METALLURGICAL ABSTRACTS

I.—PROPERTIES OF METALS

Concerning the Reflective Power of Metals in Thin Layers for the Infra-Red [Antimony Mirrors]. R. Bowling Barnes and M. Czerny (*Phys. Rev.*, 1931, [ii], **38**, 338–345).—Antimony mirrors were prepared by distilling antimony on to glass in a high vacuum. The visible changes in the film of antimony are described, and suggest that 3 modifications can exist. Transformations from one form to another are accompanied by the appearance and growth of spots. An equation is deduced giving the reflecting power of a thin plane parallel plate of an absorbing substance as a function of the thickness. Experiments on the reflective power of antimony and silver mirrors were carried out. For use in the visible spectrum the layer of silver must be at least 6 times as thick as that of a silver mirror for infra-red use. With antimony, however, which is a much poorer electrical conductor, the thickness plays an opposite rôle, and for use in the infra-red the antimony layer must be at least 3 times as thick as that suitable for visible light.—W. H.-R.

Researches on Beryllium. Heinz Borchers (*Metallwirtschaft*, 1931, **10**, 863–866).—Abstract from a dissertation, Aachen, 1930. The influence of the conditions of melting on the absorption of impurities in beryllium has been investigated. Beryllium can be melted in a vacuum, or in argon or hydrogen carefully freed from oxygen; the presence of carbon or gaseous hydrocarbons results in the formation of beryllium carbide. Magnesia, silica, and alumina are reduced by beryllium, so that beryllia or beryllia-lined magnesia crucibles must be used. The melting point of pure beryllium (99·7%) is 1285° C.; the metal begins to vaporize in appreciable quantities only above 1500° C., and, as both the oxide and nitride also begin to sublime at this temperature, sublimation does not provide a means of removing these impurities, although iron is readily removed in this manner. Carbon can be removed by maintaining the molten metal for some time at 1400° C. to allow the heavy carbide to settle to the bottom.—v. G.

The New Light Metal Beryllium and its High Value Alloys. Anon. (*Apparatebau*, 1931, **43**, 230–231).—The properties of beryllium and its alloys with copper are briefly discussed.—M. H.

The Hall Effect in Induced Currents in Circular Discs of Bismuth and Antimony. Carl A. Beck (*Phys. Rev.*, 1932, [ii], **39**, 185).—Abstract of a paper read before the American Physical Society. Corbino (*Physikal. Z.*, 1911, **22**, 561) found this induced effect in bismuth. According to his theory, the quantity of electricity that flows radially is $-(1/8\pi R)c_H SH^2$, where R is the resistance of the galvanometer circuit, and c corresponds with the final field, H. Thus the equivalent change of flux in this circuit is $N = (-c_H SH^2)/8\pi$. On the other hand, K. K. Smith deduced the formula, $N = -S/4\pi \int^H c H dH$. These expressions agree only if the coeff. c is independent of H. Experiments on bismuth show that the value of the coeff. in the first formula is always greater than that derived from the second, for the coeff. decreases as the field increases, and the value calculated from the first formula corresponds not with the final field but rather with a weaker field. By using rectangular plates cut from the circular discs, it is found, with steady currents and steady magnetic fields, that the ratio of Hall coeff. to resistivity agrees more nearly with the coeff. derived from the second formula than with that

from the first. In antimony the induced effect has been found. It is small and opposite in sign to that in bismuth. The coeff. decreases only slightly as the field increases.—S. G.

Thermal Expansion of Electrolytic Chromium. Peter Hidnert [with G. E. Renfro, R. M. Fowler, H. C. Vacher, and E. L. Peffer] (*Phys. Rev.*, 1932, [ii], **39**, 186).—Abstract of a paper read before the American Physical Society. The linear thermal expansion of a 300-mm. tube of electrolytic chromium, prepared at the U.S. Bureau of Standards by *G. E. Renfro*, was investigated between 20° and 500° C. The composition, determined by *R. M. Fowler*, was : chromium, 99·3 ; silicon 0·002 ; iron 0·002% ; manganese, lead, and copper not detected. Chromium produced in the Bureau under similar conditions was found by *H. C. Vacher* to contain about 0·1% of hydrogen. Further tests will be required to identify the remaining 0·6% in this material. During the first expansion test the chromium tube contracted considerably on heating to 500° C., due to evolution of hydrogen. After cooling to 20° C., the tube was 1·1% shorter than before heating. The following coeff. of expansion were derived from the observations on heating in the second and third tests :

| Temperature range, °C. | Average coefficients of expansion per ° C. | |
	Test 2.	Test 3.
	$\times 10^{-6}$	$\times 10^{-6}$
20–60	6·2	5·9
20–100	6·8	6·7
20–200	7·5	7·5
20–300	8·1	8·1
20–400	8·5	8·6
20–500	8·6	8·8

E. L. Peffer found that the density of a duplicate tube of electrolytic chromium (before heating) was 6·93 grm./cm.³ at 25° C.—S. G.

The Magnetic Moment of Tetravalent Cobalt. A. Serres (*Compt. rend.*, 1931, **193**, 1327–1328).—The magnetic susceptibility of cobalt in the tetravalent form as it occurs in a magnesium cobaltite of the formula $CoO_2 \cdot MgO$, prepared in the electric furnace, has been determined in the temperature range − 180° to + 550° C. The magnetic susceptibility–temperature curve becomes linear between 233° and 550° C., and the magnetic moment calculated from this part of the curve was found to be $29 \cdot 0 \pm 0 \cdot 1$ magnetons.—J. H. W.

The Magnetization of Single Crystals of Cobalt at High Temperatures. Kôtarô Honda and Hakar Masumoto (*Kinzoku no Kenkyu*, 1931, **8**, (11), 583–594).—[In Japanese.] See abstract from English source, *J.*, this volume, p. 1.—S. G.

Electrical Copper. J. Bradley (*Electrician*, 1931, **106**, 846–847).—The production of high-conductivity copper is briefly described and the effect of various impurities on the resistance of copper is mentioned. In cases where high strength coupled with high conductivity are required, the increase in strength must be produced by cold-work. The average annealing temperature for copper is 500° C., although where the hardness of the original material is more than 80 Brinell temperatures as low as 300° C. may be used. This is an important point to remember when soldering hard-drawn copper, because if the metal is in contact with molten solder for more than 10 minutes a weakening of the copper will occur.—S. V. W.

Supercooling Liquid Copper. J. J. Hopfield (*Phys. Rev.*, 1932, [ii], **39**, 185).—Abstract of a paper read before the American Physical Society. A

striking example of supercooling is provided by liquid copper. No other case is known to H. where this phenomenon is shown by the change in brightness of a body. The apparatus necessary is a glass rod (preferably Pyrex) with a globule of copper fused to it, and a blast lamp using oxygen. The demonstration is as follows : the glass containing the metal is heated until the copper is melted and then removed from the flame. If the copper sphere has a diam. of 2 mm. or more it cools about 40° C. below its melting point, and then flashes bright, remaining so while solidification is taking place. Under suitable conditions this supercooling of copper may furnish a handy reference point in calibrating optical pyrometers. After the initial flash there may be a weak second flash, probably due to copper oxide. The supercooling is greater for small droplets, and the flashing time is shorter. Supercooling in copper does not depend primarily on pressure, for it occurs even at atmospheric pressure. It depends on the purity of copper. Copper alloyed with about 10% of gold or silver does not show it. Under the conditions studied neither gold nor silver shows the effect.—S. G.

A New Method of Obtaining Strain Figures on the Surface of Copper. Y. Kato and N. Hayami (*J. Soc. Mech. Eng. (Japan)*, 1931, **34**, 1416–1423; *C. Abs.*, 1932, **26**, 402).—[In Japanese.] Strain figures are formed on the surface of strained copper when the latter is kept immersed in a bath of 0·4% sodium hydroxide solution for about 2½ hrs. The present paper deals with the theory and the applications of the strain figures formed under tension, compression, torsion, and shock. (1) Deep black oxide film is formed where little or no strain exists. (2) The rate of the formation of the film becomes slower as the strain is greater. (3) The formation of the film is due to the fact that the surface part of copper subjected to greater strain oxidizes and dissolves in the solution, and this dissolved copper, by further oxidation, precipitates on another part subjected to less strain. (4) Copper subjected to compressive strain behaves in a similar way.—S. G.

Photoelectric Properties of Thin Unbacked Gold Films. Ralph P. Winch (*Phys. Rev.*, 1931, [ii], **38**, 321–324).—Unbacked films of gold 2×10^{-6} cm. thick were prepared by sputtering the metal on to a polished crystal of rock salt, and then dissolving the latter in water. The photoelectric emission from such films was not constant, but showed a rapid increase on exposure to ultra-violet light, and also a shift in the long-wave limit. Solid silver and gold behaved similarly, and the effect is probably due to the removal of gas by the ejected photo-electrons. The final value of the long-wave limit for gold films was 2576 A., in very good agreement with the value 2560 A. found by Morris (*Phys. Rev.*, 1931, [ii], **37**, 1263) for solid gold.—W. H.-R.

Magnesium : Production—Properties—Applications. A. Dumas (*J. Four. élect.*, 1931, **40**, 354, 474–476).—A full account is given of the production and preparation of magnesium and of its reducing, anti-corrosion, and mechanical properties. Its applications largely depend on its use as an addition metal, as a deoxidizer, and on the brilliancy of its combustion. It also has other applications, *e.g.* as hydrofluoric acid containers, in radio valve construction, and in resonator discs in Klaxon horns. Its future lies in the development of ultra-light alloys, which has already begun. See also this *J.*, 1931, **47**, 642.—J. H. W.

On the Effect of Magnetization on the Modulus of Elasticity of Ferromagnetic Rods [Nickel]. E. Giebe and E. Blechschmidt (*Ann. Physik*, 1931, [v], **11**, 905–936).—The modulus of elasticity of nickel can be raised by 1% in the case of the hard-worked metal, and by 10% in the case of the annealed metal by modifying the magnetic state of the nickel.—v. G.

Cold-Working of Platinum Wires and the Fibrous Texture Produced. Gilbert Greenwood (*Z. Krist.*, 1931, **78**, 242–250; *C. Abs.*, 1931, **25**, 5884).— [In English.] Cold-worked platinum wire has a fibrous texture resembling

other face-centred cubic metals, especially aluminium. The (111) direction is parallel to the drawing force. The texture is somewhat conical, and varies with distance from the surface, the interior zones showing greater fibrous development. A determination by Kettmann's method gave a value of $a = 3.912$ A. for platinum.—S. G.

Platinum. Donald McDonald (*Chem. and Ind.*, 1931, **50**, 1031–1041; and (abstract) *Met. Ind. (Lond.)*, 1931, **39**, 508–510, 538–542).—A lecture to the Chemical Engineering Group, discussing the history, occurrence, purification and metallurgy, physical and chemical properties, uses, production, marketing, and price of platinum.—E. S. H.

Zinc and its Alloys. (*U.S. Bureau of Standards, Circ.* No. **395**, 1931, 1–214).—The physical and mechanical properties of zinc are given, summarized from the technical literature, together with results obtained at the U.S. Bureau of Standards. Special consideration has been paid to the effect of structural condition of the metal resulting from impurities and from such factors as mechanical working, recrystallization, &c., on measured physical properties. The corrosion-resistance of zinc, especially as related to its usefulness as a protective coating for steel, is discussed. The various alloy systems are summarized from the point of view of constitution. Particular attention is given to the die-casting alloys and to the properties which determine their usefulness industrially. A rather complete bibliography is included in the form of selected references appended to the various sections in which the different properties are discussed. [*Note*.—This book should be possessed by all interested in zinc and zinc alloys. It is obtainable from the Government Printing Office, Washington, D.C., U.S.A., price 70 cents and postage.]
—S. G.

On the Suitability of Zinc and Zinc Alloys for Chemigraphical Purposes. R. E. Bartuska and E. Zalesinski (*Z. Oberschles. Berg.-u. Hüttenmänn. Vereins*, 1931, **70**, 308–315).—The use of zinc plates in printing is described in some detail and the extent to which zinc fulfils the requirements of a good plate for etching is indicated with reference to numerous papers in the literature. The presence of lead, cadmium, and iron results in the development of various imperfections during etching owing to the formation of local elements and consequent uneven attack of the etching agent; examples of typical defects are illustrated. Rapid cooling of the cast plates results in such a fine distribution of the impurities and fine crystal structure of the zinc that the action of local elements is evenly distributed and no visible irregularities occur in etching. Care must also be taken in melting and casting to avoid inclusion of gas, as this may cause lifting of the enamel during firing prior to etching. Zinc alloys with 0.4% lead, 0.1% cadmium, and 0.025% magnesium are harder than pure zinc and have a finer grain structure; they are therefore suitable for chemigraphical purposes. Casting in open moulds produces a finer grain size on the under side of the plate than on the upper side; closed moulds of suitable dimensions are therefore to be preferred. A homogeneous fibrous structure is obtained by annealing the casting for 10–12 hrs. at 375° C. in an electric furnace, cooling slowly, and rolling warm to 3–4 mm. sheet or by annealing sheet 12 mm. thick at 300° C.—A. R. P.

Supercooling and Formation of Nuclei in Homogeneous Metal Melts [Tin, Lead, Zinc]. (Frln.) Almuth Lange (*Z. Metallkunde*, 1931, **23**, 165–171).— The degree to which molten tin, lead, and zinc can be supercooled has been studied by a special method. The temperature range of supercooling is about 12°–14° C. for the three metals, and the time during which supercooling occurs varies about a mean value for any definite supercooling temperature. The variations are greater the smaller the degree of supercooling. The process is controlled by the laws of probability. Nuclei are formed according to the law of the unimolecular reaction. The variations in the time of formation

of nuclei are governed by a variable factor, the so-called time of retardation, which depends, among other things, on the degree of purity. The number of nuclei is very small within the range of supercooling investigated. On the other hand, the rate of crystallization reaches an appreciable value even near the melting point.—M. H.

Gases in Metals and Alloys. E. G. Deretchey (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (5), 626–637).—[In Russian.] A summary of published information (from foreign sources), on the occlusion of gases in metals, and the conditions governing their control and removal.—M. Z.

Contributions to the Question of Primary Crystallization. II.—Investigations on the Laws of Formation of the Primary Structure. Willi Claus and Robert Hensel (*Giesserei*, 1931, **18**, 437–442, 459–463, 478–482).—Theories of crystallization and supercooling phenomena in metals are reviewed and discussed at some length. Tests on cast metals show that the supercooling theory is untenable. Systematic melting and casting tests have been made on tin of varying degrees of purity to determine the effect of composition of the metal, type, size and temperature of the mould, casting temperature, time of casting, and rate of cooling on the nature of the primary crystallization and the time of solidification. The results show that, under all casting conditions where a fine-grained structure is produced, a well-defined outer zone is formed in which the crystals grow at right angles to the cooling surface; the depth of this zone is a function of the purity of the metal and of the casting conditions, and increases to a certain extent with the time and temperature of superheating. The inner fine-grained zone is indirectly proportional to the transcrystallization zone, and is a function of the same conditions. The grain size is a function of the cooling conditions, and the time of solidification is a function of the casting conditions.—A. R. P.

The Action of Nitric Acid on Metals in the Presence of Hydrazine. A. Kešān (*Acta Univ. Latviensis*, 1931, **2**, Kim. Ser, 145–152; *Chem. Abs.*, 1932, **26**, 402).—[In Lettish, with German summary.] Hydrazine is an effective retarding agent for preventing the oxidation of silver, mercury, copper, arsenic, bismuth, or antimony by nitric acid. The effectiveness of ammonia as a retarding agent is due to the formation of hydrazine.—S. G.

The Determination of the Character of Viscous Extension of Metals at High Temperatures. Georges Ranque and Pierre Henry (*Génie civil*, 1931, **99**, 630–631).—The 3 methods usually followed for studying the creep characteristics of a metal are : (1) at constant temperature, measure the load which decreases functionally with the extension, and plot against time; (2) at constant temperature, measure the time in relation to the extension under a constant load; (3) under constant load, measure as a function of time, the temperature necessary to maintain constant the length of the test-piece. Of these 3 methods (2) is the one usually followed, but R. and H. have developed method (3), and describe the machine set up for this purpose.—W. P. R.

Creep. Anon. (*Engineering*, 1932, **133**, 191).—A leading article in which are discussed certain of the more recent contributions to the subject of the effect of temperature on the properties of metals.—W. P. R.

Creep Properties of Metals. H. J. Tapsell (*Met. Ind. (Lond.)*, 1932, **40**, 128–129).—Abstract of a paper read before the Institution of Structural Engineers. Briefly considers the creep properties of metals and suggests that short-time creep tests are often unreliable and that long-time creep tests should be amplified by creep tests at comparatively high stresses.

—J. H. W.

On the Problem of Fatigue in Metals. W. Kuntze (*Metallwirtschaft*, 1931, **10**, 895–897).—K. considers that the experimental results of Dawidenkow and Schewandin (*Metallwirtschaft*, 1931, **10**, 710–714) confirm his theories of metal fatigue.—v. G.

Influence of Cold-Stretching on the Plasticity [of Metals] at Elevated Temperatures. E. Schmid and G. Wassermann (*Z. Metallkunde*, 1931, **23**, 242–243).—Hard-drawn and recrystallized copper wires (0·15 mm. diam.) were stretched with a constant load at temperatures between 200° and 450° C. and flow curves (elongation-time) were taken. Between 250° and 400° C. the hard-drawn wire shows a considerably larger flow, *e.g.* after 15 minutes at 350° C. the elongation of the hard wire is 5 times that of the soft wire. At 200° C. the soft wire flows slightly more rapidly, and at 450° C. the rate of flow of both wires is nearly equal. At lower temperatures flow is determined only by the crystal plasticity in both cases. With a rise in temperature the crystal recovery of the hard wire becomes increasingly evident and the plasticity produced by atomic interchange (" amorphous plasticity ") reaches and then exceeds the crystal plasticity of the soft wire. At still higher temperatures recrystallization takes place in a very short time and both wires behave similarly on stretching.—M. H.

New Experimental Results on the Plastic Behaviour of Metals. K. Hohenemser (*Z. angew. Math.*, 1931, **11**, 423–425).—Considerations of a theoretical nature on the mathematical conditions which should be obeyed by the process of plastic deformation.—v. G.

The Utility of Elongation Measurements in Practice. Joseph Geiger (*Maschinenbau*, 1931, **10**, 709–710).—It is pointed out that elongation measurements on loaded, finished constructional parts give sufficient information on the distribution of stresses in the material to allow of the selection of correct materials and dimensions for the purpose in view.—v. G.

Ways to Obtain a True Idea of Strength [of Materials]. Ernst Lehr (*Z.V.d.I.*, 1931, **75**, 1473–1478).—The problem is discussed as to how far modern knowledge on the influence of stress distribution (especially that produced by notches and alternating vibrations) and of high temperatures affects the principles of construction.—v. G.

On the Deposition of Sulphide Films on Metals. Ernst Beutel and Artur Kutzelnigg (*Monatsh.*, 1931, **58**, 295–306).—Copper and brass become slowly coated with a sulphide film in boiling sodium thiosulphate solution and with a film of sulphur when made the anode in a cold thiosulphate solution. In complex thiosulphate solutions of heavy metals, gold, platinum, and palladium sulphides may be anodically deposited, and lead, antimony, bismuth, manganese, iron, nickel, and cobalt sulphides cathodically deposited on brass and copper. Silver and cuprous sulphides are deposited from a double thiosulphate solution only when the copper or brass is in contact with a more electropositive metal. Anodically deposited sulphides tend to occlude free sulphur, and cathodically deposited films frequently contain free metal. The iron, nickel, cobalt, and manganese films are a matte black colour, and the lead and antimony films have a lustrous grey colour.—A. R. P.

The Effect of Cold-Working on the Magnetic Susceptibility of Metals. Kôtarô Honda and Yosomatsu Shimizu (*Kinzoku no Kenkyu*, 1931, **8**, (10), 565–582).—[In Japanese.] The effect of cold-working on the magnetic susceptibility of metals has not yet been systematically studied. H. and S. have measured the effect on 10 metals belonging to the cubic system, *e.g.* copper, silver, gold, lead, aluminium, platinum, rhodium, palladium, molybdenum, and barium. The important facts observed are as follow : The relation between the changes in magnetic susceptibility and density is linear; the magnetic susceptibility of diamagnetic metals, *i.e.* copper, silver, gold, lead, &c., decreases in a marked degree by cold-working and that of paramagnetic metals, *i.e.* aluminium, platinum, rhodium, palladium, molybdenum, and barium, also decreases. In the case of copper—a weak diamagnetic metal—its susceptibility changes from diamagnetic to paramagnetic by severe cold-working. These experimental results are satisfactorily explained by Honda's theory of magnetism.—S. G.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 76–82.)

[Contribution] to the Knowledge of the Binary Systems of Aluminium with Cadmium, Lead, and Bismuth. M. Hansen and B. Blumenthal (*Metallwirt-schaft*, 1931, **10**, 925–927).—The systems have been examined by thermal and X-ray analysis. Liquid aluminium dissolves up to 5% cadmium which reduces the melting point by 11° C., but at 550° C. the solubility of cadmium is less than 1%, and decreases with falling temperature. The alloy with 0·4% cadmium hardens on ageing at 150° C. after quenching from above 500° C. The freezing point of aluminium is lowered by 1·5 ± 0·5° C. by lead and by 3·5° ± 0·5° C. by bismuth, so that in each case there is a small solubility in liquid aluminium. Addition of aluminium to lead, cadmium, or bismuth has no effect on the melting point.—v. G.

A New Aluminium Alloy. T. W. Bossert and J. A. Nock, Jr. (*Metals and Alloys*, 1931, **2**, 238–239).—The alloy contains 1% manganese and 1% magnesium and is not susceptible to heat-treatment, but has a corrosion-resistance equal to that of pure aluminium. The following table shows its mechanical properties in various states :

Condition.	Tensile Strength lb./in.²	Yield Point lb./in.²	Elongation on 2 in. %.	Brinell Hardness Number.	Shear Strength lb./in.²
Annealed	26,000	10,500	20	45	16,000
¼-hard	31,500	28,000	5	60	18,000
½-hard	34,500	32,000	5	65	19,500
¾-hard	39,000	34,000	3·5	73	22,000
Hard	43,000	39,000	3	79	23,000

The endurance limit is 14,000 lb./in.² in the annealed state and 15,000 lb./in.² in the hard-worked state. The alloy has found extensive use in the manufacture of side and roof sheets for omnibuses and railway cars and for small parts of such fabricated articles as cameras as well as for underground cable sheaths.—A. R. P.

