, with the approximate silica or alumina content of several refractories.—P. M. C. R.

The Thermal Conductivity of Fire-Resisting Ceramic Material. Its Calculation from the Conductivity of the Constituents. A. Eucken (Forschungshe/t 353, 1932, 1-16).—A series of experiments was undertaken to determine the thermal conductivity of the following refractory materials and its dependence on the properties of the constituents: silica, fireclay, sillimanite, carborundum, magnesite, and corundum. The conductivity depends less on the chemical than on the physical and crystallographic properties of the material, especially on the ratio of crystalline to amorphous material. A suitable formula for calculating the thermal conductivity is derived from a formula of Maxwell's for electrical conductivity, suitably modified to take into account the high degree of expansion of the crystalline material. The application of this formula involves some difficulties in many cases, and extrapolation and approximation must be resorted to, and although the calculations will not give individual increments in the conductivity, they can be used to confirm the observed absolute values and to check the experimental temperature curves of a number of refractories.—J. H. W.

The Corrosion of Refractories—A Quantitative Durability Test. J. F. Hyslop and H. C. Biggs (*Trans. Ceram. Soc.*, 1932, **31**, 173–176).—After briefly referring to the chief types of corrosion tests for refractories, that developed by H. and B. is described. The test-piece is rotated in a furnace and flux fed on to it from a water-cooled spoon. The time taken for the flux to sever the test-piece is a direct measure of the durability of the refractory under the conditions of test.—S. V. W.

Apparatus for Measuring the Thermal Expansion of Refractory Materials in the Temperature Range 0°-1700° C. H. Reich (*Ber. deut. keram. Ges.*, 1932, 13, 157-166; *Ceram. Abs.*, 1932, 11, 493).—A new apparatus for determining the thermal expansion of refractory materials over a range of 0°-1700° C. in a normal carbon-resistance furnace with comparatively simple auxiliary equipment is described. The reproducibility of the measurements was demonstrated by results of measurements. The serviceability of the apparatus for regular practice was demonstrated by two examples.—S. G.

Mistakes in Pressing Refractory Bricks. Hans Kremski (Tonind. Zeit., 1932, 56, 814–815).—A description of faults, e.g., edge cracks, formation of bars, &c., which occur in moulding refractory bricks, and methods for avoiding them.—B. Bl.

Heat Insulation. H. N. Bassett (*Eng. Rev.*, 1932, 46, 152–155).—A survey of the requirements of heat-insulation for high-temperature work, together with a summary of the properties of kieselguhr, asbestos, rock wool, slag wool, magnesia mixtures, aluminium foil, and various more complex proprietary materials.—P. M. C. R. Asbestos for Insulating Purposes. Anon. (Eng. Rev., 1932, 46, (1), 13).— A short account of the sources, properties, and preparation of blue asbestos. —P. M. C. R.

# XVII.-HEAT-TREATMENT

#### (Continued from p. 212.)

Research in Bright-Annealing Brass and Other Metals. Anon. (*Met. Ind.* (*N.Y.*), 1933, 31, 16).—A review of improvements made during the year 1932. —A. R. P.

On the Heat-Treatment of Metal Strip in Continuous Annealing Furnaces. —II. O. Junker (Z. Metallkunde, 1932, 24, 301-302).—See this J., 1932, 50, 694. The influence of different methods of pickling brass strip and of the rate of passage through the annealing furnace on the course of the heating curve of the strip is graphically shown. The influence of heat-treatment on the quality of metal strip is discussed with reference to the annealing conditions in the continuous annealing furnace.—M. H.

**Progress in the Annealing of Wire.** O. S. Haskell (*Wire and Wire Products*, 1933, 8, 37–39).—An electric furnace for batch-type annealing and the method of low uniform bright-annealing of copper wire are described and the various requirements for the equipment are given.—J. H. W.

# XVIII.-WORKING

### (Continued from pp. 212-216.)

The Hot-Extrusion of Hard-Brass "Ms 58" [58: 40-41: 2-1 Copper-Zinc-Lead Alloy]. R. Hinzmann (Z. Metallkunde, 1933, 25, 67-70).—In the rear end of hot-extruded rods the  $(\alpha + \beta)$ -structure is granular owing to the temperature having fallen too far in the last stages of the extrusion. This structure causes cracking on subsequent hot-pressing; its development can be prevented by the use of smaller ingots or by increasing the rate of extrusion. The extrusion temperature should be as high as possible without overheating of the front ends of the extruded rods. The temperature of the material for the subsequent hot-pressing should, however, be as low and the heating period as short as possible.—M. H.