The Equilibrium Diagram of the Cobalt–Chromium System. Yōnosuke Matsunaga (*Kinzoku no Kenkyu*, 1931, **8**, (10), 549–564).—[In Japanese.] The equilibrium diagram of the system cobalt–chromium has been studied by means of thermal and magnetic analyses, microscopic examination, and dilatation and electrical resistance measurements. In the liquid state cobalt and chromium are completely miscible. In the solid state there exist four phases α, β, γ, and δ ; the α and β phases are solid solutions consisting mainly of cobalt, the former being face-centred cubic and stable at higher temperatures, whilst the latter has a hexagonal lattice and is stable at lower temperatures. The γ phase is a solid solution of an intermetallic compound, and the δ phase a solid solution consisting mainly of chromium and possessing a body-centred cubic lattice. The α and δ phases form a eutectic at 1395° C., 42% chromium. The α and γ phases form a eutectoid at 1275° C., 51% chromium. The β and γ phases form a peritectoid at 918° C., 38% chromium. The solubility limit of the α-phase is 38·5, 38, and 38% chromium at the eutectic, the eutectoid, and the peritectoid temperatures, respectively, whilst that of the β-phase is 38% at the peritectic and room temperatures. The solubility limit of the δ-phase is 49, 49, and 27% cobalt at the eutectic, eutectoid, and room tempera-

tures, respectively. The existing range of the γ-phase is 62, 57–63, and 58–63% chromium at 1306° C., the eutectoid point, and room temperature, respectively. The magnetic transformation point of cobalt is lowered to room temperature at 21% chromium. The hardness and electrical resistance have also been measured at room temperature.—S. G.

Electrical Resistivity of Certain Copper Alloys in the Molten State. C. S. Williams (*Metals and Alloys*, 1931, **2**, 240–241).—A method of determining the resistivity of molten metals by the use of a quartz tube in an induction furnace is described and the apparatus is illustrated, the electrical connections being shown diagrammatically. Figures have been obtained for copper and zinc, for brass with 13 and 19% zinc up to 1200° C., and for bronze with 2 and 4% tin up to 1400° C. The curves for all the alloys tested show a larger melting range than is indicated by thermal analysis. The slope of the resistivity curve for liquid brass is smaller than that for copper when the brass contains 19% zinc, but greater when it contains 13% zinc, whereas the slopes of the curves for the tin alloys are both slightly greater than that of copper.—A. R. P.

Industrial Alloys of Copper. Reginald G. Johnston (*Met. Ind. (Lond.)*, 1932, **40**, 55–57).—The principal properties of the industrial alloys of copper, *i.e.* those alloys in which copper is the chief constituent, are reviewed, and in particular the composition, properties, and applications of arsenical copper, aluminium–copper alloys, and alloys of the brass type. A special development of these last is Al-Dur-Bra, an alloy consisting of copper 76, zinc 22, and aluminium 2%, cast by the Durville process, and of special application as condenser tubes on account of the formation of a " self-healing " film which enables it to compete successfully with cupro-nickel for this purpose.

—J. H. W.

The Hall Effect and other Physical Properties of the Copper–Cadmium Series of Alloys. Wallace Richards and E. J. Evans (*Phil. Mag.*, 1932, [vii], **13**, 201–225).—The electrical resistivities, temperature coeff. of resistance, thermoelectric powers, Hall coeff., specific heats, and densities of the copper–cadmium series of alloys have been measured. Curves giving the relation between the electrical properties and compositions of the alloys show, in general, singular points at compositions corresponding approximately with those of the compounds $CuCd_3$, Cu_2Cd_3, Cu_4Cd_3, and Cu_2Cd. The last, however, is not indicated by the graphs relating composition with (1) Hall effect and (2) temperature coeff. of resistance. The discontinuities observed were much less pronounced in the graphs relating composition to (1) density and (2) specific heat. Variations of electrical properties follow changes of phase of the system. Annealing produced little effect on the electrical resistivity except in the region 36–44% of copper. The comparatively large changes in this region are attributable to separation of the γ phase.—J. S. G. T.

[Contribution] to the Knowledge of the System Copper–Lead and Related Heterogenous Systems. W. Claus (*Z. Metallkunde*, 1931, **23**, 264–265).— See *J.*, this volume, p. 77.—M. H.

Magneto-Resistance and Magneto-Caloric Effects in Iron and Heusler Alloys. H. H. Potter (*Phil. Mag.*, 1932, [vii], **13**, 233–248).—Measurements of the change of electrical resistance and of magnetic energy of iron and Heusler alloy due to the application of an external magnetic field show direct proportionality of the former change to the latter. The proportionality factor differs considerably for different substances.—J. S. G. T.

Chemical Studies of Ancient Chinese Coins.—I. Tsurumatsu Dōno (*Nippon Kwagaku Kwai Shi (J. Chem. Soc. Japan)*, 1930, **51**, 463–472; *C. Abs.*, 1932, **26**, 395).—[In Japanese.] Analyses of 12 ancient Chinese coins from different localities showed copper 46·30–87·56; lead 1·44–41·56; tin 3·37–15·81; iron trace–1·33; nickel trace–0·28; cobalt trace; gold trace; silver trace–0·20%. The coins containing most lead are probably the oldest.—S. G.

A Greek Bronze 2400 Years Old. L. Anastasiadis (*Z. Metallkunde*, 1931, **23**, 282).—An analysis of a small piece of a cooking utensil gave 90·0% copper, 8·58% tin, no lead, no iron. The microstructure showed cored α-solid solution.
—M. H.

Influence of Impurities in Foundry Brasses and Bronzes. H. M. St. John (*Metals and Alloys*, 1931, **2**, 242–245).—The effects of small quantities of aluminium, antimony, arsenic, beryllium, cadmium, chromium, cobalt, iron, magnesium, manganese, nickel, oxygen, phosphorus, silicon, sulphur, hydrogen carbon monoxide, carbon dioxide, nitrogen, and sulphur dioxide on the properties of brass and bronze are summarized with reference to recent articles in the literature.—A. R. P.

Magnetic Properties of Gold–Iron Alloys. J. W. Shih (*Phys. Rev.*, 1931, [ii], **38**, 2051–2055).—The magnetic susceptibilities of annealed gold–iron alloys containing from 0·07 to 10 (weight) % iron have been measured at temperatures from 20° to 800° C. The diamagnetism of gold is destroyed by 0·1% iron, the alloys becoming paramagnetic up to 5% iron, but the 10% iron alloy is ferromagnetic. The paramagnetic susceptibility decreases with temperature, at first rapidly and then more slowly, but the variations do not follow the laws of Curie or Weiss exactly; there is no sudden change in susceptibility at about 790° C. (the Curie point of pure iron). The iron atoms in dilute solid solution in gold lose their ferromagnetic nature, in agreement with the recent quantum interaction theories, according to which the molecular field is due to resonance between the spinning electrons of neighbouring atoms, and this will be impossible if the iron atoms are too widely separated. If χ is the mass susceptibility, an approximately linear relation exists between $\chi^{1/2}$ and the percentage of iron atoms in the alloy.—W. H.-R.

The Alloys of Lanthanum. G. Canneri (*Metallurgia italiana*, 1931, **23**, 803–823; *Chem. Zentr.*, 1931, **102**, II., 3035–3036).—Thermal and micrographic examination has been made of electrolytically prepared alloys of lanthanum with lead, tin, thallium, magnesium, silver, copper, and gold. With lead the following compounds are formed : Pb_2La (1090° C.), PbLa (1246° C.), $PbLa_2$ (1318° C.), as well as eutectics at 962°, 1044°, and 776° C.; alloys with less than 80% lead are pyrophoric, hard, and brittle. With tin, 3 compounds are formed, viz. Sn_2La (1150° C.), Sn_3La_2 (1192° C.), $SnLa_2$ (1425° C.), and eutectics at 219°, 1108°, 1142°, and 716° C.; alloys with up to 82% tin are pyrophoric and hard, maxima in both cases being obtained with La_2Sn. Thallium forms $TlLa_2$ (1260° C.), TlLa (1182° C.), and Tl_2La (1096° C.) and eutectics at 604°, 942°, and 1018° C. Alloys with magnesium are pyrophoric only between 4 and 25% magnesium, are formed with little evolution of heat, and are less sensitive to atmospheric oxidation than any of the preceding alloys; the system contains limited series of solid solutions and the compounds Mg_4La, Mg_3La, MgLa, and $MgLa_4$. MgLa readily takes fire and burns almost explosively. With copper, Cu_4La (902° C.), Cu_2La (834° C.), and eutectics at 851°, 742°, and 468° C. are formed; CuLa appears to form at 581° C. in the solid state. The alloys are yellow with 30% copper, bronze-coloured with 60% copper, and pyrophoric with 12–60% copper. With silver, lanthanum forms Ag_3La (955° C.), Ag_2La (at 864° C. in the solid state), and AgLa (886° C.) with eutectics at 778°, 741°, and 518° C. With gold, the compounds Au_3La (1204° C.), AuLa (1214° C.), $AuLa_2$ (1360° C.), and $AuLa_2$ (at 665° C. in the solid state) are formed with evolution of much heat; eutectics occur at 798°, 1054°, 1148°, and 561° C.—A. R. P.

Effect of the Pouring and Mould Temperatures on the Mechanical Properties of Lead-Bearing Metals. Anon. (*Z. ges. Giesserei-Praxis : Das Metall*, 1931, **52**, 123–124).—Experiments are described, the results of which show that high mould temperatures lower the hardness of lead-bearing metals. For

instance, with a mould temperature of 0° C. the hardness was 91·5, with 100° C., 88·7, and with 200° C., 83·8. The results of a series of experiments carried out by Fermans (Freman ?) on bearing metal containing tin 0–91% are discussed. These experiments show that the addition of 8% thorium to bearing metals containing lead 67·5–81, antimony 20–5, and tin 5% raises the strength of the alloys considerably.—J. H. W.

Magnesium and its Alloys. R. Cazaud (*Aciers spéciaux*, 1931, **6**, 504–513). —(Continued from *Aciers spéciaux*, 1929, **4**, 83, 131. See this *J.*, 1930, **43**, 407.) The composition, microstructure, mechanical properties, and applications of industrial magnesium alloys are given, together with examples of magnesium alloy castings, forgings, and stampings. It is considered that the development of these alloys has only just begun and that it will progress to a very large extent in the near future.—J. H. W.

Magnesium and its Alloys. Anon. (*Amer. Machinist* (*Eur. Edn.*), 1932, **75**, 795–796, 833).—Notes are given of the physical and mechanical properties of magnesium, its principal alloys, strength, casting peculiarities, heat-treatment, forging, milling, tapping, drilling, liability to catch fire, sheet metal working, riveting, welding, surface treatment, and finishing.—J. H. W.

Magnesium and its Alloys (Elektron). B. P. Rolschtchikov (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (3), 355–366).—[In Russian.] A review of the present technical and economic position of the metallurgy of magnesium and a study of its properties and those of its alloys compared with other metals. The activities in this field in Germany, America, and Italy are considered in some detail, from the point of view of research, production, and trade connections. The various physical and mechanical properties and uses of typical magnesium alloys of the Elektron type are critically discussed, and compared with copper and aluminium alloys. A table of the various standard brands of alloys, summarizing their main properties, is given.—M. Z.

The Elektron Group of Magnesium Alloys. Anon. (*Machinery* (*Lond.*), 1930, **35**, 769–772).—A table gives the tensile (6·3–25·3 tons/in.²) and compressive (19–28·6 tons/in.²) strength, endurance bending strength, Brinell hardness (42–90), and elongation (2–18%) of 14 alloys of the Elektron type. The extremely high capacity for energy absorption in relation to elastic deformation is characteristic; the endurance strength as tested under 400 million stress reversals exceeds that of Duralumin by about 3000 lb./in.². The melting point is about 1197° F. (647° C.), but as the conductivity is very high, there is little tendency to " burn," although oxidation is of course rapid. Unlike aluminium, Elektron is not readily attacked by alkaline solutions, whilst the grey oxide film protects it from atmospheric corrosion. The alloys are largely used in the automobile and aero industries, not merely for furniture, &c., but for highly stressed members such as pistons, connecting rods, pulleys, the steering mechanism and rudder parts, wings, and fuselage. Another important field of application is in the textile and machine tool industries; the power required for acceleration and the stresses due to centrifugal forces are reduced, whilst increased accuracy results from relieving the weight on guide ways, tables, and beds. Details are given of uses in certain machines. Replacement of rapidly moving cast-iron components by Elektron in machines such as those used in the manufacture of cigarettes increases production markedly. In a cutting machine in which a swinging cutter carrier was replaced by Elektron the increase of output amounted to 60% as compared with cast iron and 30% as compared with aluminium. The high price of the alloys is compensated by the ease of machining, which is greater than that of all other known metals or alloys : cutting speeds of 4550 ft./minute are practicable, and the power consumption is less than with any other metal. Usually no cooling agent is used. Suitable forms of cutting tool are illustrated. Elektron alloys may be used for sand-, die-, and pressure-casting, but sand or dirt may cause the

formation of silicides, which make the castings brittle. The best pouring temperature is 1328°–1418° F. (720°–770° C.), and the metal must be protected by sulphur from oxidation during pouring. Forging and pressing improve the mechanical properties, and are effected at 608°–752° F. (320°–400° C.). Extrusion may be performed as with brass, but lower speeds and greater pressure are necessary. Rolled sheets are available from 0·012 to 0·4 in. in thickness, and may be softened by annealing at 572° F. (300° C.). Rolling and drawing are best carried out at 518°–662° F. (270°–350° C.); the best drawing speed is 7–17 ft./minute. For deep-drawing Elektron is said to be equivalent to the aluminium alloys. Butt-welding is satisfactory, but other types of weld usually contain occlusions; the oxy-acetylene flame is recommended. Welded seams are of nearly the same strength as the base metal, and by hot-forging the elongation may be raised to 4%. The alloys cannot be soldered or brazed.

—H. F. G.

X-Ray Determination of the Solubility of Manganese in Magnesium. E. Schmid and G. Siebel (*Metallwirtschaft*, 1931, **10**, 923–925).—Precise determinations of the lattice constants of manganese–magnesium alloys after various heat-treatments give the solubility of manganese in magnesium as 0·1 atomic-% at 300° C., 0·2 atomic-% at 490° C., and 3·4 atomic-% at the eutectic temperature (645° C.). At 200° C. the solubility is practically nil.

—v. G.

The Properties of Nickel–Chromium Alloys and their Manufacture. A. M. Korolkov (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (11), 1471–1484).—[In Russian.] The manufacture of alloys possessing a high electrical resistance and strong corrosion-resistant properties during long periods of heating at temperatures of 1000° C., and their suitability for wire and strip, were investigated. A large number of such alloys at present on the market was examined, and those produced by Heraeus Vacuumschmelze were selected as the most suitable to copy. The metals used—nickel, chromium, manganese, and iron—were the purest obtainable, and the crucibles were specially constructed of china clay to withstand the high temperatures (1650° C.) and avoid carburization of the alloys. Both resistance and high-frequency induction furnaces were used for melting, the nickel being introduced first, followed, when melted, by chromium, iron, and finally manganese (as a deoxidizer and desulphurizer, although its presence also raised the electrical resistance). The alloys obtained contained nickel 61·62–84·2, chromium 9·0–22·3, iron 10·2–22·3, and manganese 1·7%, with traces of sulphur, carbon, and silicon. Losses of chromium through burning away were invariably high (15–20%). The microstructures of the following types of alloys : nickel–chromium, nickel–iron, nickel–manganese, iron–chromium, iron–manganese, and nickel–iron–manganese, were examined and found to consist of a continuous series of solid solutions. From all the alloys, strip (by cold-rolling) and wire (with annealing at 950°–1000° C. between two series of passes) could be made satisfactorily. The electrical resistance temperature coeff., and tendency to oxidation at high temperatures render the alloys entirely suitable for use in heating coils—the ternary nickel–chromium–iron alloys being the best. The paper contains numerous tables, diagrams, and illustrations.—M. Z.

Thermal Expansion of Heat-Resisting Alloys : Nickel–Chromium, Iron–Chromium, and Nickel–Chromium–Iron Alloys. Peter Hidnert (*U.S. Bur. Stand. J. Research*, 1931, **7**, 1031–1066; *Research Paper* No. 388).—This paper gives data on the linear thermal expansion of various heat-resisting alloys (nickel–chromium, iron–chromium, and nickel–chromium–iron). The alloys contain nickel 0–77, chromium 5–27, and iron 0–82%. The coeff. of expansion of the alloys were determined for various temperature ranges between 20° and 1000° C., and the effects due to temperature, chemical composition, heat-treatment, &c., were determined. Critical regions were located on the

thermal expansion curves of some of the alloys. For a given temperature range, the coeff. of expansion of nickel–chromium alloys containing from 0 to about 20% chromium are nearly the same. The effects of chromium content, carbon content, heat-treatment, &c., on the coeff. of expansion of iron–chromium alloys for various temperature ranges are indicated in a figure. The results on the thermal expansion of nickel–chromium–iron alloys were correlated with the structure of the alloys. Transformations from one phase to another caused significant changes in thermal expansion. The expansion curves on the first heating of nearly all of the cast nickel–chromium–iron alloys indicate a retardation or decrease in expansion between 700° and 800° C., due to precipitation of carbide. The effects of change of composition on the coeff. of expansion of both cast and annealed nickel–chromium–iron alloys are indicated. A table in the summary gives a comparison of the coeff. of expansion of the three groups of alloys.—S. G.

On the Magnetostriction of Iron–Nickel Alloys. Yosio Masiyama (*Kinzoku no Kenkyu*, 1931, **8**, (12), 649–660).—[In Japanese.] The magnetostriction of iron–nickel alloys in different concentrations was measured for change of (i) volume, (ii) longitudinal length, and (iii) transverse length. In each case an anomalous change occurred in the region of 20–35% nickel, corresponding with a mixture of the α- and γ-solid solutions. The transverse change of length is nearly the reverse of the longitudinal change, and the volume change is the differential effect of these two.—S. G.

Measurements on Magnetostriction Vibrators [Nichrome, " Stainless " Steel, Stoic Metal, Nickel]. John M. Ide (*Proc. Inst. Radio Eng.*, 1931, **19**, 1216–1232; *Rev. Sci. Instruments*, 1931, **2**, 574).—Describes measurements carried out on rods of Nichrome, Monel metal, " stainless " steel, Stoic metal, and nickel, having natural frequencies near 30,000 cycles/second. The dependence of the vibratory characteristics on rod diameter was determined by making measurements on a nickel rod, as its diameter was reduced in steps. The rod was annealed before each set of measurements, by heating to redness and cooling in air. Another nickel rod cut from the same bar was bored axially with concentric holes of successively larger diameter, and measurements were made at each step. This was done in an endeavour to determine something about the flux distributions across the section of the vibrating rod. The effects of annealing and of changing the number of turns on the a.c. coil (in which the rod was supported) were investigated. The effect on the vibratory characteristics of varying the alternating magnetic field on the rod was also measured. Of the materials studied Monel metal is preferable for use in frequency stabilizing circuits. Its chief disadvantage is the necessity for some sort of polarizing arrangement, because its residual magnetism is small.

—S. G.

The Silver Coinage. S. W. Smith (*Ann. Rep. Royal Mint (Lond.)*, 1928, **59**, 47–51).—Report of the Chief Assayer. When the alloying constituent of an alloy containing 50% silver is solely copper, the colour is unsatisfactorily reddish for coinage work. Nickel of itself improves the colour sufficiently, but introduces physical and mechanical difficulties that preclude its use alone with copper. Zinc gives satisfactory results as regards colour and working properties, but, owing to its volatility, does not allow the close tolerances required to be maintained when used in sufficient quantity for this purpose. By combining these two an alloy considered satisfactory on all counts has been evolved. An addition alloy having the composition copper 50, nickel 25, and zinc 25% is made up and added to the required amount of silver to give an alloy having the composition silver 50, copper 40, nickel 5, and zinc 5%. The loss of zinc by volatilization is practically confined to the manufacture of the addition alloy. The use of this quaternary silver alloy involves special precautions to control the composition, and these are discussed.—J. H. W.

Preparation and Some Physical Properties of Strontium–Cadmium Alloys.
Harold C. Hodge [with Ronald Bloamer, Charles Crowell, Robin Dunn, Reiji
Funabiki, Reginald Gianelli, and Theresa Woo] (*Metals and Alloys*, 1931, **2**,
355–357).—Alloys of strontium with cadmium were obtained by electrolysis
of a mixture of fused strontium and sodium chlorides over metallic cadmium
using a carbon anode and 12–14 amp. at 6 v. The maximum strontium con-
tent obtainable in this way is about 25%. A preliminary study of the system
has revealed the presence of the compound $Cd_{12}Sr$ and possibly also of CdSr.
Two eutectics have been found with 0·9 and 13·8% cadmium, respectively.
The microstructures of some typical alloys are shown, together with hardness
and sp. gr. curves.—A. R. P.

Babbitts with a Tin Base and Low Antimony and Copper Contents. A. M.
Botchvar and S. I. Irodov (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931,
6, (9), 1139–1147).—[In Russian.] Examination of the ternary tin–antimony–
copper alloys used in England and U.S.A. as alloys in aviation showed that
they consisted of hard, needle-like crystals of the solid solution of tin and
antimony embedded in the main mass of soft α-solid solutions of tin in anti-
mony, the hard, cubic β-solid solutions of tin in antimony being entirely
absent. The constitution and properties of such alloys, however, are not
given in the literature; they were therefore carefully examined micro-
graphically to determine the conditions governing the absence of the β-solid
solutions, and their hardness (by Shore and Brinell methods) and ageing pro-
perties at different temperatures were determined. The specimen ingots of
the various alloys were both chilled and also slowly cooled, and the composi-
tion was verified by chemical analysis. The presence or absence of the cubical
β-crystals was determined by micrographical examination, the results being
shown photographically and plotted on a triangular phase-rule diagram.
The latter showed that alloys lying to the left of a line joining the tin–anti-
mony and copper–antimony axes and running at about 7–8% antimony
contained no β-crystals, the most suitable alloys having a copper plus antimony
content of 10–11%. Slow cooling resulted in an enormous increase in the
size of the β-crystal grains (see photographs). The suitable alloys are similar
to, although somewhat harder than, the widely used Charpy alloy, and do not
show the phenomenon of ageing. The choice between Charpy's alloy (copper
5–6, antimony 10–12%) and an alloy of the type copper 5, antimony 5%
as most suitable for aviation will require further investigation from the
mechanical point of view. The paper is illustrated with diagrams and figures.
—M. Z.

Predicting the Behaviour of a Babbitt. A. Hoyt Levy (*Power*, 1930, **72**,
720–721).—Of all the materials used in machine construction, less seems to
be known about bearing metals than about any other. Many engineers when
considering the selection of a Babbitt metal attach more importance to Brinell
hardness than to any other of its properties, yet Brinell hardness is of little
value in estimating how a Babbitt will stand up against shock, load, and
speed. The most important factors in determining the suitability of a Babbitt
for a specific purpose are, in order of importance : (*a*) measure of resistance
to pounding, (*b*) pressure, and (*c*) friction. Resistance to pounding and pres-
sure can be determined only by tension and compression tests. The tension
test is a measure of the Babbitt's ability to withstand pull or strain on the
lining under load. The compression test measures its ability to carry the
load without distortion. There need be no more than 5 formulæ to cover
practically every Babbitt requirement, yet the American Society for Testing
Materials recognizes 13, and those do not represent half the number that
manufacturers are asked to make. The methods of determining the working
load of a Babbitt by the compression test, tensile strength, and coeff. of
friction are described.—F. J.

New Zinc Die-Casting Alloy. E. Dorn (*Z. Metallkunde*, 1931, **23**, 292).— A zinc alloy with about 4% aluminium, 3% copper, and 0·1% magnesium produces sound die-castings (pressure castings). Its properties are as follows : density 6·8, melting range 370°–390° C., tensile strength 32–38 kg./mm.², elongation 2–3%, bending strength 70 kg./mm.², compression strength 63 kg./mm.², Brinell hardness (5 mm. ball, 250 kg. load) 100–120 kg./mm.², torsion strength 50 kg./mm.², electrical conductivity 14–15 m. ohm.⁻¹ mm.⁻², coeff. of thermal expansion 0·000030. In contrast with most other zinc die-casting alloys, it does not show appreciable changes in length during exposure to the atmosphere over a period of several years.—M. H.

On the Transformations in Copper–Zinc and Silver–Zinc β Alloys.—I. M. Straumanis and J. Weerts (*Metallwirtschaft*, 1931, **10**, 919–922).—A Röntgen furnace is described in which the test-pieces in the form of thin plates, the backs of which are covered with a salt bath, are heated ; the X-rays are directed on to the clean front sides, from which they are reflected to the photographic plate. In this way the interference lines reflected at 80°–90° are utilized. From photographs taken of aluminium up to 400° C. the coeff. of expansion can be determined in accordance within 2% of that obtained dilatometrically. Examination of the β-phase in the zinc–silver system with this apparatus has shown that above the transformation point at 280° C. the distribution of the silver and zinc atoms in the cubic face-centred lattice is irregular, and that on annealing below 280° C. the β-phase is converted into another phase, ζ, which has a Röntgenograph containing numerous lines and which, according to a private communication from A. Westgren, has a trigonal symmetry. A single crystal of β is converted during this transformation into a large number of regularly oriented crystals of ζ, which are re-converted into the original β-crystal on subsequently annealing at 400° C. The superstructure lines corresponding with a cæsium chloride structure do not occur in the stable state either above or below the transformation point (280° C.); they can be found only in specimens which have been quenched from above 280° C. The cæsium chloride structure is therefore to be attributed to a supercoolable intermediate state through which the alloy passes near the transformation point.—v. G.

Temperature Coefficient of Rigidity of Aircraft Instrument Diaphragm and Spring Materials [Aluminium, Duralumin, Monel Metal, Brass, Phosphor–Bronze, Coin Silver, Nickel–Brass, and Steels]. W. G. Brombacher and E. R. Melton (*U.S. Nat. Advisory Cttee. Aeronautics, Report* No. **358**, 1930; *Rev. Sci. Instruments*, 1930, **1**, 697).—An investigation at the U.S. Bureau of Standards of the temperature coeff. of the moduli of rigidity of a number of metals and alloys which may prove useful for the elastic elements of aircraft and other instruments has been partly completed. The torsion pendulum method was used to determine the modulus of rigidity and its temperature coeff. for aluminium, Duralumin, Monel metal, brass, phosphor–bronze, coin silver, nickel–brass, three high-carbon steels, and three alloy steels. The moduli at room temperatures were in most cases measured also by the deflection method. Experiments with the torsion pendulum were made in the range − 25° to + 50° C., in a thermally insulated chamber which could be cooled by an ammonia refrigeration system, or heated electrically, whilst the air within was circulated by an electric fan. The temperatures indicated by a liquid-in-glass thermometer were observed through a window in the chamber to an estimated accuracy of 1° C. The torsion pendulum consisted of a wire of the material under investigation, held vertically under tension between two chucks, one at the top of the temperature chamber and one near the bottom. The lower chuck was provided with a holder for weights in the form of annular discs, which were used to control both the stress in the wire and the moment of inertia of the pendulum. A fine platinum wire attached to the weight-holder was used to make electrical contact at each half period of oscillation

of the pendulum. These impulses recorded on a chronograph tape made possible the measurement of the period to about 1 part in 1000. The moment of inertia of the lower chuck and weight-holder, which was small in comparison with that of the weights used, was measured experimentally to about 2 parts in 100. The moments of inertia of the weights were calculated from their dimensions and masses. The values of the moduli of rigidity are directly calculable from the measured quantities. The effect of damping due to internal stresses in the wire, to air, and to the electric contact mechanism, and the effect of the change in dimensions of the pendulum with temperature were considered negligibly small. Small changes in the moduli with variation in the stress in the wires are indicated, but the method is not well adapted for measuring such effects quantitatively. The values for the temperature coeffs. of the moduli were obtained by a graphical method of reduction. Effects due to damping were neglected, but correction was made for changes in the dimensions of the pendulum with temperature. The effect of heat-treatment on the temperature coeff. of the modulus was determined for a number of the materials. Chemical analyses of the samples investigated and comparisons with the results of other investigators are included. In many cases the values finally recorded are tentative. The investigation is being continued by another method which it is hoped will yield more reliable data with less time required for the observations.—S. G.

Non-Ferrous Alloy Metals at Elevated Temperatures. C. L. Clark and A. E. White (*Power*, 1930, **72**, 984).—Abstracted from papers by C. and W. read before the American Society of Mechanical Engineers. The results obtained from non-ferrous alloys of the copper–zinc, the copper–zinc–tin, the nickel–copper, and the nickel–cobalt–titanium series are recorded. Many of these alloys find wide use at slightly elevated temperatures in such applications as valve fittings, whilst others are used in tubular form at higher temperatures. This investigation included short-time tensile tests at normal and elevated temperatures, determination of recrystallization temperatures by means of hardness tests, and metallographic examination and long-time creep tests at selected elevated temperatures. In so far as the temperature of recrystallization is concerned, the alloy series arrange themselves in the following order of decreasing temperatures, *viz*. nickel–cobalt–titanium, copper–nickel, and copper–zinc alloys. The short-time tensile tests show the high-nickel alloys to possess the maximum strength over the entire temperature range. The ductility of each of the alloys tends to increase with temperature. Creep tests again show the superiority of high-nickel alloys at all temperatures and to be capable of use at higher temperatures than the copper-base alloys.—F. J.

Contribution to the Problem of Coring. E. Scheuer (*Z. Metallkunde*, 1931, **23**, 237–241, 282).—Formulæ are derived for calculating the concentration of the solid solutions crystallizing from melts during any stage of the crystallization process when no diffusion takes place during solidification. By applying these formulæ to alloy systems with limited solid solubility it is possible to calculate the maximum quantity of solid solution which will separate in the first stage of solidification, and the composition of the metal which crystallizes in the second stage during rapid solidification. The minimum average concentration of the solid solution calculated from these formulæ generally lies far below the concentration at equilibrium. Experiments have shown that aluminium–copper and copper–tin alloys, the compositions of which lie within the α-solid solution range, solidify nearly without diffusion, whereas aluminium–zinc and copper–zinc alloys (α-solid solutions) solidify with appreciable and nearly complete diffusion respectively.—M. H.

Precipitation Hardening and its Possibilities of Application. Erhart Dorgerloh (*Maschinenbau*, 1932, **11**, 5–7).—A short review of the theory and technical importance of ageing phenomena in alloys of iron and non-ferrous metals.—v.G.

III.—CORROSION AND PROTECTION

CORROSION

The Corrosion of Aluminium Alloys. Henry Gibb (*Met. Ind.* (*Lond.*), 1932, **40**, 27–30, 34).—Forty aluminium alloys were subjected to the corroding influence of both the atmosphere and sea-water for approximately 6 months by immersion in the sea in such a manner that they were uncovered at each low tide. The results of the best 18 alloys are tabulated. It was found that copper up to 3% causes brown discoloration with fine pitting; manganese increases the amount of very fine pitting; lead causes very minute pitting; calcium silicide in small amounts causes fairly small local pitting, and silicon causes fairly fine uniformly-distributed pitting. From the loss-in-weight data it is concluded that : (1) lead and silicon are the most suitable metals to add to aluminium–zinc–copper alloys for resistance to sea-water corrosion; (2) small amounts of calcium silicide increase the corrosion of these alloys; (3) copper may be added up to 2·5% with an optimum amount of 1–1·5%; (4) the most hopeful aluminium–zinc alloys from the point of view of corrosion lie within the limits : zinc 10–15, chromium 0·5, silicon 1–8, lead 1–3%; (5) passification increases the resistance to corrosion of most of these alloys. The reasons for the discordance of the results obtained by various investigators are discussed.—J. H. W.

Investigation of the Corrosion of Duralumin in Relation to its Chemical Composition. W. O. Kroenig (*Korrozia metallov* (*Corrosion of Metals*). *First Pan-Union Conference on Corrosion, Moscow, Nov.* 1–6, 1929; *Transactions of the Institute of Applied Mineralogy,* 1931, 179–203).—[In Russian.] Cf. this *J.*, 1931, **47**, 380.—N. A.

Corrosion Embrittlement of Duralumin. V.—Results of Weather Exposure Tests. Henry S. Rawdon ([*U.S.*] *Nat. Advisory Cttee. Aeronautics, Tech. Notes* No. **304**, 1929, 1–26).—See this *J.*, 1929, **41**, 477.—S. G.

Determining Causes of Condenser Tube Corrosion. Bert Houghton (*Power,* 1931, **73**, 822–823).—A committee composed of representative condenser and condenser-tube manufacturers was set up to investigate the causes of failure and to determine ways of increasing tube life. It proved that those plants which had to use harbour water experienced the greatest difficulties, although many fresh-water plants did not escape corrosion troubles. On tide-water installations Admiralty brass was in common use, whilst on fresh-water installations both Admiralty and Muntz metal were used. The following failures were noted : (1) general thinning or general corrosion; (2) general dezincification; (3) deposit attack or pitting; (4) trailed-type pitting; (5) true corrosion; (6) impingement attack; (7) scale thinning; (8) solution; (9) splitting and season cracking. Although air was considered a corrosion agent, the extent of its action at temperatures which might be found in the condenser was not at all certain. Definite progress has been made in the investigation of condenser-tube corrosion. Comparative tests, made with air-saturated solution and solutions under vacuum, indicated a marked increase in the corrosion rate due to air.—F. J.

Corrosion Problems [in Naval Construction]. Auguste Le Thomas (*Aciers spéciaux,* 1928, **3**, 591–603).—Part of a longer paper entitled : " The Collaboration of Metallurgy and Modern Naval Construction." The action of corrosion agents on condenser tubes and propeller blades and its effect on the brasses and bronzes commonly used are discussed. The composition of suitable brasses and bronzes, the origin of common impurities, and their effect on the corrosion resistance of these alloys and other alloys suitable for withstanding steam corrosion and high temperatures are discussed.—J. H. W.

The Corrosion of Tin, Iron, and the Tin–Iron Couple. J. M. Bryan (*Dept. Sci. Indust. Research, Rep. Food Investigation Board*, 1929, 86–92; *C. Abs.*, 1931, **25**, 5887).—Corrosion was studied in 0·5% citric acid with sodium citrate as buffer. Tin corrodes only slightly in the absence of oxygen; in the presence of oxygen it corrodes maximally at p_H3, chiefly at the water-line. The corrosion of iron in the absence of air falls off almost linearly with increasing p_H; in the presence of a limited amount of air corrosion was more rapid, in the more acid solutions mostly at the edges, and in the less acid solutions mostly at the centre. This agrees with the theory of Evans that the charge on the iron varies in different parts according to the ease of access of oxygen or of hydrogen ions. With the tin–iron couple the corrosion of the tin and that of the iron decreased with decreasing acidity. The high overpotential of hydrogen on tin, and the fact that tin salts raise the overpotential of hydrogen on iron, make the tin–iron couple relatively slow in corroding.—S. G.

The Corrosion of Tinplate. T. N. Morris (*Dept. Sci. Indust. Research, Rep. Food Investigation Board*, 1929, 92–94).—Cf. this *J.*, 1931, **47**, 315, 529; and preceding abstract. The corrosion of tinplate gives less uniform results than the tin–iron couple. The tin is maximally corroded at p_H 4–5, the iron at p_H3. Maximum production of hydrogen, and also maximum total corrosion occurs at a p_H about 3. The extent of corrosion of the iron and the tin in a given time varied inversely.—S. G.

Metals and Mortar Materials. D. Dieckmann (*Tonind.-Zeit.*, 1931, **55**, 1211–1212).—Although free lime in mortars and concrete tends to act as a protection against the rusting of iron embedded in the material it has just the opposite effect on lead. On the other hand, Sorel cement and gypsum which promote the rusting of iron are inert towards lead.—A. R. P.

Corrosion Problems in Central Heating and Boiler Plants. —— Kröhnke (*XIII. Kongress für Heizung und Lüftung, Berlin*, 1930, 60–87).—A lecture in which problems associated with the corrosion and protection of iron in boiler installations and central heating apparatus are discussed with reference to 27 illustrations showing characteristic corrosion phenomena.—A. R. P.

Corrosion of Metals. Tadeusz Kuczynski and Michal Smialowski (*Przemysl Chem.*, 1931, **15**, 52–61, 99–104; *C. Abs.*, 1932, **26**, 411–412).—Modern theories of corrosion are briefly reviewed, especially with reference to the rôle of oxygen. Those of Duffek (*Korrosion*, 1927, **2**, 38–40, 1928, **3**, 5–6) and of Tödt (*Korrosion u. Metallschutz*, 1929, **5**, 169–174) were investigated experimentally with saturated solutions of potassium chloride and sodium chloride. The static method does not give a clear picture of the resistance of metals to corrosion. The method of Tödt, which uses an auxiliary electrode, gives interesting results from the theoretical point of view. The rate of diffusion of oxygen to cathode areas and the ability of these areas to de-activate the oxygen have an important effect on the rate of corrosion. The current rate was independent of the pressure in the electrolyte in small quantities of quinoline, brucine, mannitol, and sodium meta-arsenate, but was decidedly reduced by a small quantity of potassium cyanide, which apparently acted as a negative catalyst, diminishing the active area of the cathode. Carbon electrodes surrounded by graphite and manganese dioxide were used for cathodes to eliminate cathode polarization, which usually limits the rate of current flow. Current rates were smaller than those demanded by Ohm's law, and deviations from Ohm's law decreased with increasing current rates. These deviations were due to surface-coating polarization. The resistance of this layer was measured with varying currents; it decreased with increasing current rate.—S. G.

A Corrosion Tester for Pressure Vessels. Cloyd M. Chapman (*Instruments*, 1931, **4**, 527–531; *C. Abs.*, 1932, **26**, 340).—A gate valve is attached to the pressure vessel by a short nipple. A yoke, carrying a long spindle which

passes through a stuffing-box in the inner end of the yoke and has the outer end threaded for a hand wheel, is attached to the outer end of the closed-gate valve after the test-specimen has been attached to the spindle. The valve is then opened and the specimen passed into the vessel, which is designed for 400 lb. pressure.—S. G.

PROTECTION

Surface Coatings for Aluminium Alloys. W. H. Mutchler (*Metals and Alloys*, 1931, **2**, 324–330).—The following methods of protecting aluminium and its alloys from corrosion are reviewed with reference to recent work : anodic oxidation, electroplating, cementation with other metals, spraying with other metals, coating with pure aluminium sheet (Alclad) or Duralumin sheet (Duralplat), painting, and varnishing. Of the various procedures which have been suggested for anodic oxidation, that of Bengough and Sutton using 3% chromic acid appears to be best, but the amount of chloride in the bath must not exceed the equivalent of 0·2 grm./l. of sodium chloride and the amount of sulphate the equivalent of 0·5 grm./l. of sulphuric acid. Plated, cemented, and sprayed coatings generally are unsatisfactory.—A. R. P.

The Protection of Light Alloys against Corrosion. M. Pubellier (*Aciers spéciaux*, 1931, **6**, 575–585).—The causes of corrosion, the various theories put forward to account for it, and the methods by which it is measured are discussed. The means of protecting light alloys against corrosion consist of selecting alloys of suitable composition, special heat-treatment, painting and doping, surface oxidation (anodic treatment), the " Cilum " process (immersion in sodium silicate and electrolysis of the solution), metal coatings, cadmium and zinc plating, and the " Vedal " process (covering Duralumin with a thin coating of very pure aluminium). These are described and the applicability of the various methods in various circumstances is discussed.—J. H. W.

Protective Coatings for Aluminium Alloys. Anon. (*Iron Age*, 1931, **128**, 1636).—The results of an investigation of the U.S. Bureau of Standards into the effectiveness of the oxide, the metallic and the organic type of protective coating for aluminium alloys against corrosion by salt-spray, intermittent immersion, and weathering show that aluminium-pigmented spar varnish applied to an anodized surface afforded protection for an appreciable period under severe conditions. A 20% sodium chloride solution was used for the salt-spray test and a solution containing 9 parts normal sodium chloride, and 1 part hydrogen peroxide solutions for the intermittent immersion test.

—J. H. W.

Corrosion Prevention by Protective Coatings. W. S. Johnson (*Power*, 1931, **74**, 155–157).—Of the metals usually used as protective coatings for iron and steel (*viz.* zinc, lead, tin, copper, nickel, and chromium), zinc may be applied in 3 different ways : electrodeposition, galvanizing, and Sherardizing. Tin and lead coatings or a combination of both are applied by a hot process, terne plate being the most common commercial example. Copper, nickel, and chromium are electrodeposited. Aluminium is applied by the calorizing process. Dissolved oxygen is the principal cause of under-water corrosion and de-aeration of water is extensively used in most modern plants.—F. J.

Electrolytic Coating of Metals with Lead Peroxide and its Anticorrosive Properties. N. A. Isgarischev and A. A. Kusnezowa (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (4), 449–453).—[In Russian.] Cf. this *J.*, 1931, **47**, 589. The properties of lead peroxide as a protective deposit for anodes have led to attempts to adapt it as an anti-corrosive coating which has, at the same time, an attractive finish for a variety of metal goods. Solutions of lead nitrate did not give satisfactory results, so that alkaline solutions were adopted, the optimum concentration being 10·5 grm. of lead per litre, the current density, 0·3–0·4 amp./dm.², and the temperature 60° C.

The pure electrolyte, however, had a poor throwing power, and the deposits were not firmly adherent nor of a satisfactory appearance; consequently a number of admixtures which should exert an influence on the rate and nature of growth of the crystalline deposits were made to the solutions. Substances such as tar emulsions, phenols, and cyanides had a detrimental effect on the deposition; many salts, glue, gelatine, essential oils, and some organic acids were neutral, whilst resorcinol, tannin, glycerol, and mixtures of glucose with ammonium persulphate or perborate exercised a pronounced positive influence : elastic, firmly adherent black deposits of lead peroxide with a fine finish being obtained on copper and brass with 0·001% of resorcinol. Very good deposits could also be obtained on wrought and cast iron, provided a copper base had been " flashed " on. The deposits were resistant to atmospheric and aqueous corrosion and also to corrosion by dilute sulphuric acid. It is considered that lead peroxide deposition could replace, with advantage, oxidizing baths of the cyanide or " nickel black " type.—M. Z.

Sherardizing. Fred L. Wolf (*Metals and Alloys*, 1931, **2**, 341–342).—Hot-dipped galvanized coatings on malleable iron provide a much greater protection against corrosion than do sherardized coatings.—A. R. P.

The Adherence of Zinc Coatings. William H. Finkeldey (*Metals and Alloys*, 1931, **5**, 266–271).—When galvanized coatings on iron and steel are produced under standard conditions the adherence is generally greater the thinner the coating; coatings of 0·3–0·4 oz./ft.^{2} are generally more malleable and less liable to crack when the sheet is bent than are coatings of 1–3 oz./ft.^{2}. Rapid bending increases the tendency of the coating to crack and peel. The presence of cadmium in the galvanizing bath promotes the formation of the brittle iron–zinc compounds, and thus increases the tendency of the zinc film to crack on bending; addition of 2·5–8% of aluminium to the bath, on the other hand, is claimed to result in the production of more pliable galvanized sheets, which can be bent without causing the film to peel or crack. Addition of tin produces a brighter but less ductile film. The percentage of carbon in the steel sheets used has a definite effect in determining the adherence of the zinc film which is poorest on pure iron and best on steel with 0·6% carbon. Better adherence of the zinc coating is obtained by annealing the galvanized sheets at 430°–450° C. immediately after their removal from the zinc bath; this prevents peeling of the outer layer of pure zinc when the sheets are heated.

—A. R. P.

A Glance at Some Galvanizing Problems. Heinz Bablik (*Met. Ind. (Lond.)*, 1932, **40**, 81–82).—The competition of electro-galvanizing has caused a closer investigation into the theoretical considerations of hot-galvanizing, and the practice with regard to both these processes has advanced accordingly. There are, however, many problems still to be solved and these are briefly reviewed.

—J. H. W.

A Pure-Zinc Galvanizing Process. L. Whitehead (*Ironmonger*, 1930, **191**, 64–65; *C. Abs.*, 1931, **25**, 585).—The advantages of electro-galvanizing over hot-galvanizing of wire and strip are pointed out, and a new process of electro-galvanizing is described. The important difference between the new and the old processes of electro-galvanizing is in the use in the old process of galvanizing baths 60–80 ft. long which are costly to construct and difficult to keep liquor-tight. Photomicrographs are included showing the structure of coatings produced by hot-galvanizing and by electro-galvanizing, from which it is observed that the hot-galvanized coating is not uniform in composition. Various methods of proving the efficiency of pure zinc have shown that electro-galvanized wire has a greater resistance to corrosion than have hot-galvanized products.—S. G.

IV.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from p. 86.)

The Technique of Metallographic Testing. N. F. Bolchovitinov (*Vestnick Ingenerov i Tehnikov* (*Messenger of Engineers and Technologists*), **1930**, (5), 182–191).—[In Russian.] A detailed description of the modern technique of metallographic testing, *i.e.* the preparation of polished sections, etching, handling of the microscope, and photomicrography.—N. A.

Preferred Orientation Produced by Cold-Rolling in the Surface of Sheets of Aluminium, Nickel, Copper, and Silver. Cleveland B. Hollabaugh and Wheeler P. Davey (*Metals and Alloys*, 1931, **2**, 246–250, 302–312).—Cf. this *J.*, 1931, **47**, 485. The changes which occur in the orientation of the crystallites of aluminium, nickel, copper, and silver sheets during the process of cold-rolling have been carefully followed by X-ray analysis at every stage of the rolling operation. In all cases one face diagonal of the lattice cube always lies in a plane perpendicular to the rolling surface and parallel to the direction of rolling. The number of passes through the rolls has no effect on the limits of the preferred ranges of positions in copper, nickel, and silver; in every case there is a range of preferred positions symmetrical to the surface of the sheet, but in aluminium the limits of the preferred positions change with increasing reduction in thickness. In the case of silver there are 2 symmetrical preferred ranges about the transverse axis with no limitations about the longitudinal axis, in the cases of copper and nickel there is only one such range about the transverse axis, but there are symmetrical limitations about the other axis, and in the case of aluminium there are 2 preferred but unsymmetrical ranges about the transverse axis and variable limitations about the longitudinal. The disagreement between these results and those of earlier workers is attributed to differences in the thicknesses of metal tested; whilst earlier workers used foil H. and D. worked on sheet varying in thickness from 0·32 to 0·05 cm., and they suggest that with such thick metal only the two outer layers adopt a preferred orientation during rolling, the central zone being less strained and acting as a cushion, so that straining of each surface layer takes place from one side only. They consider that their results more nearly represent the behaviour of metal during commercial rolling operations.—A. R. P.