Investigations on the Stress Distribution in the Roll-Gap. E. Siebel and W. Lueg (Mitt. K.-W. Inst. Eisenforschung, 1933, 15, 1-14).—The vertical rolling pressure over the whole breadth and length of the roll gap has been measured by means of a piezo-electric device for copper, aluminium, and iron in various conditions. The results for unrestricted broadening of the metal in the roll confirm those deduced theoretically by E. Siebel (this J., 1929, 42, 648; 1930, 44, 678) and T. von Karman (this J., 1925, 34, 604). The maximum of the rolling pressure, however, is less sharply defined. As the material enters the roll gap the vertical stress  $S_{\sigma}$  rises very rapidly to a mean value about 15% above that of the resistance to flow in the cone-compression test; as it leaves the rollgap, which, owing to the deformation of the rolls, extends a little to the far side of the middle plane of the unloaded rolls,  $S_{\sigma}$  falls rapidly to zero as the metal springs back elastically. The maximum value of  $S_{\sigma}$  occurs slightly beyond the point of closest approach of the rolls and then decreases both in the direction of rolling and also laterally. Compression stress models have been determined for various rolling conditions. The resultant of the vertical rolling pressure lies nearer to the end of the roll gap the greater is the specific reduction in thickness. With the same absolute reduction in thickness the influence of the horizontal component of the force on the specific rolling pressure increases

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with decreasing initial thickness of the metal being rolled. With artificially increased friction between the rolls and the metal  $S_{\sigma}$  and its decrease on both sides of the gap increase markedly. In the longitudinal direction in the metal, compression stresses are produced in the roll gap, whereas on the sides tensile stresses develop; both are increased by increasing the friction. The rolling pressure is reduced in drawing rolls which are not power-driven. In hotrolling tests on rectangular rods the specific rolling pressure rises only a little above the compression resistance when the diameter of the rolls is large. The relative movement of the metal against the roll surface has been estimated; it appears to proceed generally in the direction of the maximum fall in pressure and is, in the region of the roll gap at the edges of the rod, greater in the transverse direction than in the direction of rolling.—J. W.

The Non-Ferrous Rolling Mills. William J. Pettis (*Met. Ind.* (*N.Y.*), 1932, **30**, 13-14).—A brief review of modern rolling-mill practice with special reference to the non-ferrous metal industry.—A. R. P.

Effect of Temperature and Impurities on the Rolling of Zinc. I.—Rolling Tests on Electrolytic and Refined Zinc at Different Temperatures. II.—Effect of Impurities on the Rolling of Zinc. O. Bauer and P. Zunker (*Mitt. Material.*, Sonderheft 21, 1933, 93-102).—See this J., 1932, 50, 701.—J. W.

Structure of Cold-Drawn Tubing. John T. Norton and R. E. Hillier (*Trans. Amer. Inst. Min. Met. Eng.*, 1932, 99, (Inst. Metals Div.), 190–201; discussion, 201–202).—See this J., 1932, 50, 191.—S. G.

Aluminium Cases and Boxes. J. Bally (*Rev. Aluminium*, 1032, 9, 1941– 1947).—The manufacture of aluminium cases and boxes by stamping and pressing and the methods of finishing these articles are described.—J. H. W.

Workability of High Brass Sheet. M. H. Medwedeff (*Metal Progress*, 1933, **32**, (2), 18–22).—The correct framing of specifications for commercial  $\alpha$ -brasses is of the first importance to the user; for maximum efficiency and cheapness a balance must be arrived at between hardness and ductility. Works methods for rapidly measuring these qualities are discussed; the Erichsen or Olsen ductility tests may be substituted for ordinary tensile testing if the latter is considered too lengthy and cumbrous a method, and, subject to certain definitely formulated limitations, the Rockwell hardness test is recommended. The influence of grain-size is discussed; the addition of a provision for grainsize to the specification is desirable. Typical analyses of commercial brasses are given, and Rockwell figures for "high-brass" sheets of varying degrees of temper and thickness are appended. Certain special brasses are discussed.

-P. M. C. R.

Hot Brass Pressings. J. Willis Beard (Machinery (Lond.), 1932, 41, 249–252).—An illustrated account of a paper to the Scottish Local Section of the Institute of Metals. A general review is given of the use of friction or screw-type and crank-type presses for making hot-pressings. The importance of correctly designing dies so that the metal will flow to the best advantage is emphasized and questions relating to die steels, split dies, provision for air release, and lubrication are briefly discussed. Metals commonly used for pressings include forging quality brass (copper 58–60, lead up to 2%, zine balance), manganese-" bronze" (copper 58, lead up to 1, manganese 1, iron 0.1%, zine balance), Naval "bronze" (copper 61, tin 1%, zine balance), and high-conductivity copper. Nickel-bronze, aluminium-" bronze," silicon-copper, aluminium-zinc, and aluminium-silicon alloys can also be used for pressings.—J. C. C.

Straightening of Alloy Airscrew Blades. H. E. F. (Aircraft Eng. Workshop and Prodn. Section, 1932, 4, (46), 4).—Aluminium alloy blades which have been bent or twisted in minor accidents can usually be straightened. If the deformation is slight, the blades can be straightened by a qualified engineer. If the deformation is considerable, the blades are annealed, re-formed, heat-treated, and finally straightened, but this should be done by the manufacturer. -H. S.

Machine Tools for Light Metals. Ph. Kelle (Z. Metallkunde, 1931, 23, 309-313; and (summary) Metallurgist (Suppt. to Engineer), 1932, 8, 46-47).—The nature and operation of tools for the working of light metals are explained. The tungsten carbide tools have proved most suitable for drilling light alloys containing silicon (Silumin, Alusil); for the other aluminium alloys high-speed tool steels are sufficient. In connection with the description of certain machine tools, the machining of a light-metal piston by turning the outside, the grooves, and the convex face is discussed.—M. H.

Diamond Tools in the Machining of Metals. A. Meyer (Werkzeug (Suppt. to Maschinenkonstrukteur), 1932, 8, (17/18), 101-103).—M. reviews the construction, application, and performance of diamond tools, which, he considers, should be used to supplement those of Widia (see F. K. Böck, Maschinenkonstrukteur, 1931, 64, 220; J., this volume, p. 52). Light alloys, bearing metals, copper, brass, synthetic products, hard rubber, and paper, and commutator materials containing mica are easily cut by diamond tools, which show no signs of wear after an output of more than 100 times that given by other high-grade tool materials. For iron and steel the performance of diamond does not justify its adoption, but the Widia or Stellite tools preferable here are improved by finishing with diamond dust of suitably selected grain-size. Suitable forms, cutting angles and speeds, for diamond tools are quoted from results obtained in use.—P. M. C. R. Diamond-Hard High-Speed Cutting Alloy [Ardoloy]. Anon. (Mech. World,

Diamond-Hard High-Speed Cutting Alloy [Ardoloy]. Anon. (Mech. World, 1932, 92, 277).—Ardoloy is a high-speed cutting alloy made from British materials. Examples are given of the cutting speeds possible with this alloy, including the following: copper, aluminium, and soft brass as fast as the machine will allow; cupro-nickel 350-500 ft./minute; hard brass, phosphorbronze, manganese-brass, gun-metal, Admiralty bronze, &c., 750-1250 ft./ minute; aluminium alloys 300-750 ft./minute.—F. J.

Armstrong Armide Cutting Tools. Anon. (Automotive Ind., 1932, 67, 499).—Armide, a carbide cutting alloy, is said to remain cool and securely brazed, although the cutting edge runs red-hot, because of the low thermal conductivity of the material. Since Armide does not alloy with steel or iron, the edge remains smooth and clean, thus obviating grooving.—P. M. C. R.

The Grinding of Tools with Widia Cutting Parts. J. Alberts (Werkzeug (Suppt. to Maschinenkonstrukteur), 1932, 8, (5/6), 32).—Silicon carbide (carborundum) gives the best results in preparing Widia tools, Instructions are given for wet and dry grinding, attention being directed to speed of grinding wheel, pressure, and the avoidance of overheating. The last consideration makes it desirable to avoid dry grinding when possible: for the same reason, automatic grinding may prove unsatisfactory. Semi-automatic and other special methods are briefly described.—P. M. C. R.

## XIX.-CLEANING AND FINISHING

#### (Continued from pp. 216-217.)

Industrial Metal Degreasing. Anon. (Met. Ind. (N.Y.), 1932, 30, 473-474).—Liquid-phase and vapour-phase degreasing with organic grease solvents are briefly described and a modern type of vapour degreasing plant is illustrated.—A. R. P.

Additions to Pickling Baths and Disposal of Waste Liquors in Metal Pickling. — Freitag (*Oberflächentechnik*, 1932, 9, 99–100).—The function of inhibitors in pickling baths is briefly discussed and hints regarding the recovery of valuable materials from waste liquors are given. Spent pickles from copper and brass works should be treated with scrap iron to recover the dissolved copper, which may amount to 7-10%; as the acid used in pickling may contain arsenic, the vats used in recovering the copper should be well ventilated to remove the highly dangerous arsine evolved with the hydrogen.—A. R. P.

Electrolytic Production of Protective Oxide Films on Aluminium and Its Alloys Especially for Subsequent Colouring. Georg Buchner (Oberflächentechnik, 1932, 9, 127-128).—The production and colouring of these films are briefly outlined.—A. R. P.

The Alumilite Process. Anon. (Machinery (N.Y.), 1932, 39, 217).—The Alumilite process is an electrolytic process for applying a plain or coloured coating to aluminium and its alloys. It is worked at 200° F. (93° C.). Cf., J., this volume, p. 245.—J. C. C.

Colouring of Cadmium-Plated Articles. H. Krause (Z. V. d. Kupferschmied., 1932, 44, 192–196).—Recipes are given. See also this J., 1932, 53, 192, 504.

-M. H.

Researches on Potassium Permanganate-Copper Sulphate Pickles [for Colouring Copper Alloys]. H. Krause (*Mitt. Forschungsinst. Edelmetalle*, 1932, 6, 64-67).—Cf. this J., 1932, 50, 706. Substitution of 10% of the copper sulphate content of permanganate-copper sulphate pickles for colouring copper and its alloys by an equal amount of copper nitrate gives a deeper brown colour on copper and a brown colour free from greenish tint on brass; larger proportions of copper nitrate increase the depth of colour and rate of formation, but reduce the adherence of the film, whilst copper chloride additions produce totally unsatisfactory results. Substitution of part of the copper sulphate by nickel, zinc, or cadmium sulphates yields paler films with a slight greenish tint. Addition of iron salts invariably results in poorly adherent films of unsightly colour. Potassium chlorate additions produce brighter, more yellowish, or reddish films.—A. R. P.