An X-Ray Study of the Nature of Solid Solutions [Aluminium–Silver]. R. T. Phelps and Wheeler P. Davey (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. 443, 1931, 1–14).—The lattice parameters of a systematic series of solid solutions of aluminium in silver, in the range 90–100% silver, have been studied. The densities of these solid solutions have been compared with the theoretical densities as calculated from the current theories of solid solutions. With the addition of increasing amounts of aluminium to silver the lattice parameter of the solid solution phase decreases in a regular manner until the diffraction pattern of a second phase appears at 5·4% aluminium, which marks the saturation point. The second phase corresponds with the formation of aggregates of the compound Ag_3Al. The experimental densities of the solid solution of aluminium in silver decrease linearly as the aluminium content is increased and are slightly lower than those calculated on the basis of a direct substitution of aluminium for silver atoms in the silver lattice. It is concluded, after considerable discussion, that there is only one tenable theory—that the aluminium in the solid solution is combined chemically with the adjacent silver.—W. A. C. N.

An X-Ray Examination of Iron–Chromium Alloys. G. D. Preston (*Phil. Mag.*, 1932, [vii], **13**, 419–425).—The parameter, *a*, of the body-centred

cubic unit of iron–chromium alloys varies from 2·861 A. for pure iron to 2·878 A. for chromium. The dependence of a on composition is investigated for the complete series of alloys. The parameter does not vary continuously with composition. A comparatively rapid increase up to 6·5 (atomic) % of chromium is succeeded by a smaller steady rate of increase and finally by a somewhat greater rate of increase.—J. S. G. T.

Precision Measurement of the Lattice Constant of Niobium [Columbium]. M. C. Neuburger (*Kinzoku no Kenkyu*, 1931, **8**, (11), 617–618).—[In Japanese.] See also *Z. anorg. Chem.*, 1931, **197**, 219–223; this *J.*, 1931, **47**, 348. Columbium has a body-centred cubic lattice, $a = 3·303 \pm 0·002$ A., and $d_{calc.}$ 8·56.—S. G.

Lattice Distortion and Hardness of Heat-Treated Tungsten Magnet Steels. W. A. Wood (*Phil. Mag.*, 1932, [vii], **13**, 355–360).—The decrease in magnetic quality and hardness of tungsten magnet steels on heating at about 900° C. is attributed to disappearance of lattice distortion, and the recovery of these properties by heating at 1250° C. is due to the re-introduction of the distortion. The nature of the changes occurring, as shown by X-ray analysis, excludes possible complications arising from deformation of grains by slip or the formation of sub-microscopic crystals.—J. S. G. T.

Graphical Determination of all Crystal Lattices from X-Ray Powder Method Data. Walter Soller (*Phys. Rev.*, 1932, [ii], **39**, 583).—Abstract of a paper read before the American Physical Society. The crystal analysis of solid substances available only in powdered form has in general been limited to the more symmetrical crystal structures. Analytical methods are too complex to have any practical value. The present graphical methods, because of their limitations to the more symmetrical systems and the X-ray interference due to interpenetrated lattices, give reliable results only for a limited number of substances. An X-ray diffraction pattern analyzer for all crystal lattices is discussed in this paper which should make crystal analysis for all solid substances possible. From an analytical discussion of the series of angles of X-ray reflections from lattice planes it is shown that an apparatus could be constructed which at once would indicate this series for any lattice of all crystal systems with the exception of the triclinic lattice. With this apparatus the lattice of any solid substance can be identified by matching the diffraction pattern of the substance with some pattern indicated on the apparatus. A definite procedure is possible in using the apparatus, so that the higher symmetry lattices are eliminated in order of higher symmetry until the correct match is obtained. The procedure identifies the triclinic lattice by the elimination of all the lattices higher in symmetry. From the setting of the apparatus for the match of the diffraction pattern all the parameters of the unit lattice cell, as well as the identification of the planes from which each reflection is coming, are obtained directly. The parameters of any unit lattice cell, including the triclinic, are also obtained by 3 definite settings of the apparatus distinct from the identification setting. This second determination of parameter serves as an entirely independent check of the first.—S. G.

Laue Diagrams with Large Diffraction Angles. W. Boas and E. Schmid (*Metallwirtschaft*, 1931, **10**, 917–919).—Laue photographs have been obtained by placing the plate between the crystal and the X-ray tube; in this way reflections from crystal surfaces inclined at more than 60° to the incident rays have been photographed. In many cases the symmetry of the crystals, even without exact adjustment of the specimen, is more easily recognizable than is the case with photographs taken in the normal way. Laue Röntgenograms of large specimens can also be made with this arrangement. The geometrical relations are discussed.—v. G.

V.—ANALYSIS

Analytical Procedure [Analysis of Silver Coinage Alloys]. [S. W. Smith] (*Ann. Rep. Royal Mint* (*Lond.*), **1928**, **59**, 51–52).—Report of the Chief Assayer. Analysis of the Ag in the quaternary silver coinage alloy, containing Ag 50, Cu 40, Ni 5, and Zn 5%, is done by the Gay–Lussac method. The liquid from this is filtered and boiled and the Cu determined therein by the iodide method. Cu_2O is filtered through pulp and the Ni determined in an ammoniacal solution with KCN, using $AgNO_3$ as an indicator. The Zn in the residual liquid is not easily determined by the usual methods of precipitation or titration, but is readily precipitated by 8-hydroxyquinoline in an alkaline solution, with re-solution and reprecipitation if Ca or Mg be present. The Zn compound is dried at 140° C. and weighed, and contains 18·49% Zn. Rapid determinations are made by volatilizing the Zn from samples diluted with an equal weight of Sn side by side with synthetic check samples (cf. Shibata and Kamifuku, this *J.*, 1925, **34**, 529).—J. H. W.

Tentative Methods of Chemical Analysis of Silver Solders (B 81–31 T) —— (*Amer. Soc. Test. Mat. Tentative Standards*, **1931**, 173–182).—See this *J.*, 1931, **47**, 487.—A. R. P.

Analytical Method for the Detection of the Metals. E. Defrance (*J. Pharm. Belg.*, 1931, **13**, 771–775; *Chem. Zentr.*, 1931, **102**, II., 3123).—The method described avoids the use of H_2S and $(NH_4)_2S$. Ag, $Hg^{\cdot}$, Pb, and $Tl^{\cdot}$ are removed by addition of HCl and the 5% HCl solution is then boiled with $Na_2S_2O_3$ to precipitate As_2S_3, Sb_2S_3, SnS_2, MoS_3, PtS_2, CuS, Bi_2S_3, and HgS. The precipitate is extracted with $(NH_4)_2CO_3$ and Na_2CO_3 which leaves PtS_2, CuS, Bi_2S_3, and HgS insoluble; extraction with HNO_3 removes Cu and Bi, and after dissolving the remainder in *aqua regia* Pt is tested for with KCl and Hg with NH_3. The carbonate solution is tested in the usual way for As, Sb, Sn, and Mo. The $Na_2S_2O_3$ filtrate is treated with NH_4OH and NH_4Cl to precipitate FeS and the hydroxides of Al, Cr, V, Pb, Sn, Ce, and Th, the precipitate is dissolved in HCl and the solution boiled with NaOH, whereby Al, Cr, and Pb dissolve. The NH_4OH filtrate is boiled with NaOH until the NH_3 is expelled, whereby Mn, Co, Ni, Ca, and Mg are precipitated, leaving Zn, K, Li, and V in solution. Methods for detecting these metals are detailed.—A. R. P.

A New [Method for the] Detection of Cobalt in the Presence of Elements of the Third Group. Theodor Bersin (*Z. anal. Chem.*, 1931, **85**, 428–433).— On addition of NH_3, $NaHCO_3$, or $CH_3 \cdot CO_2Na$ to a neutral $Co^{\cdot\cdot}$ solution containing thioglycollanilide a voluminous reddish-brown precipitate of $C_{21}H_{21}O_3N_3S_3Co,4H_2O$ is obtained which, on warming, is converted into the

stable compound $Co^{\cdots}\left(<^{S \cdot CH_2}_{O \cdot C\ =\ N \cdot C_6H_5}\right)_3 Co^{\cdots}$; the latter is insoluble in acids, alkalis, and organic solvents, but cannot be used for the gravimetric determination of Co. Similar precipitates are obtained with Ni and $Fe^{\cdot\cdot}$ salts, but these compounds are readily soluble in dilute acids, the Ni compound being soluble also in alkalis. The test for Co is made as follows : the solution obtained after removal of heavy metals with H_2S is boiled to expel excess of the gas, made alkaline with NH_4OH and NH_4Cl, boiled for $\frac{1}{2}$ minute to oxidize the Co, treated with a few drops of an alcoholic solution of the reagent, again boiled, and made acid with $2N$-HCl. A red precipitate remains when as little as 5×10^{-5} grm. of Co is present in 5 c.c. of solution which may contain as much as 0·1 grm. of Ni.—A. R. P.

Spectral-Analytical Investigations on Platinum Metals and Alloys. Walther Gerlach and Konrad Ruthardt (*Festschrift zum 50. Jährigen Bestehen der Platinschmelze G. Siebert G.m.b.H. Hanau*, **1931**, 51–71).—The following lines suffice for the detection in Pt of : Cu, 3274 and 3247·5; Fe, 2585·9, 2607·1, 2631·0, and 2739·6; Ir, 2564·2 and 2662·0; Ni, 2416·1, 3050·8, 3057·6, and 3619·4; Os, 2909·1; Pd, 3406·6, 3609·6, and 3634·7; Rh, 3439·9, and Ru, 3499·0. Similar sets of lines are given for the detection of the same impurities in Rh and Ir. The method of using the principle of homologous pairs of lines for the quantitative determination of Ir and Rh in Ir–Pt and Rh–Pt alloys is described and an account is given of photometric tests for determining the accuracy of the spectrographic method.—A. R. P.

On the Quantitative Separation of Lead from Iron. H. Funk and O. von Zur-Mühlen (*Z. anal. Chem.*, 1931, **85**, 435–438).—The feebly acid chloride or nitrate solution of the metals is treated cold with $CH_3 \cdot CO_2NH_4$, then with 10 c.c. of glacial $CH_3 \cdot CO_2H$, diluted to 100 c.c., and heated to boiling; Pb is then precipitated by the addition of 10 c.c. of 1% $(NH_4)_2Cr_2O_7$ for every 0·1 grm. of Pb present. After cooling, the precipitate is collected and the Pb determined iodometrically.—A. R. P.

Estimation of a Small Quantity of Antimony in Presence of Considerable Copper. Shoji Makishima (*Kōgyō Kwagaku Zasshi* (*J. Soc. Chem. Ind. Japan*), 1931, **34**, (9); *C. Abs.*, 1932, **26**, 393).—[In Japanese, with English summary in supplemental binding, pp. 322–323.] The method is designed for the determination of Sb in metallic Cu and in electrolytic Cu-refining baths. To the neutral solution, free from organic matter, add 5 c.c. of 5% $MnSO_4$, heat to boiling, and add sufficient $1·0N$-$KMnO_4$ in 1 c.c. portions to carry down all the Sb which is adsorbed on the precipitate of MnO_2. Wash the precipitate with hot water and then dissolve it in dilute H_2SO_4 containing a little H_2O_2. Reduce the Sb to Sb^{+++} by addition of Na_2SO_3, boil to remove excess SO_2, and regulate the acidity of the solution to $0·02–0·10N$ with β-dinitrophenol as an indicator. Determine the Sb colorimetrically by means of Folin's reagent. The method gives accurate results on as little as 0·05 mg. Sb in 100 c.c. of solution.—S. G.

Rapid Method for the Determination of Arsenic in White Metals. K. L. Ackermann (*Chem.-Zeit.*, 1931, **55**, 702).—The alloy (1–3 grm.) is dissolved in HNO_3, the solution evaporated to dryness, and the residue dissolved in HCl (d 1·19). The solution is treated with 2 grm. of Cu_2Cl_2 to reduce $AsCl_5$ to $AsCl_3$ and distilled whilst HCl gas is passed through to volatilize $AsCl_3$, care being taken to avoid too great a reduction in volume to prevent distillation of $SbCl_3$. The distillate is neutralized with ice-cold NaOH and titrated with I_2 in the presence of $NaHCO_3$.—A. R. P.

The Quantitative Determination of Calcium with Picrolonic Acid. Rudolf Dworzak and Wilhelm Reich-Rohrwig (*Z. anal. Chem.*, 1931, **86**, 98–113).— The solution should contain not more than 0·1 grm. of Ca and not more than 1 grm. of Mg, NH_4, or alkali metal salt. The warm neutral solution is treated with a $0·01N$-solution of picrolonic acid until the crystalline Ca salt settles out readily. The precipitate is washed with cold water, dried, and weighed as $Ca(C_{10}H_7N_4O_5)_2,8H_2O$ which contains only $5·64\%$ Ca. The method is suitable for the determination of Ca in the presence of Mg provided that the Ca : Mg ratio does not exceed 1 : 10, and for the micro-gravimetric determination of Ca.—A. R. P.

Contribution to the Iodometric Determination of Chromium and Its Separation from Iron and Nickel. E. Schulek and A. Dózsa (*Z. anal. Chem.*, 1931, **86**, 81–92).—Oxidation of $Cr^{...}$ to CrO_3 is preferably effected by Br_2 rather than by H_2O_2 as the excess of NaOBr can be removed by addition of 5% phenol solution without boiling. The $Cr^{...}$ solution is treated with 2–5 c.c. of Br_2 solution, then with 10 c.c. of 30% NaOH, and heated almost to boiling.

After cooling, 5 c.c. of 5% phenol solution are added, followed by water to 400 c.c., 4 grm. of $KHCO_3$, 50% H_2SO_4 until acid, 2 grm. of KI, and finally 25 c.c. of 50% H_2SO_4; the liberated I_2 is then titrated with $Na_2S_2O_3$. The method effects a quantitative separation of Fe and Ni from Cr.—A. R. P.

Volumetric Determination of Chromium and Nickel in the Same Solution. L. H. James (*Metallwaren-Ind. u. Galvano-Tech.*, 1931, **29**, 503).—A translation, in abstract, from *Indust. and Eng. Chem.* (*Analyt. Edn.*), 1930, **3**, 258. See this *J.*, 1931, **47**, 658).—A. R. P.

Separation and Volumetric Determination of Copper and Zinc. H. Brintzinger (*Z. anal. Chem.*, 1931, **86**, 157–159).—Cu–Zn alloys are dissolved in H_2SO_4 or $CH_3 \cdot CO_2H$ with the addition of H_2O_2, excess of which is destroyed by boiling. Cu is then determined iodometrically after addition of KI, the CuI is filtered off and the Zn precipitated as $ZnNH_4PO_4$ from the neutralized filtrate. The precipitate is collected in a glass filter crucible, washed with cold, dilute $(NH_4)_2SO_4$ solution, and dissolved in a measured quantity of $0 \cdot 1N$-H_2SO_4; the solution is then titrated with $0 \cdot 1N$-NaOH using a mixture of phenolphthalein and α-naphtholphthalein.—A. R. P.

A Quantitative Method of Estimating Gold by Means of Hydrazine Hydrochloride and its Application to Alloy Analysis. I. N. Plaksin and M. A. Kozhuchova (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (1), 35–41). —[In Russian.] The method of quantitative analysis of Au by precipitation with hydrazine hydrochloride was compared with other existing methods and found to be the most accurate, the error not exceeding $0 \cdot 1\%$. Au is converted into a solution of $HAuCl_4$ ($0 \cdot 2$–$0 \cdot 1\%$ strength) and treated with a 10% solution of hydrazine hydrochloride, when a spongy form of Au is precipitated which is heated to redness and weighed. The presence of Zn, Pb, Cu, Cd, Mg, As, Bi, Ag, Sb, and Sn in alloys gives high results, as they are occluded in the Au sponge unless previously dissolved by appropriate reagents, such as HCl or HNO_3.—M. Z.

Volumetric Determination of Lead in Babbitt. G. V. Lernerman (*J. Chem. Ind.* (*Moscow*), 1930, **7**, 387–388; *C. Abs.*, 1931, **25**, 5867).—[In Russian.] Heat 1 grm. of alloy with 25 c.c. of $6N$-HNO_3 until completely oxidized. Add 100 c.c. of water and allow to stand for 20 minutes to allow oxides of Sn and Sb to separate. Dilute to exactly 250 c.c., mix and use 100 c.c. for the Pb determination. Precipitate $PbCrO_4$ after neutralizing and making slightly acid with HOAc. Filter and wash with very dilute HOAc. Dissolve the precipitate in 15–20 c.c. of concentrated KOH solution and to clear the solution add 20 c.c. of 5% $KMnO_4$. Boil for 10 minutes and reduce the excess $KMnO_4$ by heating with 3–4 c.c. alcohol. Make up to 250 c.c., mix and use 200 c.c. of the filtered solution for the iodometric determination of CrO_4^{--} in the presence of HCl.—S. G.

Volumetric Determination of Lead with Sodium Carbonate. S. Komaretzkyj (*Z. anal. Chem.*, 1931, **84**, 407–410).—The acid Pb solution is neutralized with Na_2CO_3 using methyl orange as indicator. A second equal portion of the solution is then treated with the same volume of Na_2CO_3 solution and boiled to expel CO_2; after cooling to 40°–60° C. the liquid is titrated with Na_2CO_3 using phenolphthalein as indicator. The precipitate should be allowed to settle in order to observe the final end-point.—A. R. P.

The Determination of Manganese. Ralph G. Harry (*J. Soc. Chem. Ind.*, 1931, **50**, 434–436T).—Several gravimetric, volumetric, and colorimetric methods are discussed critically. A modification of the persulphate method is suggested and it is shown that the presence of 4% of Cu, Zn, or Pb does not affect the results. A bibliography of analytical methods for Mn is given.
—E. S. H.

The Determination of Manganese. An Investigation of Knorre's Method in the Presence of Certain Other Metals. Ralph G. Harry (*J. Soc. Chem. Ind.*

1932, **51**, 247).—Knorre's method of oxidation by means of $(NH_4)_2S_2O_8$ (*Z. angew. Chem.*, 1901, **14**, 1149) is quite suitable for the determination of Mn in the presence of Cu, Pb, Zn, and Ca; Ti, Sn, and Co interfere seriously; whilst Bi, Sb, As, V, Cr, and Ni interfere to a small extent and should be removed before proceeding with the analysis.—E. S. H.

Determination of Manganese with Potassium Periodate. C. F. Miller (*Chemist-Analyst*, 1931, **20**, (5), 8).—The sulphate solution of Mn is treated with 15 c.c. of H_2SO_4, 20 c.c. of HNO_3, and 10 c.c. of H_3PO_4, diluted to 100 c.c., boiled for 1 minute with $0\cdot2$–$0\cdot4$ grm. of KIO_4, set aside for 10 minutes on the water-bath, and cooled. The resulting $KMnO_4$ colour is compared with that of solutions containing known amounts of Mn as $KMnO_4$.—A. R. P.

A Rapid Method for the Determination of Potassium. I. S. Vladimirov (*J. Chem. Industry (Moscow)*, 1931, **8**, 972–976; *C. Abs.*, 1932, **26**, 393).— [In Russian.] Minor modifications are suggested in the method of Jander and Faber (*Z. anorg. Chem.*, 1928, **173**, 225–232; this *J.*, 1928, **40**, 596; and *ibid.*, 1929, **181**, 189–192; this *J.*, 1929, **42**, 544).—S. G.

Determination of Small Quantities of Potassium. C. F. Miller (*Chemist-Analyst*, 1931, **20**, (5), 8, 10).—The solution containing less than $0\cdot016$ mg. of K is evaporated with 1 drop of H_2SO_4 in a porcelain crucible and the dry residue is heated to dull redness, cooled, and moistened with 1 drop of HCl and 1 drop of H_2PtCl_6 solution. The mixture is evaporated to a paste on the water-bath and rinsed on to an asbestos filter with 90% C_2H_5OH saturated with K_2PtCl_6. When the C_2H_5OH has evaporated the K_2PtCl_6 is dissolved in hot water with 1 drop of HCl and the solution treated with KI to form a pink solution of K_2PtI_6, the colour of which is compared with that of similar solutions prepared from standard amounts of K.—A. R. P.

A Gravimetric Method of Determining Potassium, together with Sodium and Magnesium. W. K. Fedorenko (*Ukrainskii Khemichnii Zhurnal (J. Chim. Ukraine, Scientific Part)*, 1931, **6**, (2), 105–116).—[In Russian.] Existing methods for the quantitative analysis of the alkali metals are criticised, and a method of determining the latter as caustic alkalis (together with Mg) by titration with H_2SO_4 is described (*cf.* also, *Zhurnal Prikladnoi Khimii (Journal of Applied Chemistry)*, 1930, **3**, No. 6). The alkali metals are transformed into their sulphates by boiling with H_2SO_4 and the solution is treated with an excess of hot 4% $Ba(OH)_2$ solution to precipitate the hydroxides of all other metals, and leave a solution of the alkali metal (and Mg) hydroxides. CO_2 is then bubbled through to facilitate the precipitation of the finely-divided $BaSO_4$, and to remove excess $Ba(OH)_2$, and the alkaline solution is evaporated to small bulk and titrated with $0\cdot1N$-H_2SO_4, using methyl-red as indicator. Evaporation is continued to dryness, the residue dissolved in the least quantity of water, and the solution filtered to remove the last traces of Ba as $BaSO_4$. The filtrate is again evaporated to dryness and the residue heated to remove water of crystallization, and weighed, thus giving the total weight of sulphates of the alkali metals and Mg. The amount of the SO_4 radicle in the mixture is then determined by precipitation with $BaCl_2$, and the Mg content by the usual method of Smits. From the results obtained, the Na and K contents can be calculated.—M. Z.

The Estimation of Silicon in Copper–Silicon Alloys. W. F. Pond (*Chemist-Analyst*, 1931, **20**, (5), 7–8).—The alloy is sampled by sawing and the sample is freed from Fe by means of a magnet. 2 grm. are covered with 25 c.c. of water and 25 c.c. of HNO_3 (d $1\cdot42$) are added; when the vigorous action has subsided 1 c.c. of HCl and 2 c.c. of H_2SO_4 are added and the solution is evaporated to dryness. The residue is heated at $110°$ C. for 90 minutes and extracted with 30 c.c. of boiling water and 25 c.c. of HNO_3 (d $1\cdot4$); the SiO_2 is collected, washed with hot 5% HNO_3, ignited, and weighed, its purity being subsequently determined by evaporation with HF.—A. R. P.

Tin in Tin Drosses. W. M. Muldowney (*Chemist-Analyst*, 1931, **20**, (5), 14–15).—A composite 20 grm.-sample of coarse and fines is added to 200 c.c. of water and 60 c.c. of HNO_3 (d 1·42). When decomposition is complete, the solution is diluted to 400 c.c., boiled, and set aside over-night. The precipitate is collected, washed with 2% HNO_3, ignited, and left in the air until it ceases to gain in weight. The weighed product which contains all the Sn as SnO_2 is ground and a portion is analyzed for Sn by fusion with Na_2O_2 followed by reduction of $SnCl_4$ to $SnCl_2$ with Fe and titration with I_2.
—A. R. P.

VI.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

The Metaphot. J. Flugge (*Tech. Instrument Bull.*, 1932, **3**, (6), 86–93).—Describes a new form of photomicrographic outfit designed to be compact and easily managed. The diameter of the foot of the instrument is 12 in. and the height 21 in. The microscope is in the inverted position, the foot of the stand of the microscope forming the camera, and carries inside its lower end the mirror which reflects the light from the microscope tube on to the focussing screen. Illustrations are given.—R. Gr.