Colouring of Copper and Iron in Fused Salts. H. Krause (*Mitt. Forschungsinst. Edelmetalle*, 1932, **6**, 74-81).—The colours produced under various conditions of time and temperature on iron, copper, copper-plated iron, and Tombak in fused nitrate, hydroxide, nitrate-hydroxide, nitrite, nitritenitrate, nitrite-hydroxide, nitrate-nitrite-hydroxide, nitrate-permanganate, and nitrite-permanganate baths, are tabulated.—A. R. P.

Patina. Carl Rancke (*Oberflächentechnik*, 1932, 9, 111-113).—The composition of numerous solutions used to produce various coloured surface films on copper or copper-plated metals is given.—A. R. P.

Investigations on Brass Colouring by Pickling [in Sodium Lead Thiosulphate Solution]. Georg Gross (Metallwaren-Ind. u. Galvano-Tech., 1932, 30, 455-456).—By pickling 63: 37 brass in a solution containing 124 grm. of sodium thiosulphate crystals and 38 grm. of lead acetate crystals per litre various coloured patinas can be obtained, varying from pink through golden-brown to different shades of blue and grey, according to the time and temperature of immersion and the pre-treatment of the surface. By addition of tartrates the bath can be operated at room temperature, at which it is much more stable; a deep steel-blue tone can be obtained in 12 minutes.—A. R. P.

Polishing vs. Plating Standards. Ernest Lamoureux (Met. Ind. (N.Y.), 1932, 30, 153-154).—Polishing is considered to be the weak spot of the plating industry; methods for improving it are briefly discussed. Most of the polishing, it is considered, should be done on the base metal before plating, so that only the minimum of buffing is subsequently required to produce a bright plate.—A. R. P.

Mass Production Polishing of Aluminium Ware. Anon. (*Giesserei*, 1932, 19, 169).—The articles are first pickled in dilute caustic soda solution, then rotated in an iron drum with steel balls and a polishing mixture consisting of 6 parts of pumice, 4 parts of vaseline, 1 part of montan wax, 2 parts of rouge, and 10 parts of Vienna chalk.—A. R. P.

Polishing Operations for Aluminium Ware. E. A. France, Jr. (Abrasive Ind., 1932, 13, (11), 16-17; Ceram. Abs., 1933, 12, 1).—In the plant of the Aluminium Cooking Utensil Co. (U.S.A.), aluminium cooking utensils are produced in large quantities. The grinding and polishing operations are interesting.—S. G.

Modern Polishing Methods in Cleaning Ornamental Castings. Anon. (Abrasive Ind., 1932, 13, (2), 32-33; Ceram. Abs., 1932, 11, 220).—Modern ornamental cast metal is superior to that formerly made. This article illustrates and describes briefly some abrasive operations followed in cleaning and finishing aluminium and Monel metal castings.—S. G.

Fine Finishing of Metal Surfaces. Friedrich Huth (*Emailletech. Monats-Blätter*, 1932, 8, (10), 75–76; *Ceram. Abs.*, 1933, 12, 1).—A brief discussion of the materials used in producing different types of finishes on metal surfaces indicates that the polishing media include silica sand, chalk, iron oxide, chrome oxide, and tripoli. The separation of these materials according to the different grain-sizes for different steps in the polishing process, the relative merits of each as a polishing medium for different types of metals, and the preparation thereof for most efficient polishing are discussed.—S. G.

Shape of Abrasive Grains. Henry R. Power (Metal Cleaning and Finishing, 1932, 4, 563-564; Ceram. Abs., 1933, 12, 1).—In order to test the uniformity of shape and size of abrasive grains so as to meet specifications, an apparent density or shape test was developed. This is carried out by bumping or jolting a known weight of each variety in a vessel and then measuring the volume occupied by each. The grain that "packs" best and is of apparent high density is that which is most uniformly shaped. The equipment used is briefly described.—S. G.

Matching Abrasive Grain Samples. Torrey Allen (Metal Cleaning and Finishing, 1932, 4, 105–106; Ceram. Abs., 1932, 11, 285).—The reasons for differences in gradings of abrasives are discussed.—S. G.

# XX.-JOINING

#### (Continued from pp. 217-219.)

**Treatment of Duralumin Rivets with Solid Carbon Dioxide.** K. L. Meissner (Z. Metallkunde, 1932, 24, 310-311).—Age-hardening of quenched rivets can be almost completely suppressed by storage in solid carbon dioxide (so called "dry ice"), so that they are in a forgeable condition for a longer period. It is stated that quenched Duralumin rivets can be satisfactorily hammered after 4 hrs.' and even after 8 hrs.' ageing at room-temperature. This time is considerably longer than that generally in use in the U.S.A. (0.3-1 hr.).—M. H.

Brazing and Welding Technique. D. J. Thomas (Mech. World, 1932, 92, 285-287).—Blowpipe brazing, dip-brazing, the Hyde process of welding or soldering, electric, and oxy-acetylene welding, and burning-on are discussed. The technical details and limitations of each process are described, joints in both ferrous and non-ferrous materials being considered. Dip-brazing appears to give better and more reliable results than blowpipe brazing, and electric welding has a less harmful effect on the metal adjacent to the weld than oxy-acetylene welding.—F. J.

Brazing Alloy. Anon. (Chem. and Met. Eng., 1932, 39, 628).—Quick penetration, self-fluxing characteristics and a low melting point of 1300° F. (704° C.) are important features of a new brazing alloy containing silver, copper, and phosphorus, under the trade name of "Sil-Fos." It is used for producing joints in copper, brass, and bronze, and gives an average tensile strength of 33,000 lb./in.<sup>2</sup> (14.7 tons) in copper to copper joints.—F. J.

Small Blowpipe. Anon. (Mech. World, 1932, 92, 395).—A small blowpipe, for use on any ordinary gas supply, suitable for soft and hard soldering, light

brazing, &c., is illustrated. It can be worked by mouth-blowing, or, if long, continuous blowing is required, by connecting a football bladder to the air supply by means of a tee-piece.—F. J. Aluminium Solder [N.U.E.]. Anon. (Machinery (Lond.), 1932, 40, 540).—

An aluminium solder is marketed under the name N.U.E.-J. C. C.

Aluminium Solder [Sterlinite]. Anon. (Machinery (Lond.), 1932, 41, 354).---Sterlinite melts at 250° C., needs no flux, and is applied by contact with the previously heated metal.-J. C. C.

Facts about Soft Solder. George O. Hiers (Dutch Boy Quarterly, 1932, 10, (1), 6-8).-Cf. this J., 1932, 50, 111. Discusses the composition and properties of lead-tin solders, the technique of soldering, and the use of fluxes.—E. H.

Cadmium Soldering. G. Montelucci (Aerotecnica, 1932, 12, 291-313) .--Recalls the use of some lead-cadmium solders during the war and some recent researches, especially those by Deeley on cadmium-zinc solders, which are 6 times more resistant to slow stresses than tin-lead alloy. Tests are described on the suitability of the cadmium-zinc eutectic as a substitute for the usual solders. The shear strength is about twice that of the lead-tin alloys; another advantage is in the soldering of iron or copper in the corrosion-resistance of the soldered joint. The use of the zinc-cadmium eutectic as a substitute for brazing, is also anticipated.-G. G.

Applying Solder with Air Under Pressure. Anon. (Compressed Air Mag., 1932, 37, 3989).—Solder finds increasing application in automobile work since the introduction of the all-steel body, especially in the filling of dents. A spraying apparatus is described for the mechanical application of solder, the use of which is claimed to obviate warping, damage to paint, and waste of metal, gas, and time .--- P. M. C. R.

Economy in Soldering. E. E. H. (Machinery (Lond.), 1932, 40, 362-363; correspondence 434).-Figures are quoted to show how the composition of solder wire and the size and form of its cross-section (whether round or rectangular) can affect the quantity of solder used and the time taken in carrying out a particular soldering operation.-J. C. C.

Temperature of Wiping Solder is Most Important. G. P. Dillon (Telephone Eng., 1933, 37, (1), 17-18) .- Antimony is sometimes added to solder to produce a bright appearance, but it causes loss of strength and brittleness. Traces of zine render solder worthless, as does more than 0.08% of copper. Sulphur, bismuth, mercury, cadmium, arsenic, and phosphorus are possible and undesirable impurities. Old scrap solder is usually unsatisfactory, but if it must be used it may be improved by the following treatment : the metal is heated to 800° F. (427° C.), sulphur and resin are added, and after being well stirred, the metal is skimmed; tallow is added to liberate most of the remaining sulphur, and the required degree of fineness is produced by adding the necessary quantity of tin.-H. F. G.

Soldering and Its Importance to the [Telephone] Industry. Roy Blain (Telephone Eng., 1930, 34, (5), 17-18) .- Practical notes are given. Resin, without other admixture, is considered the only suitable flux for small electrical connections. Solder made from scrap metals is most objectionable, as traces of antimony, zinc, and/or aluminium, which are frequently present, prevent a good electrical joint being made, and may give rise to corrosion.

-H. F. G.

Acid Core Solder Used in Telephone Work. B. C. Burden (Telephone Eng., 1932, 36, (10), 13-14).-Acid core solder is recommended for use on galvanized, copper, and bronze wire, but acid remaining on the wire should be neutralized with soda.-H. F. G.

Copper to Iron Connections Must Be Soldered. Anon. (Telephone Eng., 1931, 35, (3), 30).—A brief note on telephone cable connections.—H. F. G.