The Busch Univertor. F. Hauser (*Tech. Instrument Bull.*, 1932, **3**, (6), 81–85).—Describes the "Univertor" or "Universal Vertical Illuminator" made by Busch. The illuminator allows of the examination of objects of any size with a wide range of magnification in external reflected light (dark field), and permits of simple change being made from dark to light field. The weakly convergent light issuing from a lamp falls directly on a plane ring-shaped mirror, inclined to the beam at an angle of 45°, and from this it is reflected round the objective inside a housing concentrically surrounding the objective, on to an aspherical concave mirror ring, by which it is concentrated in the focal plane of the objective. This method of illumination necessitates special objective mountings. Illustrations are given of the components and photo-micrographs with bright and dark field illumination of a chill-casting.—R. Gr.

Polishing Metal Specimens Automatically. American Instrument Co. (*Abrasive Ind.*, 1931, **12**, (9), 37–38; *Ceram. Abs.*, 1931, **10**, 794).—An automatic metallographic polishing machine is described, based upon a similar machine, designed by the U.S. Bureau of Standards, to effect a standardization of methods employed in polishing specimens of metals for microscopic examination.—S. G.

On the Use of High-Frequency Furnaces in Laboratories. W. Kroll (*Metallwirtschaft*, 1931, **10**, 751–754).—Experiments with a Lorenz furnace (8000 periods, 4 kw. furnace load, 11 kw. transformer load, 100–200 v. working voltage) and with a Ribaud furnace (60,000 periods, 12·5 kw. transformer load, 8000 v. working voltage) are described. The higher voltage with the Ribaud furnace is a disadvantage owing to the danger to workers and the necessity of having between coil and crucible a good quartz insulation which requires frequent renewal. The melting capacity of the Ribaud furnace is greater than that of the Lorenz furnace (*e.g.* with 12·5 kw. input to the transformers 150 grm. of nickel is melted in 1½ minutes). In the Ribaud furnace metal powders can be melted especially after briquetting. Zirconium, thorium, silicon (after preheating to 1000° C.), beryllium, magnesium, and aluminium can be melted without difficulty in the Ribaud

furnace, whereas aluminium and magnesium are difficult to melt in the Lorenz furnace. With both furnaces it is possible to melt and cast either in hydrogen or *in vacuo*. Aluminothermic and magnesiothermic reactions proceed smoothly to completion in high-frequency furnaces owing to the additional heat generated in the interior. For temperatures up to 2000° C., crucibles 1 mm. thick made from powdered fused alumina, fused crystalline magnesia, or powdered pressed magnesite have proved satisfactory.—v. G.

Laboratory Furnaces and Temperature Regulators. P. Chevenard (*Rev. Mét.*, 1931, **28**, 453–468).—The influence of the nature and mode of wiring on non-uniformity of temperature is determined by direct observations of temperatures within the furnaces. Reference is made to a device embodying automatically operated rheostats for securing a desired rate of heating of furnaces of the resistance type, and to apparatus for regulating temperatures.
—H. S.

A Voltage Regulator for Furnace Control. Vaughan H. Stott (*J. Sci. Instruments*, 1931, **8**, 313–316).—Describes a regulator for maintaining an accurately constant " root mean square " voltage in the circuit of an electric resistance furnace. This consists essentially of a well-lagged mercury bulb, electrically heated, and maintained at constant temperature by the expansion of the mercury in a capillary tube. By means of relays this is connected with the furnace circuit in such a way that energy proportional to that supplied to the mercury bulb is supplied to the furnace, and arrangements are provided for neutralizing the effects of fluctuations in room temperature. With a well-lagged laboratory tube furnace the day and night variation was too small to be detected by an instrument reading to 2°–3°, whilst the regulator is cheaper and simpler to operate than the Haughton–Hanson thermostat. Larger furnaces may also be controlled by means of a series of relays.—W. H.-R.

The Application of the Protos-Vacuum-Switch for Temperature Regulation. Werner Jubitz (*Siemens-Z.*, 1931, **11**, 472–481; and (in English) *Siemens Rev.*, 1931, **7**, 285–292).—Description of different types of very simple devices for temperature regulation manufactured by Siemens & Halske A.G., Berlin. Two of these are well suited for temperature regulation of electrically heated tube furnaces. Under favourable conditions the temperature may be maintained constant at 1200° C. within 2°–3° C.—M. H.

Thermostats. Anon. (*Glas App.*, 1930, **11**, 156; *Ceram. Abs.*, 1931, **10**, 795) —Two new types of thermostat are described. (1) A variable contact D.R.-P. thermometer can be employed for the thermostat and any desired temperature between 1° and 550° retained to an accuracy of 1/10° (provided the contact thermometer is graduated in 1/10° divisions). A tilting mercury cup causes the main heating circuit to be broken or remade, as the upper or lower extent of the permissible variation is reached. (2) The second type, for use only with a variable maximum and minimum thermometer, enables temperatures to be maintained constant between such wide limits as 20° and 30°, an automatic coil arrangement being employed in this instance —S. G.

Micrometer Microscope is Designed. R. Y. Ferner Co. (*Abrasive Ind.*, 1931, **12**, (9), 38; *Ceram. Abs.*, 1931, **10**, 794).—A new micrometer microscope has been developed by the Société Genévoise d'Instruments de Physique, Geneva, Switzerland. The instrument is illustrated.—S. G.

Measuring Apparatus for the Determination of Elongation. Ernst Lehr (*Maschinenbau*, 1931, **10**, 711–725).—A review of the mechanical, optical, and electrical contrivances which have been devised for the static and dynamic measurement and registration of small deformations especially elongations. Numerous references are appended.—v. G.

Measurements with the Glass-Scratch Elongation Marker of the German Research Institute for Aeronautics. F. Seewald (*Maschinenbau*, 1931, **10**,

725–727).—The deformation to be measured is marked in natural size on a glass plate by means of a diamond point and can then be magnified in the laboratory. The sources of error met with in other apparatus in using a lever device are thus eliminated and very small (0·001 mm.) and rapid (0·01 second) as well as very slow deformations can be registered.—v. G.

A Proposal on the Determination of the Absolute Repeatability of Electrical Instruments. W. Oehlerking, H. Krauss, and A. Griesbach (*Z. Instrumentenkunde*, 1931, **51**, 205–207; *Rev. Sci. Instruments*, 1931, **2**, 432).—The repeatability or certainty of calibration (*Einstellsicherheit*) of an electrical instrument is defined by Keinath as the ratio between the turning moment and the friction moment. According to this definition most good commercial instruments seem to be quite satisfactory with respect to this property. Such a definition, however, neglects the fact that when the pointer is in the neighbourhood of its equilibrium point the friction moment becomes equal to or greater than the turning moment. It thus comes about that there is a band of definite width about the ideal point of equilibrium within which the pointer may come to rest. This is a fact which is well recognized, and which must be guarded against in all standardizing laboratories. To obviate this ambiguity of definition the authors propose a new definition of this property which does not readily lend itself to abstracting. An investigation of two commercial instruments in the light of the new definition leads to very satisfactory results. It is believed that the new definition more nearly represents or describes the actual performance of an instrument than the old. As a result of their investigation, the authors reach the conclusion that " both the pointers and the scale markings can safely be made broader than on the instruments investigated without in any way decreasing the absolute accuracy of the readings."
—S. G.

How to Determine Wire Sizes for Electromagnets. H. B. Brooks (*Indust. Engineering*, 1929, **87**, 349–350; *Rev. Sci. Instruments*, 1930, **1**, 608).—If carried out from first principles, the calculation of the size of wire for an electromagnet requires a knowledge of the magnetic properties of the iron used and experience in estimating the effect of leakage flux, as this latter is not susceptible of exact calculation. For electromagnets to be produced in large numbers, the cost of the necessary expert development work is not a serious matter, but for individual jobs it is prohibitive. Also, it is often necessary to re-wind an electromagnet for a voltage different from that for which it was originally intended. For such cases a rapid, accurate, and simple method is required. The following method is applicable to the case of electromagnets to be operated from a constant-voltage d.c. supply. It does not go into the dimensions of the magnetic circuit—that is, it is assumed that the iron structure is already available and that the problem is to find the correct size of wire for a given supply voltage. B. shows how it is possible, by means of a trial winding of any convenient size wire, and a single experiment on the operation of the magnet on a variable voltage, to determine the size of wire necessary for successful operation on a given constant voltage. A practical discussion of heating effects is also given. It is proved also that for a wire of a given material at a given temperature, wound in a given bobbin and connected to a constant-voltage source, the number of ampere-turns depends only on the diameter of the bare wire, and not at all on the number of turns. The article should be of considerable use to those who are called upon from time to time to wind or re-wind magnet coils.—S. G.

The Recording of Non-Periodic Phenomena with the Cathode-Ray Oscillograph. K. O. Hollmann (*Arch. Elektrotech.*, 1931, **25**, 689–694; *Rev. Sci. Instruments*, 1932, **3**, 60).—A method is described by means of which one can record non-periodic phenomena with the cathode-ray oscillograph. The method operates in the following manner. The cathode ray is deflected in the time

axis by vacuum tube oscillations. A vacuum tube relay alternately connects and disconnects to the oscillograph circuit the phenomenon to be analyzed at predetermined points on the time axis. A vacuum-tube relay is described which is so made from standard parts and tubes as to reduce the number of sources of voltage necessary. The practical application of this method is illustrated with oscillograms of acoustic and electrical oscillations.—S. G.

Improvements in Cathode-Ray Tube Design. V. K. Zworykin (*Electronics,* 1931, **3**, 188–190; *Rev. Sci. Instruments,* 1932, **3**, 60).—Describes an adaptation of the Western Electric sealed-off oscillograph. The instrument employs an oxide-coated, indirectly heated, cathode as a source of electrons, and therefore operates in a high vacuum. A double anode structure is employed in which a silver coating on the inside of the glass cone furnishes the second anode. Focusing of the spot is accomplished by means of this double anode structure. The second anode gives a final acceleration to the electron beam and focuses the beam into a small spot on the fluorescent screen. A special electrode is provided which gives an undistorted control of the intensity of the spot. The tube operates at voltages from 500 to 15,000 v.—S. G.

Glass or Metal Discharge Tubes. H. Dicks (*Arch. Elektrotech.,* 1931, **25**, 523–524; *Rev. Sci. Instruments,* 1931, **2**, 765).—Cathode-ray oscillographs as ordinarily constructed have glass discharge tubes. D. proposes to investigate the advisability of using metal discharge tubes. An oscillograph having a glass tube was therefore set up and operated at 50 kv. and 0·3 m.amp. This current represents a considerable overload on the instrument, since at this voltage a current of 0·1 m.amp. permits a recording velocity of 63,000 km./second. After 1000 hrs. of operation the glass tube was still entirely serviceable, although cathode metal had so thoroughly sputtered over the inside of the tube as to make it approximate a metal tube. It was noted that the tube far outlasted the cathode itself. Mere length of life itself is therefore no argument for or against a given type of tube, if the cathode itself necessitates a periodical dismantelling of the entire apparatus. Oscillographs were also constructed with metal discharge tubes. These metal tubes distorted the fields present and introduce difficulties peculiar to themselves. It is shown, however, that proper construction will overcome all the new difficulties so introduced. Although the investigation is still in progress, it is indicated that with metal discharge tubes, properly constructed, the deterioration of the cathode is considerably diminished and the power capacity of the tube considerably increased.—S. G.

H_2S Generator. A. Mayham (*Chemist-Analyst,* 1931, **20**, (5), 23).—The generator comprises a 250 c.c. bottle closed with a rubber stopper carrying a thistle funnel for adding hydrochloric acid, a delivery tube for the gas and a glass rod to the lower end of which is suspended by means of a platinum or tungsten wire a large Gooch crucible containing the ferrous sulphide. By pushing this crucible below the acid, hydrogen sulphide is evolved, and the gas supply is stopped by pulling up the glass rod until the crucible is above the acid surface.—A. R. P.

A Simple Constant Pressure Hydrogen Sulphide Generator. Ralph F. Nickerson (*Chemist-Analyst,* 1931, **20**, (6), 18, 20).—The acid is stored in a large stock bottle placed at some height above a second inverted bottle which serves as the generator. Below the latter is placed a smaller bottle which acts as a trap for the sludge which forms in the generator. The acid from the stock bottle passes down through a long tube which reaches to the middle of the trap, thence upwards by a short tube to the generator. Hydrogen sulphide is taken by a tube which projects, to the top of the inside of the generator and passes through a washing bottle thence to the supply cocks. A third tube reaching to the bottom of the trap serves for removing the sludge therefrom as required.—A. R. P.

VII.—PHYSICAL AND MECHANICAL TESTING AND RADIOLOGY

(Continued from pp. 91–93.)

Material Testing. Ernst Lehr (*Z.V.d.I.*, 1931, **75**, 1401–1409).—A report of the proceedings at the Congress in Zürich of the New International Association for Testing of Materials, September 6–12, 1931.—v. G.

The Stress Distribution in Fusion Joints. E. G. Coker and R. Levi (*Proc. Inst. Mech. Eng.*, 1931, **120**, 569–588).—Models of butt joints have been made in transparent material, and the stress distribution under tension has been examined by photo-elastic methods. In many butt joints the added metal is allowed to form an outer bulge with curved contour, resulting in a thickening of the bar at the weld. Models were made with bulges on both sides of the weld, and also on one side only, giving an unsymmetrical joint. In each case the characteristic is a high stress at the junction of the curved and straight portions, so that in a metallic weld failure may begin at this point even though the bars joined are within the safety limit. A double-butt strap joint was also examined. The method assumes a perfectly made joint, with added material of the same properties as those of the bars which are joined. The limitations of the method and its applications to metal welds are dealt with in a discussion.—W. H.-R.

Torsional Fatigue Tests of Cold-Drawn Wires. F. C. Lea and J. Dick (*Proc. Inst. Mech. Eng.*, 1931, **120**, 661–677).—Wire specimens gripped in ordinary steel collets and subjected to alternating torsion generally break at the grips, and the results are useless for determining the safe range of stress. Special metal moulds are described by means of which the ends of the specimen, after being tinned, are enlarged by casting on a soft white metal head. The metal mould prevents any serious rise in temperature. Results from tests on specimens of steel wires prepared in this way are in agreement with those from tests on spiral springs, and the safe range of torsional repeated stresses may be as much as 20% greater than when fracture occurs at the grips. The experiments refer to steel wires, and do not therefore require abstraction, but they suggest that dry drawing is slightly less destructive than wet drawing, and that the safe ranges of stress may be 50% less than when the specimen is carefully ground so as to remove all surface defects.—W. H.-R.

The Fatigue of Metals. Ph. T. (*Rev. gén. Sci.*, 1931, **42**, 493–496).—A general revue of the present position as regards fatigue and methods of fatigue testing.—W. P. R.

Stresses set up in Freely-Swinging Overhead [Electric] Wires. H.-M. Pape (*Metallwirtschaft*, 1931, **10**, 815–817).—A model of an overhead line is described by means of which it is possible to subject conductor wires to all the stresses met with in practice. With this apparatus the influence of various shapes of clamps has been determined.—v. G.

Plasticity and Tenacity in Notched Specimens. W. Kuntze (*Z. Physik*, 1932, **74**, 45–65).—The mechanism of the extension, contraction, and fracture of notched test-pieces of steel, brass, and Lautal under tension is investigated. Amongst the points examined are the dependence of plastic contraction, tensile limits, tenacity, and cross-section at fracture upon the depth of the nick.—J. S. G. T.

On the Determination of the Elastic Modulus of Rods by Means of Bending Vibrations. E. Goens (*Ann. Physik*, 1931, [5], **11**, 649–678).—The theory of the bending vibrations of a rod suspended from 2 nodal points by means of threads so as to leave both ends free is discussed, and it is shown how to

calculate the modulus of elasticity from its sp. frequency which is measured by comparing the note of the vibrating rod with that emitted by an electrically operated tuning fork, the current actuating which is varied until its frequency is the same as that of the rod, *i.e.* until no surgings can be heard. Results obtained with rods of different materials and with different dimensions show a good agreement between theory and experiment.—v. G.

VIII.—PYROMETRY

(Continued from p. 94.)

On the Regulation of Temperature in Laboratory and Works Practice. D. N. Nasilov and P. P. Schumilov (*Neftjanoe Khoziastvo (Oil Economy)*, 1931, **20**, (6), 492–494).—[In Russian.] Liquid thermostatic controls for gas and electric heaters, metallic thermocouples, for rough temperature regulation (to 0·1° C.), and special fine adjustment control devices accurate within 0·001° C. are described.—N. A.

Thermocouples. Horatio W. Lamson (*Gen. Radio. Exper.*, 1931, **6**, 1–3; *Rev. Sci. Instruments*, 1932, **3**, 57).—A brief article, which deals with three types of thermocouples or thermoelements designated as mutual, contact, and separate heater types. The advantages and disadvantages of each are discussed. Reference is made to commercially available contact and separate heater types mounted in evacuated containers.—S. G.

Use of the Tungsten–Molybdenum Thermocouple. Anon. (*Instrument World*, 1932, **4**, 186).—Read before the Institute of Fuel, North-Western Section, December 9, 1931. The manufacture and use of tungsten–molybdenum thermocouples for the measurement of temperatures up to 1700° C. are briefly described. A neutral point occurs just above 600° C. and the reversal temperature is about 1200° C. The useful range of the couple is thus from 1200° C. to the softening point of the furnace refractory material. At 1600° C. the power of the couple is 8 micro.-v. per degree. Readings taken over a period of 2 hrs. were consistent within the limits of experimental error. The part of the couple exposed to hydrogen at high temperatures became extremely brittle and could not be subsequently cold-worked. A fresh junction had therefore to be made after handling the wires.—J. S. G. T.

A Simple Method of Calibrating Laboratory Thermocouples. D. E. Frear (*Chemist-Analyst*, 1931, **20**, (6), 16).—The couple is placed in the furnace and connected outside with a millivoltmeter; close to the end of the couple are placed 2 stout nickel wires which are connected outside the furnace with a dry cell and a small electric lamp. Pieces of metal of known melting point are placed across the ends of the wires to close the circuit and the furnace current is switched on. The reading of the millivoltmeter is taken when the metal melts and breaks the circuit causing the lamp to go out. Tin, lead, zinc, and aluminium are used for iron–Constantan couples for ordinary laboratory work.—A. R. P.

Improved Potentiometer Pyrometer. Leeds and Northrup Co. (*Brick and Clay Record*, 1931, **79**, 178; *Ceram. Abs.*, 1931, **10**, 792).—The " Micromax " pyrometer is more sensitive, more rugged, and faster in operation, is fully automatic, and eliminates daily attention and adjustments due to a new mechanical balancing device and an automatic standardizer which checks the instrument circuit every 45 minutes or less. Details of construction and operation are given.—S. G.

The Crossed Filament Pyrometer—a New Radiation Pyrometer. H. Grüss and G. Haase (*Siemens Rev.*, 1931, **7**, 298–300).—See *J.*, 1931, **47**, 493.—R. Gr.

IX.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

Plating of Iron and Steel Castings with Cadmium. E. T. Richards (*Giesserei*, 1931, **18**, 516–518).—Practical hints for cleaning the castings, for plating them with cadmium, and for maintaining the plating bath in a good condition are given and the advantages of cadmium plating over zinc plating are pointed out. Cadmium is not a suitable undercoat for nickel or chromium plate, but affords a sufficiently protective coating without these other metals, especially for such articles as the strings of a piano, where, in spite of the vibrations, the coating does not peel. The lustre of cadmium plate may be enhanced by introducing a small quantity of nickel cyanide into the bath or by addition of a colloid such as sulphite–cellulose residues or Turkey-red oil.—A. R. P.

The Electrodeposition of Cobalt–Nickel Alloys.—I. S. Glasstone and J. C. Speakman (*J. Electroplaters' Depositors' Tech. Soc.*, 1930, **6**, 49).—Read at a joint meeting with the Faraday Society. See this *J.*, 1931, **47**, 39, 162.—S. G.

The Electrodeposition of Cobalt–Nickel Alloys.—II. S. Glasstone and J. C. Speakman (*J. Electroplaters' Depositors' Tech. Soc.*, 1931, **6**, 57–63).—Read at a joint meeting with the Faraday Society. See this *J.*, 1931, **47**, 588.—S. G.

Chromium Plating Practice and Theory. W. Pfanhauser and G. Elssner (*Z. Elektrochem.*, 1931, **37**, 874–886).—Critical considerations are given of the constitution and physical properties of baths used for chromium plating, of the effects of different cathode materials, of the differences of the deposit when chromium is plated on to old and on to freshly deposited nickel under-coats and of the throwing power of the baths. E. Müller's hypothesis connecting the hydrogen potential with the character of the base metal was confirmed, and the bath temperature was found to be an important factor. Considerable variation was observed in the measurement of the potential in the case of chromium deposited on to brass owing to the high solution pressure of the metal. The greatest variation was found with nickel cathodes owing to the passivity of the cathodes, which was probably due to the formation of an oxide layer. Differences in the coating were found when it was deposited on to freshly deposited nickel undercoats and on to older ones. The effect of the evolution of hydrogen enters at quite low current densities, so that, in many cases, chromium cannot be deposited with even the highest current densities. The dependence of the potential on the time was also investigated. The second part of the paper deals with the practical determination of the effects of the bath composition and temperature and the form of the cathodes on the potential.—J. H. W.

On Chromium Plating. Anon. (*Metallbörse*, 1931, **21**, 243–244, 291–292, 341–342).—The chemistry of the chromium-plating process is discussed and the effect of varying conditions on the nature of the deposit and the current yield is described.—A. R. P.

Electrolytic Chromium Plating. W. P. Ilyinsky, N. P. Lapin, and L. N. Goltz (*Korrozia metallov (Corrosion of Metals*). *First Pan-Union Conference on Corrosion, Moscow, Nov.* 1–6, 1929); *Transactions of the Institute of Applied Mineralogy*, 1931, 62–69).—[In Russian.] Published more fully in the *Zhurnal Prikladnoi Khimii (Journal of Applied Chemistry*), 1930, **3**, 311–320. Cf. this *J.*, 1931, **47**, 105.—N. A.

Researches on the Production of Electrolytic Chromium Deposits of Sufficient Thickness and free from Fissures and Pores. P. Hentschel (*Metallwaren Ind. u. Galvano-Tech.*, 1931, **29**, 525–526).—When chromium is deposited directly on brass at a current density above 6 amp./dm.^{2} the deposit is broken

up by numerous microscopic fissures, so that when the brass is dissolved away by warming with nitric acid the chromium film is completely broken up into innumerable small flakes. On the other hand, if the chromium is deposited with a current density of less than 6 amp./dm.² the coating is practically free from fissures and pores and, when the brass is dissolved away, it remains as a bright coherent film. The tests show that it is possible to produce thick, lustrous, dense chromium deposits free from pores and fissures by using a low current density and a bath of high throwing power.

—A. R. P.

Chromium Plating of Pure Aluminium and Its Alloys. K. Altmannsberger (*Metallwaren-Ind. u. Galvano-Tech.*, 1931, **29**, 501–502).—The highly-polished articles are electrolytically degreased in an alkaline bath at 7–8 v., whereby the surface is roughened and charged with hydrogen, which prevents oxidation during transfer to the next bath. The articles are then rinsed in water and dipped into a concentrated solution of sodium zincate (prepared by boiling zinc sheet in caustic soda until a solution of d 1·25 is obtained), whereby they become coated with a silver-white adherent deposit of zinc. After washing in water they are next plated with nickel at 2·5 amp./dm.² for 1 minute, then at 1–1·5 amp./dm.² for 30 minutes, in an old citrate bath (100 grm. of nickel sulphate, 15 grm. of sodium citrate, 10 grm. of boric acid, and 2·5 grm. of citric acid per l.). Finally an outer layer of chromium is deposited from any of the usual plating baths.—A. R. P.