## XXI,-INDUSTRIAL USES AND APPLICATIONS

### (Continued from pp. 168-172.)

British Standard Specification for Wrought Light Aluminium Alloy Bars for General Engineering Purposes. —— (Brit. Stand. Inst., No. 477, 1933, 1-13).—This specification covers the alloy known as Duralumin and is for alloys of sp. gr. not greater than 2.85. The aluminium used is to be in accordance with British Standard Specifications Nos. 359 (98%) or 360 (99% aluminium), the copper is to be electrolytic, with only scrap of maker's own manufacture. The chemical composition specified is : copper 3.5-4.5, manganese 0.4-0.7, magnesium 0.4-0.7%, with aluminium the remainder and iron, as impurity, not more than 0.75%. The bars may be extruded, rolled, or forged as required. The minimum specified tensile strength (tons/in.<sup>2</sup>), proof stress (0.15% permanent extension), elongation, and reduction of area respectively are : for bars up to  $2\frac{8}{5}$  in. diameter 25, 15, 15, 20; for bars above  $2\frac{8}{5}$  in. to 4 in. in diameter 22, 12, 15, 20; and for bars above 4 in. to 6 in. 20, 10, 15, 20. Tables are appended showing permitted margins of manufacture in dimensions and notes on the heat-treatment of the alloys are given.—R. G.

British Standard Specification for Wrought "Y"-Alloy Bars for General Engineering Purposes. — (Brit. Stand. Inst., No. 478, 1933, 1–13).—The aluminium used is to be in accordance with British Standard Specifications No. 359 or 360, and the copper electrolytic with only maker's scrap. The alloy is required to contain: copper  $3\cdot5-4\cdot5$ , nickel  $1\cdot8-2\cdot3$ , magnesium  $1\cdot2-1\cdot7\%$ , with aluminium the remainder and maximum impurities iron  $0\cdot5$ and silicon  $0\cdot6\%$ . The bars may be extruded, rolled, or forged as required. The minimum specified tensile strength (tons/in.<sup>2</sup>), proof stress ( $0\cdot15\%$  permanent extension), elongation and reduction of area respectively are: for bars up to  $2\frac{5}{2}$  in. diameter 23.5, 14, 15, 25; for bars above  $2\frac{5}{2}$  in. to 4 in. diameter 21.5, 11, 15, 25; and for bars above 4 in. to 6 in. diameter 18, 10, 15, 25. Other clauses deal with freedom from defects, test samples, and re-tests. Tables are appended showing permitted margins of manufacture in dimensions, and notes on the melting preparation of the alloy and its heat-treatment are added.—R. G.

S.A.E. Specifications for Sheet Duralumin (Alloy No. 26). Anon. (Machinery (N.Y.), 1932, 39, (Data Sheet 238), 200A).—Specifies physical properties and thickness tolerances for aluminium alloy S.A.E. No. 26, commonly known as "Dural" or "17S."—J. C. C.

Report of Committee B-7 [of A.S.T.M.] on Light Metals and Alloys, Cast and Wrought. J. B. Johnson and J. A. Gann (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (I), 292-293).—See this J., 1932, 50, 495.—S. G.

Removal of Beer Scale from Aluminium, V2A Steel and Other Metals. A. Freymann (Schw. Brau.-Runds., 1933, 44, 13; J. Inst. Brewing, 1933, 39, 128).—Tests have been made with "TST" for the removal of beer scale from the surface of aluminium and other metals. This preparation, which is obtained in the form of a paste, is an acid derivative of benzol, contains no nitrie acid, and is non-poisonous. It does not require an asbestos brush for its application, as does nitrie acid, which it replaces. In addition, no gas is evolved, and the danger from nitrous fumes, which is present with the use of nitric acid, is avoided. V2A steel, iron, and pitch are not attacked, whilst its effect on aluminium, copper, and brass is exceedingly slight. An aluminium surface coated with "TST" for 24 hrs. lost 0.018 grm. of metal per 100 cm.<sup>2</sup>, compared with 0.0617 and 0.2823 grm., respectively, with 15% and 8% solutions of nitric acid. If the coating is allowed to remain for 2–3 hrs., only one application is usually necessary, but even in stubborn cases where the scale is relatively thick, a period of 24 hrs. is more than sufficient.—S. G.

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\*Russ, E. Fr. Die Elektrische Warmbehandlung in der Industrie. Mcd. 8vo. Pp. v + 259, with 239 illustrations. 1933. München und Berlin: R. Oldenbourg. (Geb., M. 14.)
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\*Tiemann, Hugh P. Iron and Steel (A Pocket Encyclopædia), Including Allied Industries and Sciences. With an Introduction by Henry Marion Howe. Third edition. Pp. xvii + 590. New York: McGraw-Hill Book Co., Inc. (S4.00); London: McGraw-Hill Publishing Co., Ltd. (24s. net.)

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\*Vogel, Friedrich. Neuere Wege in der Metallurgie der Lager und Weissmetalle. Med. 8vo. Pp. iv + 97, with 8 illustrations. 1933. Halle (Saale): Wilhelm Knapp. (Br., R.M. 7.50; geb., R.M. 8.80.)

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# XXIV.-BOOK REVIEWS

(Continued from pp. 223-224.)