Chromium Plating Silver Ware. Anon. (*Metallwaren-Ind. u. Galvano-Tech.*, 1931, **29**, 483–485).—Chromium plating on silver ware adheres most strongly when a very thin nickel undercoat is applied; this undercoat should never exceed 0·001 mm. in thickness, but it is usually sufficient to apply a coating of only 0·0001 mm. in thickness. Chromium can be applied directly to silver (835- or 925-fine), but the deposits are always matt and require polishing. The colour of the plate resembles that of silver only when the plate is extremely thin; the nickel undercoat in no case affects the colour. With a thickness of 0·0005 mm. of chromium the silver remains unaffected for at least 1 hr. in a 2·5% solution of sodium polysulphide.—A. R. P.

The Determination of Some Characteristics of a Hard Chromium Plating Bath. Ed. de Winiwarter and J. Orban (*Rev. Univ. Mines*, 1931, **6**, 173–178). —The effect of additions of 4–20 grm./l. of sodium bisulphate to a chromium plating bath containing 350 grm. of chromium trioxide and 5 grm. of chromic sulphate per litre has been examined. With increasing bisulphate content the hardness of the deposits on steel increases considerably and the resistance to wear increases eventually to 10 times that of a plate obtained from a bisulphate-free bath. The necessary current density and temperature for obtaining satisfactory deposits increase and the throwing power diminishes rapidly with increase in the bisulphate content of the bath.—A. R. P.

Tarnishing of Chromium Plating. W. M. Phillips (*Monthly Rev. Amer. Electroplaters' Soc.*, 1931, **18**, (11), 14–15).—Cf. this *J.*, 1931, **47**, 287 and this volume, p. 96. Cases of so-called tarnishing of chromium plate on brass have been found to be due to peeling of the plate owing to insufficient thickness of the nickel undercoat; for satisfactory chromium plating the undercoat of nickel should be at least 0·0002 in. thick.—A. R. P.

Nickel and Chromium Plating at High Current Density. N. R. Laban (*Elect. Times*, 1931, **80**, (2073), 87).—Full abstract of paper read before the Electroplaters' and Depositors' Technical Society. See this *J.*, 1931, **47**, 39, 106.—S. V. W.

High-Speed Nickel Plating as Practised in England. Ernest R. Canning (*Monthly Rev. Amer. Electroplater's Soc.*, 1931, **18**, (11), 9–12; discussion, 12–14).—Read before the Electrochemical Soc., see this *J.*, 1931, **47**, 221, 359, 495; this volume, p. 97.—A. R. P.

Low p_H Nickel Solutions. A. K. Graham (*Monthly Rev. Amer. Electroplaters' Soc.*, 1931, 18, (11), 31–41; discussion, 41–46).—An account of recent American work on nickel plating at high current density from acid solutions of p_H 2 (cf. this *J.*, 1931, 47, 289).—A. R. P.

Studies in the Electrodeposition of Nickel. I.—The Effect of p_H and of Various Buffering Agents; the Presence of Oxygen in the Deposits. J. B. O'Sullivan (*J. Electroplaters' Depositors' Tech. Soc.*, 1929–30, 5, 37–42, discussion 43).—Read at a joint meeting with the Faraday Society. See this *J.*, 1930, 43, 601–602.—S. G.

The Influence of Small Amounts of Chromic Acid and of Chromium Sulphate on the Electrodeposition of Nickel. D. J. Macnaughtan and R. A. F. Hammond (*J. Electroplaters' Depositors' Tech. Soc.*, 1930, 5, 151–160).—Read at a joint meeting with the Faraday Society. See this *J.*, 1931, 47, 39.—S. G.

The Influence of Acidity of the Electrolyte on the Structure and Hardness of Electro-deposited Nickel. D. J. Macnaughtan and R. A. F. Hammond (*Met. Ind. (Lond.)*, 1932, 40, 171–180; discussion, 180). Abstract of a paper read at a joint meeting of the Faraday Society and the Electroplaters' and Depositors' Technical Society. See this *J.*, 1931, 47, 590.—J. H. W.

New Rhodium Plating Process. Anon. (*Met. Ind. (Lond.)*, 1932, 40, 42).— Short note describing a new process of electroplating jewellery with rhodium, using a solution known as "Wilco." It is claimed that all base metals except iron and alloys containing more than 10% zinc can be plated, even when set with stones, in about 30 seconds. A platinum anode is used, but this is not affected by the solution. The absence of gassing is stressed.—J. H. W.

The Electrodeposition of Silver from Argentocyanide Solutions. Samuel Glasstone and Edward B. Sanigar (*J. Electroplaters' Depositors' Tech. Soc.*, 1929–30, 5, 28–36; discussion, 44–48).—Read at a joint meeting with the Faraday Society. See this *J.*, 1930, 43, 601–602.—S. G.

An Efficient Electro-Tinning Process. F. F. Oplinger (*Met. Ind. (N.Y.)*, 1931, 29, 529–532).—For tin-plating iron, steel, and other metals the following bath is recommended, the figures in parentheses being the preferred composition : sodium stannate 8–18 (12), sodium hydroxide 0·5–2 (1), sodium acetate 2–4 (2), and hydrogen peroxide 0·16–0·66 (0·33) or sodium perborate, 0·12–0·25 (0·12) oz. per gall. Pure tin anodes are used, the best anode : cathode ratio being 1 : 2, the best current density 20–60 amp./ft.^{2} at 4–6 v. and 60°–70° C. The bath will deposit smooth, adherent, semi-bright deposits of any desired thickness at cathode current densities up to 100 amp./ft.^{2} without deterioration over long periods, provided that small quantities of perborate or hydrogen peroxide are added daily to keep the tin in the quadrivalent state. Maintenance of the sodium hydroxide within the above-named limits is of paramount importance for smooth working. Methods of analyzing the bath during use and of preparing the ware for plating are described in some detail.—A. R. P.

Layout of a Small Electrozincing Department. John L. Everhart (*Met. Ind. (N.Y.)*, 1931, 29, 527–528).—A brief description of a small plant used for zinc plating (cyanide process) handle yokes for shovels.—A. R. P.

Galvanic Deposits on Aluminium and Aluminium Alloys. Anon. (*Metallwaren-Ind. u. Galvano-Tech.*, 1931, 29, 531).—In most methods that have been advocated for plating aluminium trouble is caused by peeling or lifting of the deposit owing to the difficulty of removing the oxide film from the metal and keeping the metal unoxidized during transfer from the cleaning to the plating bath. It is claimed that these difficulties are avoided by the Jirotka process, in which the metal is immersed for 15–40 seconds in a boiling bath of unstated composition, after which it can be plated with copper, brass, nickel, chromium, or silver.—A. R. P.

X.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 101–109.)

Bearing Metals. Christopher H. Bierbaum (*Met. Ind. (Lond.),* 1932, **40,** 156–157, 160).—Abstract of a paper presented at a conference on metals and alloys held under the auspices of the Cleveland Engineering Society and the Case School of Applied Science (*Amer. Metal Market,* 1931, Dec. 12). Homogeneous metals never give satisfactory service as bearing metals, which must contain 2 or more phases—*viz.* hard and relatively soft micro-particles. The mechanism by which the various constituents of a good bearing metal act in order to render good service is explained. The chemical composition of a bronze, for example, is not the final criterion of its bearing value, and while heat-treatment may improve the physical properties of the alloy, it may at the same time destroy its hard and soft crystalline structure. The microstructure, therefore, as well as the chemical composition, determines the usefulness of a bearing metal. This applies both to tin-base Babbitt metals and to bronzes. One improvement in bearing bronzes in recent years has been effected by the addition of nickel to the extent of 1%, giving a nickel-phosphor–bronze. The final finishing of bearings should be done with the sharpest possible tool with a light cut at high speed.—J. H. W.

Bearing Metals and Their Behaviour in Practice. —— Kunze (*Maschinenbau,* 1931, **10,** 664–670).—The practical requirements of a bearing metal and its most important properties and methods of testing are discussed with reference to practical experience especially that of the German railways.

—v. G.

Bearing Metals. A. E. (*Machinery (Lond.),* 1930, **36,** 84).—A note of the troubles which arise from pouring at too high or too low a temperature, and from segregation due to insufficient stirring immediately prior to pouring. Mixing " secrets " are imaginary, as the order in which the component metals are melted and mixed is immaterial. The structure of a bearing metal is of far greater importance than its exact chemical composition.—H. F. G.

[**High-Lead Bronze Bearing Alloys.**] D. A. H. (*Machinery (Lond.),* 1930, **36,** 49).—Brief note on the increasing use of high-lead bronzes as bearing metals. The alloys are capable of running for long periods without lubrication; they may contain up to 50% of lead, and when pressed into place must subsequently be reamed, owing to the closing-in which results from the softness of the metal.—H. F. G.

White Metal Antifriction Alloys. F. C. Thompson (*Tin,* 1931, Dec., 4–6).—A good white metal antifriction alloy must have high compressive strength and plasticity, high thermal conductivity, and low rate of wear. The important consideration of interaction between the metal and the lubricant has not yet been studied, but tin or tinning is known to prolong the life of a lubricated bearing. The general properties and applications of tin-base and lead-base bearing metals are compared. In particular, warning is given against hammering a bearing metal surface and against careless melting, which produces tin oxide.—J. H. W.

The Application of Light Metals in the Swiss Postal Administration. —— von Salis (*Hauszeit V.A.W. u.d. Erftwerk A.G. Aluminium,* 1931, **3,** 365–375).—An illustrated article which especially describes the use of aluminium as material for hand-carts for the transport of parcels, small conveyors, &c.—M. H.

Light Metal in the Construction of Railway Wagons for the Traffic in the City of Berlin. C. Wagner (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium,* 1931, **3,** 376–385).—An illustrated account of the application of Lautal and Skleron in the construction of railway wagons, especially for the framework, the skeleton of the roof, and the walls.—M. H.

The Application of Aluminium Alloys in the Construction of Railway Wagons and Tram Cars. Felix Thomas (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1931, **3**, 386–399).—An illustrated article practically identical with a paper by P. M. Haenni in *Z. Metallkunde*, 1931, **23**, 12–18; see this *J.*, 1931, **47**, 168.—M. H.

Development of Aluminium as an Engineering Material. H. H. Richardson (*Engineering J.*, 1930, **13**, 393).—A brief outline of the properties of aluminium and its alloys. The additional cost of aluminium for truck bodies and railway cars is usually returned within a year, as a result of reduced operating costs.
—H. F. G.

Aluminium in the House. Anon. (*Aciers spéciaux*, 1931, **6**, 404–414).—An account of the applications of aluminium and its alloys for internal decoration.—J. H. W.

Alloy 43 in Architecture. —— Baducci (*Fonderie mod.*, 1931, **25**, 433–434).—Abstract of a paper read before the 6è. Congrès Internationale de Fonderie at Milan. Alloy 43 is an aluminium–silicon alloy, very resistant to corrosion, with a breaking stress of 14 kg./mm.^{2} (8·9 ton/in.^{2}), an elongation of 3–7%, and a Brinell hardness of 40. Its weight is $\frac{1}{3}$ that of iron or bronze and its casting properties are said to be very good. It is used on a large scale for constructional purposes, particularly for skyscrapers in the U.S.A.—J. H. W.

Aluminium. H. H. Richardson (*Engineering J.*, 1930, **13**, 712).—A brief note of properties, uses, &c. The 5% silicon alloy is being used in architectural work, principally for window sills and ornamentation.—H. F. G.

A Corrosion-Resistant Aluminium Product. Anon. (*Machinery (Lond.)*, 1930, **36**, 72).—A brief description of Alclad, which is manufactured by lining the casting mould for the aluminium alloy used with sheets of commercially pure aluminium. The billet obtained may be rolled into thin sheets, of which the surface consists of pure aluminium, and which are therefore highly resistant to corrosion; even if the outer layer of metal is removed over a comparatively large area the alloy is not readily attacked, as it is electropositive to the pure metal. The soft, ductile surface of Alclad offers advantages in forming operations, whilst the sheets may be welded without destruction of the surface layer.—H. F. G.

Aluminium in Modern Marine Construction. A. de Biran (*Aciers spéciaux*, 1928, **3**, 642–650).—Aluminium is becoming increasingly useful in modern marine construction work. The composition, mechanical and physical properties, and special applications of aluminium and the principal aluminium alloys are described.—J. H. W.

Aluminium in Marine Construction. A. de Biran (*Aciers spéciaux*, 1931, **6**, 586–594).—The suitability of aluminium and its alloys and their application in marine construction work are described.—J. H. W.

Aluminium–Silicon Alloys as Piston Materials. Anon. (*Engineering*, 1932, **133**, 169).—With the rapid development of aluminium alloys for pistons, the wearing properties of these alloys have become important. Heat-treated " Y " alloy can be obtained with a Brinell hardness of 125, but increasing the hardness does not always mean an increase in wearing properties. The article indicates the possibility of an alloy containing 3% copper and 18% silicon, remainder aluminium, possessing good wearing properties, since the microstructure is similar to that of certain well-known and extensively used bearing metals.—W. P. R.

Aluminium–Silicon Alloys as Piston Materials. L. C. Percival (*Engineering*, 1932, **133**, 184).—Cf. preceding abstract. A letter pointing out that in a slowly-cooled bronze bearing metal the compound existing in the α solid solution matrix is the α and δ compound and not the γ body.—W. P. R.

The Evolution of Aluminium Pistons. Anon. (*Rev. Aluminium*, 1931, **8**, 1521–1527).—The particular applicability of aluminium alloys to piston heads is discussed and the composition and characteristics of suitable alloys, such as Alpax, the 12% copper alloy, K–S alloy and high (20%) silicon alloys are given.—J. H. W.

Development of Light Piston Alloys has Increased Wearing Qualities. Anon. (*Automotive Ind.*, 1931, **65**, 163, 177).—Review of article by E. Mahle in *Automobiltech. Z.* Modified design and production of harder alloys have largely obviated the use of bi-metallic pistons. Temperature is plotted against Brinell hardness for cast iron and for various important piston alloys. Excessive attack in the ring belt is attributed to the marked decrease in hardness at elevated temperatures of light alloys as compared with cast iron. Wear of cylinder wall is ascribed to faulty lubrication of piston rings, and therefore to inaccurate seating of the latter.—P. M. C. R.

All-Metal Aircraft Construction. Anon. (*Machinery (Lond.)*, 1930, **35**, 761–765, 833–836).—The advantages of light metals, such as Duralumin, over steel and wood are outlined ; the modulus of elasticity, rather than the strength, is the deciding factor for many components, and on this basis Duralumin is 1·3 times as strong as steel; thicker, *i.e.*, stiffer members may therefore be used. Details are given of the construction of the type of aeroplane wing developed by the Fairey Aviation Co. : tubular drawn spars and built-up ribs fabricated from 24-gauge sheet Duralumin are used; the spars are cadmium-plated. Wide Duralumin strip is cut into narrow strips in a slitting machine, this procedure having proved preferable to rolling narrow strip. The method of drawing the beading which is riveted along the edges of the webs is described. After fabrication, the Duralumin members are subjected to anodic treatment in a bath of chromic acid. Metal airscrews are now generally adopted; they are made from a single flat forged strip of Duralumin, with a hub thickness of up to 1·5 in. After milling to form, the ends of the blades are bent in a special worm-reduction drive machine.—H. F. G.

Navy Completes U.S.S. Akron. Anon. (*Foundry*, 1931, **59**, (16), 24–27).— Cf. this *J.*, 1931, **47**, 591. The new U.S. Naval Airship ZRS–4, is described and illustrated. The gas-bags, inflated with helium, are secured to a fabricated aluminium frame, which is light but strong.—F. J.

More Airships. Anon. (*Indian Eng.*, 1931, **89**, (9), 198).—Contains a description of a forthcoming American airship. The exterior is to be of Alclad.—P. M. C. R.

Aluminium in Electrical Engineering. E. T. Painton (*Indian Eng.*, 1931, **90**, 478).—Summary of a lecture by P. Aluminium and its alloys readily lend themselves to such cheap methods of production as die-casting, and now that the problem of soldering has been solved, the lightness and non-magnetic quality of these materials should lead to their greatly increased use in the manufacture of electrical plant and apparatus.—P. M. C. R.

132,000-Volt Transmission Line of the St. John River Power Company— Grand Falls to Dalhousie, N.B. R. A. Lowther (*Engineering J.*, 1929, **12**, 499–503).—Steel-reinforced cable, consisting of 26 strands of aluminium, each of 0·135 in. diam., and 7 strands of steel, each of 0·101 in. diam., was used in the construction of a system for the transmission of a total of 60,000 H.P. at 132,000 v. The ultimate strength of the cable is 17,950 lb., and the current-carrying capacity 450 amp.—H. F. G.

Travelling Cranes Built of Aluminium Alloy. E. C. Hartmann (*Power*, 1931, **73**, 518–519).—An unusual design of truss-type bridge travelling cranes built of structural aluminium alloy shows a large decrease in weight and has other desirable features compared with the plate-steel girder type. These aluminium cranes are for shop use, but they suggest possibilities in power-houses and other applications, because of the truss design and light weight.

The 8 cranes recently completed for the United States Aluminum Co. represent a marked departure from the conventional design for overhead travelling types. They have carrying capacities of 5–10 tons and operate on various span lengths, ranging from 51 ft. 10 in. to 76 ft. 6 in. Prior to the construction of the truss-type cranes, a number of aluminium cranes of the conventional box-girder type had been built. Photographs of various cranes are reproduced.—F. J.

Chain Hoist of Aluminium Alloy [Al-lite]. Anon. (*Power*, 1931, **73**, 603–604).—" Al-lite " is the name given to a new aluminium-alloy chain hoist recently brought out by the Chisholm-Moore Hoist Corporation, Towanda, N.Y., U.S.A. Being ½ lighter than the regular chain hoist for the same capacity, the new hoist is more easily handled and is hung in place by one man.—F. J.

Thermal Insulation by Means of Aluminium Foil. Ph. T. (*Rev. gén. Sci.*, 1931, **42**, 626–627).—In general, the loss of heat from a heated chamber is chiefly accounted for by radiation, which in turn, is determined by the emissivity of the outer surfaces of the heated chamber. The emissivity of polished aluminium is sensibly equal to 8% of that of a black body, and thus forms an excellent outer container for furnaces, &c. By using several layers of thin aluminium foil, each layer being separated by means of distant pieces about 1 cm. long, a very efficient form of thermal insulation is obtained. The thermal conductivity of such insulation as determined at the National Physical Laboratory, Teddington, is found to vary from 0.041 cal./in.^{2}/hr./$^\circ$ C. at 50° C. to 0.082 cal./in.^{2}/hr./$^\circ$ C. at 300° C. A particularly important advantage of the use of aluminium foil for thermal insulations is its lightness and non-inflammability.—W. P. R.

Aluminium Paint. Ph. T. (*Rev. gén. Sci.*, 1931, **42**, 692–693).—Aluminium powder used in aluminium paint is obtained by crushing very thin sheets of the metal in the presence of a lubricant. The small flakes so obtained are about 1–2 μ thick, but their diameter may be up to 400 μ. The aluminium used must be at least 99% pure, as iron and silicon contents of more than 1%, give rise to flakes the thickness of which is of the same order as their diameter, and which are unsuitable for making aluminium paint. Various uses of the paint are given in the article, which also states that good aluminium paint reflects 70% of the light which falls upon it, whilst the emissivity is approximately 30% of that of a " black body."—W. P. R.

Choice for Binder for Aluminium–Bronze [in Paints]. Stefan Loewengart (*Farben-Chem.*, 1931, **2**, 463–465; *C. Abs.*, 1932, **26**, 608).—Both aqueous and non-aqueous vehicles are used for " aluminium–bronze," the former for wall-papers and advertizing posters, the latter for general painting and press work. Nitrocellulose lacquers are not desirable vehicles because of their gelatinizing tendencies when mixed with " aluminium–bronze."—S. G.

Beryllium Alloys Improve Springs. A. E. B. (*Sci. American*, 1932, **88**, 58).—The properties of beryllium have been exploited in the manufacture of springs which maintain their elasticity at red heat, from a ferrous alloy containing 1% beryllium, 12% chromium, and 8% nickel.—W. P. R.

Use of Bismuth in Metal Forming. Walter C. Smith (*Metals and Alloys*, 1931, **2**, 236–237).—Bismuth alloys of low melting point are useful for filling brass and copper tubes which have to be bent into coils or spirals; the core prevents collapse and may easily be melted out afterwards without wetting or adhering to the interior of the tube. Wood's metal is useful for making glass-to-metal joints. " Matrix alloy " containing 48% bismuth, 28·5% lead, 14·5% tin, and 9% antimony and melting at 120° C. has recently been developed for mounting dies and punches and for the production of models and templets for the Keller die-sinking machine; it can be cast in green plaster-of-Paris moulds, does not shrink on solidification, and is hard and strong.—A. R. P.

Chromium Plate in Paper Mills. John B. Allen (*Paper Mill*, 1931, 54, (45), 8–9; *C. Abs.*, 1932, 26, 595).—A discussion of the advantages of chromium-plated equipment (callendar rolls, press rolls, felt rolls, pasting rolls, embossing rolls, screen plates, suction box covers, dryers, breaker rolls, and evaporator tubes).—S. G.

Action of Copper in Glass Tanks. M. F. Suhr (*Glasshütte*, 1931, 61, 90–99; *Ceram. Abs.*, 1932, 11, 17).—S. describes tests in which pieces of copper were deposited in a glass tank to ascertain the effect of copper on the glass and the walls of the tank. The copper had no effect, or only a very slight one, on the walls of the tank; it melted and was partly dissolved in the glass. The glass mass in contact with or near the copper was coloured ruby red by the action of the dissolved CuO_2. This colour became paler and changed into pink and green farther away from the copper.—S. G.

The Present Situation in the Use of " Aluminium Bronzes " in Marine Work. R. Loiseau (*Aciers spéciaux*, 1931, 6, 610–612).—" Aluminium-bronze," a copper–aluminium alloy containing about 10% aluminium and certain other metals, such as nickel, iron, manganese, &c., has considerable application in marine work, *e.g.* the manufacture of torpedoes, and in naval construction. The mechanical properties and compositions required of bars, and forged and cast material are given.—J. H. W.

Copper–Zinc Alloys (Brass). Marks. Standards Committee OST. 312 (*Liteinoe delo (Foundry Practice)*, 1930, (4), 29).—[In Russian.] The marks for brass approved by the Standards Committee are given.—N. A.

Metals and their Alloys. James S. Hoyt (*Engineering J.*, 1929, 12, 660).—The composition and properties of various bronzes are briefly described. With new metals alone it is impossible to obtain satisfactory alloys; about 60% of recast material should be used. An alloy of copper 50, lead 50% is very difficult to cast, but is useful for high-pressure packings. Copper castings are very hard and difficult to machine, but ordinary buttermilk provides an excellent cutting lubricant.—H. F. G.

New Ingot Metal Standards. Anon. (*Met. Ind. (N.Y.)*, 1931, 29, 517–518). —A.S.T.M. tentative specifications for bronze, red brass, semi-red brass, yellow brass, and high-lead brass are tabulated and tables showing typical mechanical properties of the specified alloys are appended.—A. R. P.

The Principal Copper Alloys Used in Marine Construction. R. Loiseau (*Aciers spéciaux*, 1928, 3, 629–641).—An account of the compositions, mechanical, and physical properties, and applications of the principal copper alloys used in marine construction.—J. H. W.

Copper Alloys Used in Marine Work. M. Ballay (*Aciers spéciaux*, 1931, 6, 560–574).—The composition, mechanical properties, and applications of tin-bronzes, brasses, tin-brasses, " aluminium-bronzes," cupro-nickel, and special copper-nickel (such as Monel metal) alloys are described. The special problem of corrosion of condenser tubes if discussed at some length.

—J. H. W.

World Copper Use, Cut 18 per cent. in 1930. Anon. (*Elect. World*, 1931, 98, 39).—The world's production of copper in 1930 was 1,750,000 short tons, which is 18% lower than that for 1929. Tables showing how this production was distributed between the chief copper-producing countries, and the chief purposes for which the copper was used, are given.—S. V. W.

Lead versus Compounds for Pipe Joints. E. G. Bradbury, et al. (*J. Amer. Water Works Assoc.*, 1931, 23, 1588–1602; *C. Abs.*, 1932, 26, 542).—Leadite and cement are referred to, especially *versus* lead. The flexibility of lead is a point in its favour; its lack of elasticity is against it. Low cost is always in favour of compounds. Many cases are described where compounds were found to be as, or even more, satisfactory than lead. The general sentiment seemed to favour leadite.—S. G.

Magnesium Alloys in Aircraft-Engine Construction. G. D. Welty (*Soc. Automotive Eng., Preprint,* **1931,** Sept., 1–9).—A common magnesium alloy for castings contains 7% aluminium, 0·4% manganese and has similar properties to the more generally used aluminium casting alloys, but it is distinctly superior in its fatigue-resisting properties. Magnesium alloys, however, appear to be much more sensitive to the presence of sharp corners and small radii, but by careful machining practice and the provision of corners with more generous radii this trouble can be overcome. In some instances it is necessary to increase the section of a casting if magnesium alloys are to be used, but even in these cases there is a net saving in weight of 30–35%. Magnesium and magnesium alloys offer no special difficulty in machining, but they should not be cut with the same tools as are suitable for aluminium. Cutting tools should possess practically no side or top rake; tools suitable for brass are usually also suitable for magnesium alloys. It should be appreciated that in operations where heat may be generated together with the production of very fine machinings, a fire hazard exists, and suitable precautions should be taken. As far as atmospheric corrosion is concerned, magnesium alloy castings and forgings are suitable only in inland areas free from salt spray or salt-laden atmospheres.—W. P. R.

Mercury Drive Turbines. Anon. (*Power House,* 1931, **25,** (3), 51).—An outline of the method of operation and advantages of the mercury turbine, as developed by W. Le Roy Emmet.—H. F. G.

Nickel and Its Alloys in Decoration. Anon. (*Aciers spéciaux,* 1931, **6,** 383–403).—Deals with the use of nickel and its alloys for internal decoration and fittings. (Cf. *Revue du Nickel,* **1931,** April, pp. 35 *et seq.*)—J. H. W.

Applications of Monel Metal in Marine Construction. Jacques Picard (*Aciers spéciaux,* 1928, **3,** 616–626).—Monel metal is particularly useful in marine construction for material in contact with steam and sea-water, and for internal furnishings. The mechanical properties of the alloy are compared with those of other alloys used for such purposes and its special advantages under marine conditions are pointed out.—J. H. W.

Platinum and Its Alloys in Dentistry. Karl Falck (*Festschrift zum 50-jährigen Bestehen Platinschmelze G. Siebert G.m.b.H., Hanau,* 1931, 51–71).— The use of platinum and its alloys as pins for artificial teeth is described in detail and an account is given of the gradual development of various methods of fixing the pins in the teeth, *viz.,* burning the pins in when the teeth are fired, soldering platinum alloy pins into platinum collets which have previously been fired into the teeth, and fusing gold-plated nickel pins into platinum collets in the teeth. Platinum is frequently added to gold alloys used for dentures, springs, and similar devices used in dentistry to produce harder but readily malleable alloys. Recently age-hardening gold alloys with 10–15% platinum and a small percentage of zinc have been introduced into orthodonty.—A. R. P.

Industrial Alloys of Tin. Paul G. J. Gueterbock (*Met. Ind. (Lond.),* 1932, **40,** 61–62, 74).—The industrial applications of tin alloys for solders, anti-friction metals, foil, collapsible tubes, bronzes, terne plates, printing metals, pewter, die-casting, and miscellaneous alloys are reviewed.—J. H. W.

Vanadium, its Ores, Methods of Extraction, and Applications. Anon. (*Metallurgia,* 1932, **5,** 83–85).—The more important vanadium minerals are given and the manufacture of 30–85% and 93–98% ferro-vanadiums is briefly described. The use of vanadium as an alloying element in the manufacture of structural, forging, and tool steels is fully discussed.—J. W. D.

Zinc in Marine Construction. M.-J. Mauri (*Aciers spéciaux,* 1928, **3,** 651–652).—Owing to its great resistance to corrosion, zinc has many applications in marine construction for decoration purposes and for galvanizing.
—J. H. W.

Metal Foil Applications. R. P. Stranahan (*Metals and Alloys*, 1931, **2**, 206–208).—The manufacture and uses of tin, lead, and aluminium foil are described. Aluminium foil is a valuable thermal insulator, as when highly polished it reflects 95% of the heat radiated on to its surface. Several layers of foil 0·25–0·5 in. apart have an efficiency as good as that of any known heat insulator, and are many times less in weight. Aluminium foil insulators have been used satisfactorily for low-temperature work.—A. R. P.

Investigation of Materials to Reduce Steam Turbine Blade Wear. J. L. Ray (*Power*, 1931, **73**, 804–808).—Steam turbine blading has been and continues to be one of the main sources of operating trouble. Although wear has never been excessive, it has necessitated enough blade replacement to justify the researches made to reduce or eliminate it. Stainless iron has definitely proved its worth in decreasing the occurrence of wear and corrosion at the stage where condensation begins, but it fails to show any marked superiority over standard materials in the last stage. In 1927–28 chromium plating attracted attention on account of the great hardness of the deposits. Other tests included shielding strips applied by brazing to the wearing edge of the blade. The material used for the strips was an alloy known as " A.T.V." containing nickel 36 and chromium 12%. Other materials used as shields are tungsten, tantalum, stellite (cobalt 55, chromium 40%), Contracid (nickel 60, chromium 15%), Rezistal No. 7 ' (chromium 25·5, nickel 20%), B.T.G. (nickel 60, chromium 12%), &c. Of these, tantalum and Stellite are the most promising. The investigations, described at length, have been undertaken in order that high-speed low-pressure blades might be produced to give the maximum possible life.—F. J.

XI.—HEAT-TREATMENT

(Continued from p. 110.)

The Chemical Effect of Gaseous Atmospheres in the Bright Annealing of Metals. R. J. Cowan (*Met. Ind.* (*N.Y.*), 1931, **29**, 333–335).—Brass can be bright-annealed in an atmosphere containing hydrocarbon vapours only at above 675° C.; at 425° C. tarnishing occurs. Flue gases free from oxygen but containing a little SO_2 and water vapour in addition to carbon monoxide and carbon dioxide do not affect copper and nickel or their alloys at high temperatures, provided that the metals are free from zinc. Alloys containing zinc are, however, rapidly attacked, but if the moisture is removed from the gas and replaced by methyl alcohol vapour, no attack on the metal takes place at above 540° C., at which temperature the alcohol dissociates into hydrogen and formaldehyde.—A. R. P.

Annealing Plant in the Aluminium Industry. H. Derstroff (*Werksleiter*, 1931, **5**, 438–440).—Some of the types of furnace manufactured by Siemens-Schuckert are described; the possibility of exact temperature control is one of the great advantages in using electric furnaces for the heat treatment of aluminium alloys.—v. G.

The Heat-Treatment of Non-Ferrous Metals. D. Hanson (*Met. Ind.* (*Lond.*), 1932, **40**, 83–84, 108).—The progress recently made in the investigation of the effects of heat-treatment in the development of specific properties of great diversity in an increasingly wide range of alloys is reviewed.

—J. H. W.

XII.—JOINING

On Metallic Cements. L. Arndt (*Z. ges. Giesserei-Praxis*: *Der Modellbau*, 1931, **52**, 31–32).—The composition of cementing material made of alloys of lead, antimony, and bismuth with and without zinc and silver, and melting at low temperatures, and the technique of using these alloys with non-metallic cements, are discussed.—J. H. W.

Low Melting-Point Brazing Alloy [Sil-Fos]. Anon. (*Power*, 1931, **74**, 547).—See this *J.*, 1931, **47**, 596.—F. J.

Copper Brazing in Controlled Atmosphere Furnaces. H. M. Webber (*Metals and Alloys*, 1931, **2**, 284–287).—The parts to be joined are thoroughly cleaned, then covered with copper powder, paste, chips, or wire, and heated in an electric furnace, through which is passed a mixture of hydrogen and carbon monoxide in such proportions that no carburization of the metal occurs. Under these conditions the oxide films on the metals are reduced and the copper runs readily into crevices wetting the metal (*e.g.* steel) completely. The process is useful for joining Widia cutting tips to steel shanks. Various types of furnaces for this kind of work are illustrated and briefly described.—A. R. P.

Silver Solders and Their Uses. R. H. Leach (*Metals and Alloys*, 1931, **2**, 278–283).—Photomicrographs are shown of joints in copper, iron, and 65 : 35 brass soldered with an alloy of silver 20, copper 45, zinc 30, and cadmium 5%; of Monel metal, nickel, brass, and copper soldered with an alloy of silver 50, copper 34, and zinc 16%; of copper soldered with an alloy of silver 65, copper 20, and zinc 15%, and with an alloy of silver 80, copper 16, and zinc 4%; and of iron soldered with an alloy of silver 40, copper 30, zinc 28, and nickel 2%. The joints were made with an oxy-acetylene torch using a reducing flame and a flux of boric acid or alkali fluoride and borax. The longer the time of heating the greater in all cases is the zone of diffusion. Silver solders of the above types flow well into narrow openings and produce sound and strong joints.—A. R. P.

The Important Fluxes in the Welding of Aluminium and Their Applications. Anon. (*Z. ges. Giesserei-Praxis*: *Das Metall.*, 1931, **52**, 122–123).—The composition, properties, and applications of 15 fluxes suitable for use in welding aluminium alloys are described.—J. H. W.

The Electric Arc-Welding of Aluminium. W. M. Dunlap (*Mech. and Welding Eng.*, 1931, **5**, 64–66).—A full description is given of the practice recommended by the Aluminum Company of America. Metallic arc-welding of sheets not thinner than 14 g. is said to be a simple process. Backing strips are necessary, and copper or iron is proposed. [*Note by Abstractor*: These are impracticable in many cases.]—H. W. G. H.

Welding of Aluminium in the Oil Industry. John J. Bowman (*Refiner and Natural Gasoline Manufacturer*, 1931, **10**, 101–110; *Chem. Zentr.*, 1931 102, II, 1915–1916).—Aluminium storage tanks and apparatus are widely used in the American petroleum industry. B. gives a comprehensive review of the methods used in constructing these tanks, &c., with special reference to the welding of joints, the behaviour of fluxes in welding, and the selection of suitable welding rods which generally contain silicon or manganese or both.—A. R. P.

Production of Aircraft Specialties. Anon. (*Indust. Gases*, 1931, **12**, 102–104).—Examples of oxy-acetylene welded steel, aluminium, and Duralumin parts are described.—H. W. G. H.

Welding of Duralumin in Aircraft. Edwin Joyce (*Welding*, 1930, **1**, 447–453; and *Indust. Gases*, 1930, **11**, 94–100).—The results of research carried

out at the U.S. Naval Aircraft Factory are described. Welds performed with rods of Alclad Duralumin, Lynite Duralumin, and 5% silicon alloy showed that ease of welding is in this order. Strength values are given, and show that the cast structure of the welds has less effect than is usually supposed. Considerable improvement is effected by heat-treatment, a tensile strength of 50,000 lb./in.^{2} being obtained in a dressed weld. The important details for welding Duralumin are described, and emphasis is laid on the need for controlling distortion. The composition of a suitable flux is given. Heat-treated welds are usually as resistant to corrosion as the adjoining surfaces, but welded parts not heat-treated are rapidly attacked in the regions adjacent to the weld. Methods for heat-treatment are recommended. No microscopic work is reported, but the results of a scleroscopic investigation are given.—H. W. G. H.

The Oxy-Acetylene Welding of Copper and Aluminium and Some of Their Alloys. Francis A. Westbrook (*Met. Ind.* (*N.Y.*), 1931, **29**, 424–425, 469–470).—Practical hints for welding copper, brass, Monel metal, aluminium, and some aluminium alloys are given.—A. R. P.

The Influence on the Welding of Copper of Small Additions in the Welding Rods. Wilhelm Geldbach (*Autogene Metallbearbeitung*, 1931, **24**, 319–331, 335–345).—In the gas welding of copper, G. considers that agreement has been reached on the questions of technique, choice of suitable fuel gas, and satisfactory mechanical properties of the welds, but opinions differ widely on the choice of most suitable welding rod composition and the use of flux. These points have been investigated on electrolytic, firebox, and commercial Mansfeld copper. Ordinary electrolytic copper rods give welds which are free from oxide in the seam itself owing to the reducing action of the oxy-acetylene flame. Such rods can be used for thin material only. The addition of certain elements to the welding rods lowers the gas absorption capacity and melting point of the pure metal. After a summary of and commentary on previous work, a series of experiments is described to show the effect of addition elements in the rod on fluidity (" flusz ") without introducing considerations of absolute viscosity or surface tension, neither of which can be applied directly. G. does not approve of practical welding as a test, on account of the mechanical breaking up of oxide films by puddling and the mixing of weld metal with the original metal of the sheet. The conclusions reached are based on the length of rod melted off in a given time under standard conditions of heating, and the form of drops produced. The drops are viewed by cinematograph. Examples are illustrated of rods containing phosphorus and aluminium, respectively. Welding rods are divided into three classes, according to their fluidity properties. Type I are such as the high phosphorus-containing rods; Type II, the aluminium-containing rods, whilst type I (*a*) is an intermediate class in which would be put the commercial rods of the Canzler type. The use of a suitable flux will often improve types II and I (*a*) and is an advantage even with type I. A comprehensive summary is given of the properties a welding rod addition element should have and should confer on the weld. Following a discussion of some elements the effect of which is fairly well known, results with both single and two additions to the welding rods are described.

Type I : high phosphorus; lithium.

Type I (*a*) : Titanium, antimony, arsenic, zinc, nickel, silver, aluminium + phosphorus (with flux); Beryllium + cadmium (with flux, if cadmium is low); Phosphorus + cadmium (with flux) and phosphorus + manganese + arsenic (with flux).

Type II : Beryllium, aluminium, magnesium, silicon, manganese, chromium, cadmium (except chromium and cadmium, are converted to I or I (*a*) by suitable flux).

Useless : Chromium + titanium, chromium + beryllium, titanium + iron + uranium, iron + vanadium.—H. W. G. H.

Welding Sheet Copper Products. Anon. (*Indust. Gases*, 1930, **11**, 171–172). —A welding rod containing deoxidizer, a suitable flux, and deoxidized copper sheet should be used. Cold-hammering followed by annealing is recommended.—H. W. G. H.

Bronze Welding for Acetic Acid Plant. Anon. (*Oxy-Acetylene Tips*, 1930, **8**, 227; and *Indust. Gases*, 1930, **11**, 118).—Bronze welding by the oxyacetylene process is said to be the most satisfactory method of repairing copper vessels which were not made from deoxidized copper.—H. W. G. H.

A New Welding Flux for Magnesium Alloys. Anon. (*Aluminium*, 1931, **13**, (10), 7).—Failure of welded joints in magnesium and its alloys is frequently caused by inclusions of flux in the weld; owing to the low sp. gr. of magnesium, fluxes should be used which contain only the lighter alkali metals in combination with fluorine, chlorine, or bromine. Two mixtures specially recommended are (*a*) 0·8–14 parts of lithium chloride to 1 part of potassium fluoride, and (*b*) 1–5 parts of lithium bromide to 1 part of potassium fluoride. The mixtures are used as pastes, dry powders, or as saturated aqueous solutions containing a small quantity of undissolved salt. Such solutions comprise (*a*) 150 grm. of lithium chloride and 75 grm. of potassium fluoride in 1 l. of water, or (*b*) 125 grm. of lithium bromide and 50 grm. of potassium fluoride in 1 l. of water. Glycerin may be added to increase the viscosity and small quantities of potassium chloride or sodium fluoride to reduce the melting point. Welding is preferably effected with an oxy-hydrogen flame.
—A. R. P.

Welding of Nickel. H. Obermüller (*Apparatebau*, 1932, **44**, 12–13; and *Z.V.d. Kupferschmied.*, 1932, **44**, 12–13).—All welding methods can be applied to nickel. Practical hints are given.—M. H.

Gas-Welded and Brazed Joints for High Nickel Alloys. F. G. Flocke, J. G. Schoener, and R. J. McKay (*Internat. Acetylene Assoc. Preprint*, 1931, 1P–10P; and (abstract) *Iron Age*, 1931, **128**, 1489–1490).—Instructions are given for oxyacetylene welding, silver soldering, and brazing nickel alloys. A proprietary flux, solder, and brazing rod are recommended. Applications are described.—H. W. G. H.

Autogenous and Electric Welding of Monel Metal. F. Schüppel and W. Kästner (*Z. Metallkunde*, 1931, **23**, 286–289).—*Oxy-acetylene welding.*—Autogenous welding of Monel metal gives good results if some simple precautions are taken. Welded sheets (3 mm.) have a tensile strength of 48–50 kg./mm.^{2} and an elongation of about 18%, those of 1·4 mm. 53 kg./mm.^{2} and 27%, compared with 53 kg./mm.^{2} and 30% of unwelded sheet. *Electric welding.*— Sheets (1–1·4 mm.) with joints prepared by resistance welding have a tensile strength of 45–50 kg./mm.^{2} and an elongation of 10–21%. Butt seam welding has been applied without success. In arc welding the sheet should be made negative; d.c. gives better results than a.c. According to the microstructure of arc-welded joints, their mechanical properties may be at least as good as those of autogenous joints. In most cases autogenous welding is preferable. The use of a welding flux is unnecessary, if not useless. Monel metal resists well the action of various baths of the dyeing industry containing mordants, soaps, caustic soda, sulphur black, dyestuffs, &c.; it also resists corrosion to a limited extent in hypochlorite solution and formic acid, but is corroded by copper mordants used in the dyeing of furs.—M. H.

Oxy-Acetylene Welding of Galvanized Sheet. Anon. (*Indust. Gases*, 1930, **11**, 177–179).—Bronze welding is stated to have been found effective. Its use in water lines and gas bells is illustrated.—H. W. G. H.

XIII.—WORKING

Mechanics of Plastic Deformation ; Rolling, Extrusion, Drawing, &c. G. Sachs (*Z.V.d.I.*, 1932, **76**, 49–54).—An abstract of articles by S. and others in *Mitt. Material., Sonderheft* **16**, 1931. See *J.*, this vol., pp. 56–58.—v. G.

The Prevention of Recrystallization Phenomena in Metals by Means of a Short Preliminary Annealing Process. A. A. Botchvar (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (5), 582–594).—[In Russian.] Recrystallization phenomena frequently appear in metals and alloys as the result of cold-working, owing to the rise in temperature caused by the mechanical deformation. It is considered that these phenomena, which have a detrimental effect on the mechanical properties, can be prevented by a short preliminary annealing process which removes the effects of work-hardening. As the visible effect of recrystallization is the increase in size of crystal grains, the results of annealing under various conditions were examined by noting the changes in grain-size in tin slabs deformed in a Brinell press. It was found that the rate of crystal growth increased with the temperature, and was very rapid in the first few seconds of the heating period, but then fell off, approaching asymptotically to a grain-size which is characteristic for each temperature. If the slabs were first annealed rapidly (*e.g.* 5–10 seconds) at a temperature of 165°–180° C. (15° C. or more above the subsequent recrystallization temperature of 150° C.) and then air-chilled, before undergoing a prolonged reheating, it was found that recrystallization was completely arrested.—M. Z.

Crystal Structure and Rolling. —— (*Ann. Rep. Royal Mint (Lond.)*, 1929, **60**, 91–93).—Report of the Chemist and Refiner of the Melbourne Branch of the Royal Mint. When a metal is melted and cast, it assumes a crystalline structure, and, on rolling, plastic deformation of the grains occurs in the direction of rolling. In the case of fine gold, this can be seen with the naked eye. In the case of standard gold, the grain distribution cannot be seen without etching and the use of a microscope. If, however, oil is used as a lubricant, the grain structure shows up clearly to the naked eye, the visibility increasing with the viscosity of the lubricant. The structure is removed by passing the fillet through a drag bench, but returns on further rolling. A markedly crystalline fillet was annealed and re-rolled with oil, but the now smaller grains could be observed only with a lens, proving that the lubricant was not the cause. The practical applications of these results are discussed.
—J. H. W.

The Explanation of the Problem of Broadening during Rolling by the Aid of the Hypothesis of Stress Surfaces. W. Tafel and W. Knoll (*Metallwirtschaft*, 1931, **10**, 799–806).—The mechanism of deformation during rolling is explained with the aid of the so-called " tendency to broadening," which should decrease parabolically from the edge to the middle of the sheet. From this hypothesis it is possible to derive the relation between the increase in breadth during rolling and the width of the specimen, the decrease in thickness and the diameter of the rolls. The calculations hold true for lead, copper, and aluminium. Curves for facilitating the calculation are given.—v. G.

Cold-Rolled Metals : The "1931" Standard. A. L. Molineux (*Met. Ind. (Lond.)*, 1932, **40**, 93–96).—The present standard required in rolling metals as regards surface, flatness, and accuracy is discussed and the methods by which these standards are attained in modern mills are described.—J. H. W.

Cold-Rolling Strips by the Steckel Process. Anon. (*Iron Age*), 1932, **129**, 168–167, 212).—In the Steckel process of cold-rolling the strip is drawn through the rolls first in one direction and then in the other, until the required reduction

has been effected. Power is not applied to the rolls, but to the strip by means of power reels, and the rolls of the working pair are notably small in diameter. The features of this process are : that the small working rolls preserve ductility and render the process a reducing rather than a finishing one; the loading-up rolls provide for antifriction mounting; the tension on the strip has a straightening effect maintained on the delivery side, and the material is said to have no centre crown and to be very easy to gauge.—J. H. W.

Metal Lubrication and Roll Cooling in Aluminium Hot Mill Practice. Robert J. Anderson (*Iron Age*, 1931, **128**, 1674–1677).—The relative value of lubricants used in hot-rolling aluminium and aluminium alloy sheet ingots and the practice in some American and European plants are described.   In the case of aluminium, a coating forms on the rolls, and this helps to prevent slippage and acts as a heat insulator, but it may spoil the surface of the rolled product.   It can be removed by lubricants such as oils and greases, but opinion differs as to the advisability of removing it.   A lubrication-cooling system with oil + water emulsions, as used in America, is described.—J. H. W.