The Alloys of Iron and Molybdenum. By J. L. Gregg. (Alloys of Iron Research, Monograph Series.) Med. 8vo. Pp. xii + 507, with 154 illustrations. 1932. New York: McGraw-Hill Book Co., Inc. (\$6.00.) London: McGraw-Hill Publishing Co., Ltd. (36s. net.)

The task of collecting data with reference to alloys of iron and molybdenum, distributed as it is so widely through the literature of the world, is indeed a formidable one. In the first place, excepting for the pure iron-molybdenum alloys, very little systematic work would appear to have been carried out. Much of the data obtainable is rather in the nature of various tests conducted for industrial purposes. The author of this book is heartly to be congratulated on the excellent manner in which he has collected together data on this subject.

The book is well arranged into separate chapters, beginning with a general survey of the work, processes of extraction, and other introductory paragraphs. Following on this is an exhaustive treatment of the iron-molybdenum alloys, molybdenum steels of every type, and molybdenum cast-irons. There does not appear to be any feature missed. At the end of each chapter the author gives a summary of that chapter, and one cannot help but remark on the impartial attitude he adopts. These summaries do, however, give one the impression of a certain paucity in the data referring to molybdenum alloys, and also that certain investigations carried out on them require considerable revision and experimental re-determination. One excellent feature of the book consists of tables of mechanical tests, which, when possible, are augmented by graphs. Other properties, such as machinability, electrical resistance, magnetic properties, are amply dealt with; in fact, very little appears to have been missed.

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Although a book of this nature is essentially a reference book, it is eminently suited for students and those who wish to specialize in alloy steels. It is excellently written, and the printing and paper are good. Photomicrographs are given of the iron-molybdenum alloys and molybdenum cast-irons, but photographs of molybdenum steels, with the exception of highspeed steels, are not given so fully as is perhaps desirable. This may be because molybdenum steels in the correctly treated condition are composed largely of fine sorbite, and a mention of this in the text is perhaps all that is necessary.

After reading the book one's interest in molybdenum steels is certainly increased, and the metallurgical reader should be inspired to carry out further research on the effect of this valuable alloying element. The book is published under the auspices of the Iron Alloys Committee of the Engineering Foundation, and it is hoped that further publications by this Committee of an equally high standard will rapidly follow.—J. H. ANDREW.

Practical Microscopical Metallography. By Richard Henry Greaves and Harold Wrighton. Second edition, revised and enlarged. Med. 8vo. Pp. xi + 256, with 311 illustrations. 1933. London: Chapman and Hall, Ltd. (18s. net.)

The first edition of this book, which appeared in 1924, was a notable contribution to the literature of the subject, and the second, revised and enlarged edition, which is now published, is a very welcome sequel. An idea of the enlargement of this edition is given not only by the increase in the number of pages, now 256, but also by the greater number of photomicrographs and illustrations in the text; this edition contains 311 figures, of which 260 are photomicrographs.

A new chapter on "Low Power Photomicrography and Macrography," and new sections on the macrographic examination of steel and of copper alloys are valuable additions. Other sections, such as those dealing with photomicrographic technique, the structure and constitution of alloys, alloy steels, aluminium alloys, &c., have been considerably expanded.

Dr. Greaves' and Mr. Wrighton's book is so admirably written and produced, and the extensive collection of photographs of micro- and macro-structures of ferrous and non-ferrous metals and alloys is so excellent, that there is little to criticize. Attention may, however, be directed to Fig. 308, which is given as the structure of "copper-tin-antimony bearing metal containing 3.5 per cent. copper, 3.5 per cent. antimony, and the remainder tin." The structure shown is scarcely typical of this tin-base bearing metal, which should have no cubic crystals of SbSn. Perhaps the 3.5 per cent. antimony is a misprint for 8.5 per cent.—O. F. HUDSON.

Einführung in die Metallographie. Von Paul Goerens. Med. 8vo. Sechste Auflage. Pp. xvi + 392, with 485 illustrations. 1932. Halle (Saale): Wilhelm Knapp. (Geh., R.M. 15.50; geb., R.M. 17.)

In this, the sixth edition, of this well-known work it has been found necessary to introduce a few important alterations in order to bring it into line with modern developments both in theoretical and in practical directions. A new chapter has been written embodying the principles of X-rays and their applications to the examination of metals and alloys. The discussion on the use of ternary diagrams has been developed, and other equilibrium diagrams have been amended in order to bring them up to date so that they embrace the results of the more important recent investigations. In the section devoted to practical considerations diagrams of apparatus designed and employed during the last few years have supplanted those of more ancient date. Emphasis may be again hid on the clarity of the text, the illustrations and diagrams. The high standard is maintained throughout.—W. A. C. NEWMAN.

Handbuch der Spritzgusstechnik der Metallegierungen einschliesslich des Warmpressgussverfahrens. Grundlagen des Spritzgussvorganges. Konstruktionsprinzipien der Spritzgussmaschinen und Formen nebst Ausführungsbeispielen. Werkstoffkunde. Werkstattspraxis. Von Leopold Frommer. Med. 8vo. Pp. xvii + 686, with 244 illustrations. 1933. Berlin: Julius Springer. (Geb., R.M. 66.)

This book deals thoroughly with pressure die-casting, a process now of great importance in mass production of metal parts. The author is to be congratulated on presenting the first treatise dealing adequately with this subject and on the practical way in which he has handled it. The book is very well printed and illustrated.

To indicate the scope of the book the main section headings are given, the numbers in brackets indicating the number of pages devoted to each. The flow of metal in the mould (63); mould design and construction (121); casting machines (148); arrangement of mould on machine (53); industrial die-casting machines (73); alloys (151); die-casting practice (48); mathematical calculations (12). Some account is given of the "press-casting" process which has extended practical machine die-casting to brass and other higher-melting-point alloys. In general, the book contains much of interest both to the producer and to the user of die-castings and all metallurgists should welcome it as a source of reference to a branch of practice which, has developed so rapidly in recent years. Gegossene Metalle und Legierungen. Grundlagen der Metallgiessereitechnischen Werkstoffkunde. Von Willi Claus und A. H. F. Goederitz. Herausgegeben im Auftrage des Vereins deutscher Giessereifachleuto. Demy 4to. Pp. xii + 346, with 107 figures and 174 largo tables. 1933. Berlin: M. Krayn Technischer Verlag, G.m.b.H. (Geb., R.M. 68.)

This volume is devoted entirely to the non-ferrous metals and alloys from the point of view of their melting and casting. It assembles a vast amount of information on the subject, and the publishers have presented this in a sumptuous form, perhaps somewhat regardless of the poverty of would-be purchasers in these times of economic stress.

The origin of the book is the interesting collection of diagrams shown at the Düsseldorf Foundry Exhibition in 1929, which many members will have visited during the Institute of Metals meeting. These tables summarized the properties of the materials and the basic principles of the methods used in casting, and many additions have been made to the series for the present publication. The author has, moreover, written a detailed account of the theoretical and practical aspects of metallurgy which are concerned with this branch of the industry. Each section contains a bibliography which shows a wide acquaintance with the German and foreign publications.

Amongst the subjects dealt with are : gases in metals, solidification, structures, shrinkage, segregation, mould materials, and temperature measurements. Whilst copper and its alloys are treated specially fully, as would be expected from the author's well-known investigations, the light metals, nickel, zinc, &c., are not neglected.

As a reference book this volume can be recommended to all who have a sufficient knowledge of German to be able to utilize it.

The Mechanics of Deformable Bodies. By Max Planck. Being Volume II of "Introduction to Theoretical Physics." Translated by Henry L. Brose. Med. 8vo. Pp. 234, with 12 illustrations. 1932. London: Macmillan & Co. (10s. 6d. net.)

It is, to say the least, refreshing to come across a book dealing with what, for want of a better name, is customarily called classical mechanics, written by the one who, more than any other, has brought down the edifice of classical physics in ruins about our cars. The din still persists, but is perhaps a little less pronounced than in the 1920's. One thing is certain. Anyone with an easily attained minimum knowledge of mathematics can understand and appreciate the magnificent generalizations of classical mechanics; the methods and results of quantum mechanics are for the elect only, and I very much doubt whether even the elect are always aware of the speciousness of their methods and conclusions. The foundations of classical mechanics are on solid rock; quantum mechanics is built-some would say jerry-bullt-on literally shifting sand. Well here are the foundations of classical theory set out in condensed form. The subjects discussed comprise the general laws of motion of a continuously extended body, in-finitely small deformations, and finite deformations. Do I hear you say " Not much there for the metallurgist "? You are mistaken. Apart from the fact that the metallurgist, in the large-scale working of his metals and alloys, is concerned essentially with what Professor Planck and the theorists would call finite deformations (but which the practical man calls rolling, hammering, &c.), it will, I am sure, surprise him to find crystal symmetry treated in a book such as this (pp. 61-66). What can I say of the book as a whole ? To compliment Professor Planck would be but to imitate the public schoolboy who commenced his Greek paper with the remark "Homer is to be congratulated upon his Iliad." Let me, however, congratulate Professor Brose upon his translation, and the publishers upon turning out a well printed book at a very reasonable price. I commend it especially to honours students of physics and mathematics. -J. S. G. THOMAS.

Englisch-Deutsches und Deutsch-Englisches Wörterbuch der Chemie. Von Willy H. Thurow. Teil II.—Deutsch-Englisch. Cr. 8vo. Pp. x + 287.
1932. Berlin-Schöneberg : Arthur Tetzlaff. (Lw., R.M. 14.)

This is a handy little pocket dictionary designed primarily for chemists, but it is not nearly so complete, nor does it include such a wide varlety of terms relating to subjects on the borderline of chemistry, as the well-known dictionary of A. M. Patterson. Metallurgical terms, especially those relating to metallography and the testing of metals, are relatively few, but practically all branches of pure chemistry are well represented. Like many other Oerman-English dictionaries, published in Germany, it contains a number of rather quaint English words and some errors of spelling, but these should detract only slightly from its usefulness to the English reader of a German book. The type is clear, the printing and paper are good, and the arrangement of dictionary is excellent for ready reference.--A. R. POWELL.



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