The Adjustment of Rolls in Aluminium Rolling Mills by Hand Polishing. R. J. Anderson (*Metallwirtschaft*, 1931, **10**, 897–898).—A polishing stick with a radius of curvature about 0·1 mm. greater than that of the rolls, and covered with grease and polishing powder, is placed between the rolls, which are then allowed to run for several hours, whereby the surface again becomes highly polished.—v. G.

Aluminium Sheet Production. XI.—Planning Methods. Robert J. Anderson (*Metallurgia*, 1932, **5**, 87–90, 127–129).—Methods of planning the mill practice in producing aluminium sheet of various sizes, gauges, and grades are discussed.   The general aspects of planning and the effect of mill practice are considered, and typical mill-tickets and tables for use in calculating are shown.   Typical examples of order calculations are also given.—J. W. D.

An Inquiry into the Causes of the Breakage of Rolls. Frederic Bacon (*Proc. Staff. Iron Steel Inst.*, 1930–31, **46**, 115–135; discussion, 135–143).— Cf. this *J.*, 1931, **47**, 567.   The statistical inquiries of Mort (*J. Iron Steel Inst.*, 1930, **121**, 173) and of Caswell (*Proc. S. Wales Inst. Eng.*, 1930, **46**, 311) have shown that the incidence of roll breakages is greatest at the beginning of the week and is about equally frequent in top and bottom rolls. B. contends that these observations show that the rotary bending stresses to which top and bottom rolls are equally subjected must be responsible for breakages, and that the torque which is present only in the driven bottom roll cannot be a factor in producing failure.   It is computed that normal rolling practice gives rise to a skin stress cycle of about $\pm$ 4 tons/in.^{2}.   This is only about half the fatigue limit of polished chilled iron test-pieces, but notch concentration at flaws and/or heat cracks may easily cause safe limits to be exceeded.   An analysis of the conditions shows that thermal stresses set up by local surface temperature differences may exceed the elastic limit and ultimately give rise to cracks. If the specific rolling pressure is p_t, the average roll temperature θ_0, and the local surface temperature θ_1 (both in ° C.), then the compressive stress in the hot patch is given by : $p = \dfrac{E\alpha(\theta_1 - \theta_0) + mp_t}{1 - m}$, or, putting in the usual values for E, α, and m; $p = 0·2(\theta_1 - \theta_0) + 0·43p_t$.   By preheating before starting, this can be kept within safe limits and the formation of heat cracks largely avoided, with consequent better expectation of service from the rolls. B.'s examination of many roll fractures confirms that failure is often brought about by fatigue.   Investigations are still being pursued, with the co-operation of tin plate mills, by the use of breakage report forms.

—A. B. W.

Plate Bending Rolls. F. H. R. (*Machinery (Lond.)*, 1930, **35**, 767).— Details are given of a method of calculating the diam. of bending rolls needed

for a given purpose, the bending load, distance between centres of supporting rolls, actual support span, deflexion of the plate, and power required. There is no hard-and-fast rule as regards cambering the rolls; the effectiveness of camber depends on the thickness and length of the plate, and these factors determine also the load on the machine.—H. F. G.

The Extrusion of Non-Ferrous Metals and Modern Designs of Hydraulic Presses. R. Barbanel and I. Vishtynsky (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (8), 1025–1048).—[In Russian, copiously illustrated.] The history of the development of extrusion processes in non-ferrous metallurgy is outlined and the theory underlying these processes and their technical details are discussed. Diagrams of presses and reheating furnaces for the production of tubes, rods, and wire are given, and the designs of well-known types of hydraulic presses, their auxiliary machinery, and their operating technique are examined in considerable detail. It is concluded that the modern tendency is to increase the power of the presses (up to about 3000–5000 tons), sometimes without due regard to their economic efficiency, and that it is therefore more rational to fit high- and low-powered presses into a comprehensive scheme in any large works. German workers are considered to be far ahead of the rest of the world in press design and construction.—M. Z.

The Manufacture of Flexible Copper Tubes. W. Greiner (*Apparatebau*, 1931, **43**, 301–302).—A brief description.—M. H.

Structure of Cold-Drawn Tubing. John T. Norton and R. E. Hiller (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. **448**, 1931, 1–14).—The purpose of the investigation was to study the relations between the various factors of a cold-working process and the preferred orientation of the metal crystals resulting from this deformation. The formation of cold-drawn seamless steel tubing was the process investigated. Results of X-ray examination indicate that the structure in cold-drawn low carbon steel tubing is intermediate between that of a wire and a sheet. The structure is independent of the method of reduction and depends only on the dimensional changes which have taken place during the reducing process. Differences in the products of various methods of reduction are ascribed to surface conditions rather than to interior structure.—W. A. C. N.

Researches on the Properties of Drawn Wires and the Power Consumption in Wire Drawing. W. Linicus (*Z. Metallkunde*, 1931, **23**, 205–210).—Abridged from the paper by W. Linicus and G. Sachs published in *Mitt. Material., Sonderheft* **16**, 1931, 38–67; *see J.*, this volume, p. 57.—M. H.

Lattice Distortion of Cold-Drawn Constantan Wire. W. A. Wood (*Proc. Phys. Soc. (Lond.)*, 1932, **44**, 67–74; discussion, 74–75).—The space-lattice of Constantan is found to undergo large distortion as a result of cold-working. A method is described for determining the variation across the section of the wire during the drawing. It is found that (*a*) the distortion on drawing increases quickly to a steady maximum, which is maintained despite further drawing; (*b*) orientation does not begin until the maximum distortion appears; (*c*) just below the surface in the less drawn wires is a region of diminished distortion, but as the wire is further drawn the degree of distortion evens out across the section (this is explained in terms of the action of the die on the surface); (*d*) the temperature-coeff. of electrical resistance exhibits changes in drawing similar to the variation in distortion, and the two properties are practically proportional.—S. G.

The Development of Cold-Cutting, -Punching and -Stamping of Metal Foil. M. Lorcery (*Mem. et Compt. rend. Soc. Ing. civils France*, 1931, **84**, 582–599).—The applications of cold-working of metal sheet and its possibilities are explained, the various operations are described, and the suitability of many metals and alloys for each operation is discussed and illustrated.—J. H. W.

Forging and Stamping Light and Ultra-Light Alloys. E. Decherf (*Aciers spéciaux*, 1931, **6**, 441–452).—Notes on the pouring of the metal are given. Examples are also given of (1) the manufacture of an armature motor pump direct from a bar cut from the ingot by various operations without, and (2) with previous forming, (3) rough shaping by pressing to obtain a shape of the best diameter. The manufacture of other parts of aero-engines is described and the sequence of operations in the manufacture, including the examination for faulty pieces, is given. (See this *J.*, 1931, **47**, 600.)—J. H. W.

XIV.—FINISHING

Coloured Coatings for Aluminium and Aluminium Alloys as a Protection against Oxidation and Corrosion. Anon. (*Metallwaren-Ind. u. Galvano-Tech.*, 1931, **29**, 502–503).—A brief account of the effects which may be produced on aluminium and its alloys and on Elektron by the use of the Jirotka process and a list of cases where the process is of useful or ornamental value. The process itself is not described.—A. R. P.

Colouring of Cadmium Deposits. H. Krause (*Z. Metallkunde*, 1931, **23**, 283–285).—Most of the baths which can be used for the colouring of metals are unsuitable for cadmium. Certain success has been attained by pickling with a mixture of potassium chlorate and copper sulphate. Substitution of copper nitrate for the sulphate produces a pickling solution which yields deep black adherent deposits at room temperature. Pickling with potassium permanganate gives a brown deposit. Numerous formulæ for pickling baths are given. Atmospheric corrosion and salt-spray tests show that the brown colouring does not affect the protective capacity of the cadmium deposit, whereas the black colouring considerably reduces it. (See also this *J.*, 1931, **47**, 118, 235.) —M. H.

The Colouring of Tin, Tin-Lead, and Aluminium Foils. W. W. Rogers (*Met. Ind. (N.Y.)*, 1931, **29**, 341–343).—Recipes for violet, blue, green, red, and gold lacquers for colouring metal foils are given and methods of applying the lacquers to the foil are described.—A. R. P.

Equipment for Cleaning Metal.—VIII. R. W. Mitchell (*Metal Cleaning and Finishing*, 1931, **3**, 631–634; *Ceram. Abs.*, 1931, **10**, 757).—Considerable data are presented on heat losses from tank surfaces, radiating power of surfaces, and the heat conductivity of various materials. Tables for the calculation of heat losses from metal surfaces covered with various thicknesses of insulation are included.—S. G.

Degreasing and Cleaning Metal Parts. A. Burg (*Emailletech. Monats-Blätter*, 1931, **7**, (5), 51–54; *Ceram. Abs.*, 1931, **10**, 757).—In preparing metal pieces for enamelling it is necessary thoroughly to degrease and clean the surface. An annealing process is used to burn off the oil and grease picked up during the working of the piece, or it is cleaned chemically by treating it in baths of organic or inorganic solvents. The latter are divided into three classes, solvents, emulsifying, and saponifying chemicals. The various chemicals that fall into these three classes are enumerated and their respective efficiencies discussed. Some commercial cleaners are also described.—S. G.

Degreasing in Chromium-Plating Technique. Richard Justh (*Metallwaren-Ind. u. Galvano-Tech.*, 1931, **29**, 549–550).—The usual alkaline degreasing baths are not very efficient when the metal surface is coated with a mineral oil or grease, but rapidly saponify vegetable or animal oils or fats. The mineral greases are removed solely by mechanical means, *i.e.* they are melted off and float to the surface of the bath, so that on taking the goods out of the bath they are liable again to become contaminated with grease. Addition of

trisodium phosphate or sodium silicate to the bath effects some slight improvement by causing at least some emulsification of the grease, but the bath soon becomes too dirty for efficient work. All these troubles may be avoided by degreasing with trichloroethylene vapour, which efficiently and completely removes animal, vegetable, and mineral greases from all metal surfaces without deleteriously affecting the metal.—A. R. P.

Degreasing Metals by Vapour Process. E. V. D. Wallace (*Monthly Rev. Amer. Electroplaters' Soc.*, 1931, **18**, (12), 6–11; discussion, 11–15).—The method of removing grease and oil from metal surfaces by exposing them to the action of trichloroethylene vapour is described in detail. The standard tank has an area of 21×48 in., and escape of the vapour is prevented by water-cooled coils arranged at the top of the tank; the loss of liquid (boiling point 86·5° C.) is about 0·046 lb./ft.² of vapour surface in contact with air per hr. The average cost of operation of a manually worked tank is \$3.50 per ton of metal treated.—A. R. P.

Buffing Compositions with Special Reference to the Methods and Materials Employed in Finishing Chromium Irons and Steels. L. R. Eastman (*Monthly Rev. Amer. Electroplaters' Soc.*, 1931, **18**, (11), 15–28).—The composition of buffing pastes for polishing articles to be chromium plated is discussed briefly and methods of obtaining a high finish on non-rusting chromium steels are described.—A. R. P.

Grinding Machine Practice and its Use in Manufacture and Repair. P. W. Peel (*Indian Eastern Eng.*, 1931, **69**, (1), 59–65).—The interdependent progress of the motor industry, the grinding machine, and the development of the abrasive wheel presents numerous problems of lay-out, maintenance, handling, and selection of abrasive and types of machine. Tool and cutter grinding, drill grinding, and the wet grinding process are considered in detail. Various types of machinery are described and illustrated.—P. M. C. R.

Wheels for Smooth Finish. Carborundum Co. (*Abrasive Ind.*, 1931, **12**, (9), 28; *Ceram. Abs.*, 1931, **10**, 744).—Solid grinding wheels capable of producing extremely high finishes formerly attainable only by lapping with compound or other loose-grain agencies are being made. To develop such a grinding wheel it was first necessary to produce uniform grain or grits of finest sizes. Both aluminium oxides and silicon carbide are used in making these wheels, depending on the character of the material to be ground or finished. These powders are said to be as perfectly uniform in individual grit size as science and skill can make them. Grinding machine manufacturers have perfected their machines practically to eliminate vibration. The finishes required must be the result of a progression, a building up of comparably finer finishes with a series of progressively finer wheels, and a consequent diminishing stock removal to prepare the surface for the final finish. The new type of wheel is not expected to do production grinding in the sense of the removal of large amounts of metal.—S. G.

Adopt Abrasive Label. Anon. (*Abrasive Ind.*, 1931, **12**, (9), 41–42; *Ceram. Abs.*, 1931, **10**, 743).—Henry R. Power, chairman of the standing committee on simplification, programme 118, has announced that the U.S. Department of Commerce has authorized a label for use on loose abrasives, by those who are conforming to the grading standards of simplification programme R. 118. The wording, which has official sanction, is as follows : " This abrasive has been made to comply in size with Simplified Practice Recommendation 118, issued by the U.S. Department of Commerce."—S. G.

The Importance of the Water Separator in Sandblasting. C. J. Stiers (*Metal Cleaning and Finishing*, 1931, **3**, 431–432; *Ceram. Abs.*, 1931, **10**, 717).—The many sandblast difficulties resulting from the presence of too much moisture in the compressed air line may be guarded against by the installation of a good water separator.—S. G.

XV.—FOUNDRY PRACTICE AND APPLIANCES

Recent Developments in the Non-Ferrous Foundry Industry. H. C. Dews (*Found. Trade J.*, 1932, **46**, 40–42).—An account of the developments which have taken place in non-ferrous foundry practice during the past year and a review of the more important papers that have been read on the subject during that period.—J. H. W.

Defects in Non-Ferrous Castings. S. G. Homfray, A. Logan, and R. Dowson (*Met. Ind. (Lond.)*, 1932, **40**, 193–194; discussion, 194).—Abstracts of 3 short papers read before the North-East Coast Local Section of the Institute of Metals.—J. H. W.

Deoxidizers and Fluxes. G. L. Bailey (*Met. Ind. (Lond.)*, 1932, **40**, 31–34, 123–126; and *Found. Trade J.*, 1932, **46**, 6).—Abstracts of a paper read at a joint meeting of the London Local Section of the Institute of Metals and the Institute of British Foundrymen. The use of deoxidizers and fluxes in the melting of non-ferrous metals for the production of castings is described. Deoxidizers are considered as elements added to reduce existing oxides; fluxes as compounds added to form slags. The action of the former in combining with oxygen and the removal of the oxide so formed are discussed, and the properties of common deoxidizers are described. In particular, the action of phosphorus, silicon, and boric oxide (B_2O_3) is discussed in detail. Deoxidation is also effected by hydrogen, but carbon monoxide has not yet been applied commercially for this purpose, although a method of using it has been put forward. The purposes and requirements of fluxes are explained and the use of glass as a flux is described. Aluminium cannot be deoxidized by the usual method, and a solution method involving the use of a volatile salt, such as titanium chloride ($TiCl_4$) or bismuth trichloride ($BiCl_3$), is mentioned. Salts, such as zinc chloride–ammonium chloride, are used mainly as a cover. For fluxing magnesium, anhydrous magnesium chloride, " thickened " with fluorides and chlorides, is used.—J. H. W.

Pouring Practice for the Avoidance of Defects in Aluminium Ingots for Rolling. G. L. Craig (*Metals and Alloys*, 1931, **2**, 192–196).—To determine the best pouring practice for aluminium, experiments have been made in a 1-ton stationary gas-fired furnace (open-flame) under works conditions using (*a*) remelted virgin aluminium (99·5%), (*b*) the same with the addition of 40% of mill scrap, and (*c*) secondary aluminium (98–99%). After the charge reached 815° C. a mixture of 1 part of cryolite and 2 parts of ammonium chloride was thrown over the surface and the whole violently stirred; the doors were then closed for 10 minutes, after which the dross was removed and the metal tapped into a No. 150 plumbago pot for casting. Out of the various methods of pouring tried, the best results were obtained by pouring quietly down the sides of the mould using a tilting angle of less than 10° and a pouring time of 3 minutes for 100 lb. The mould was of the book type, but the walls tapered outwards towards the bottom, so as to provide a large body of metal there to equalize the cooling rate, and thus prevent the development of pouring stresses. The best mould temperature was found to be 175°–225° C., higher temperatures tending to produce blisters; the casting should be removed from the mould at 420°–480° C. Under the above conditions all the types of aluminium tried gave sound castings with the minimum length of pipe, virgin aluminium producing by far the longest pipe. On rolling, cracks developed, with too severe work, along the boundary between the outer zone of columnar crystals and the inner zone of equiaxed grains. In impure aluminium the iron-rich phase is arranged in a dendritic manner in the outer envelope of columnar crystals and in a polygonal manner in the inner equiaxed zone.

—A. R. P.

Properties of Aluminium Castings as a Function of the Temperature of Pouring, Method of Cooling, and Dissolved Gas. M. Barbero (*Fonderie mod.*, 1931, **25**, 435–436).—Abstract of a paper read before the 6ᵃ Congrès Internationale de Fonderie at Milan. The melting and pouring of light alloys, particularly the American alloy 92 : 8 aluminium–copper, and the absorption of dissolved gas by this alloy are investigated. Pouring at 630°–680° C. is the most suitable for the highest resistance to corrosion and the best structure of the alloy; higher temperatures are less suitable, owing to the increased interval between the liquid and the completely solid states thereby accentuated. This practice also gives the highest fatigue limit. At temperatures above 750° C. the alloy absorbs large quantities of various gases, all of which are not equally injurious. In some cases, for instance, they may even be of advantage in increasing the fluidity of the metal.—J. H. W.

Casting Strip in Aluminium for Rolling. P. Pontremoli (*Fonderie mod.*, 1931, **25**, 433).—Abstract of a paper read before the 6ᵃ Congrès Internationale de Fonderie at Milan. Aluminium should be melted and cast at as low a temperature as possible, chiefly owing to the ease with which it absorbs gases at high temperatures. All gases except hydrogen and coal gas are absorbed above 800° C., and the best way of removing them is to allow the metal to remain in the furnace at 670°–680° C. The temperature is finally raised to about 700° C. immediately before pouring. To avoid segregation and to obtain a homogeneous crystalline structure, the ingot moulds must not be heated to more than 300° C. The results of a series of experiments indicate that pouring should begin at 730° C. and end at 700° C., the mould temperature being 250°–300° C. on the outside. The rate of pouring is given as 8–10 kg./minute (17·6–22·2 lb./minute) for strip at least 70 mm. (2·75 in.) thick.—J. H. W.

Smelting Secondary Aluminium and Aluminium Alloys. XI.—Metal Recoveries in Secondary Aluminium Practice. Robert J. Anderson (*Met. Ind.* (*N.Y.*), 1931, **29**, 474–476).—Factors affecting recovery of aluminium from scrap are discussed; removal of oil by a low-temperature burning and of iron by means of a magnet is essential. Baling should always be practised when treating sheet and other fine scrap.—A. R. P.

Smelting Secondary Aluminium and Aluminium Alloys. XII.—Recoveries Secured in Practice on Different Kinds of Scrap. Robert J. Anderson (*Met. Ind.*, (*N.Y.*), 1931, **29**, 519–520).—The possible recoveries of aluminium in ingot form from numerous types of scrap under practical conditions are indicated. Recovery depends on the nature of the scrap, and for any given grade of scrap it depends on the pre-treatment, furnacing methods used, and the skill of the operator. Factors adversely affecting recoveries are briefly discussed.—A. R. P.

Practical Points in the Manufacture of High Strength " Aluminium Bronze." Anon. (*Z. ges. Giesserei-Praxis*: *Das Metall*, 1931, **52**, 118–119).—An " aluminium–bronze " with very good mechanical properties contains copper 90–93 and aluminium 7–10%. The 10% aluminium alloy is very hard, and is worked only with great difficulty. Usually not more than 7–8% aluminium is used. Deoxidation is done with 10% phosphor–copper. Various practical points in the preparation of this alloy are discussed.—J. H. W.

Is It Profitable to Melt and Roll Scrap of Nickel–Brass and Similar Alloys ? Anon. (*Z. ges. Giesserei-Praxis*: *Das Metall*, 1931, 52, 119–120).—The operation of melting nickel–brass scrap is studied and the economics of the process as compared with that of melting from virgin metal are discussed. It is shown that the use of scrap effects a very considerable saving in cost.—J. H. W.

Bronze in the Foundry : Notes on the Compounding and Founding of Bronze. Wesley Lambert (*Met. Ind.* (*Lond.*), 1932, **40**, 85–87).—The multiplicity of bronze specifications in use at the present time is of doubtful

advantage, and is a definite disadvantage in the foundry. It is suggested that about 20 " mixings " would fulfil all the requirements of engineering expected of this class of alloy. The composition of these suggested alloys, the preparation of the moulds, and precautions to be adopted in casting the alloys and the positioning of cast-on test-bars are discussed.—J. H. W.

Bronze Pressure Castings. J. E. Crown (*Met. Ind.* (*N.Y.*), 1931, **29**, 335–337).—Read before the American Foundrymen's Association. See *J.*, this volume, p. 123.—A. R. P.

Oxidation—A Cause of Porosity in Leaded Bronzes. E. Doughty (*Metals and Alloys*, 1931, **2**, 181–183).—In cored castings of lead–bronzes containing 10–25% lead a ring of holes is often produced just inside the casting skin around the core. Increasing the permeability of the core or coating the core with graphite does not stop the trouble, but sound castings are generally obtained with green sand cores, although their preparation is costly and tedious for large-scale production. Much more satisfactory results are obtained by melting the metal under neutral or slightly reducing conditions and deoxidizing with zinc or phosphor–copper just before casting. When zinc is used, the maximum amount permissible in the bronze, together with a quantity sufficient to make good the furnace losses, must be added. When phosphorus is used, not more than 0·05% must remain in the casting, but even this is sufficient to cause brittleness if the bronze contains iron.

—A. R. P.

The Effects of the Products of Combustion on the Shrinkage of Metal in the Brass Industry. C. Upthegrove and A. J. Herzig (*Dept. Eng. Research, Univ. Michigan Eng. Research Bull.*, No. **22**, 1931, 1–66).—The composition of the furnace atmosphere affects the shrinkage of brass by controlling to a considerable extent the conditions on the surface of the molten metal, and the condition produced on the surface by a given composition of furnace atmosphere depends on the composition of the alloy being melted. The shrinkage of a brass in a given furnace and composition of furnace atmosphere is a function of the time, the temperature, and the rate of flow of the gases through the furnace. Increasing the time and temperature of melting results in a higher shrinkage, and increasing the rate of flow of the gas, in general, gives higher shrinkage values. Shrinkage occurs either by volatilization or by oxidation of the alloying constituents, and the shrinkage of alloys in which volatilization losses predominate is less in moderately oxidizing atmospheres than in neutral or reducing atmospheres, whilst the shrinkage of alloys in which oxidation losses predominate is less in reducing or neutral atmospheres than in oxidizing atmospheres. Shrinkage is also proportional to the ratio of exposed surface of metal to the mass of metal. The use of fluxes as a means of lowering metal shrinkage must be based on similar considerations to those obtained by furnace–atmosphere control; by preventing by means of a protective crust contact of furnace gases with the metal and retarding volatilization where volatilization losses predominate, and preventing oxidation where oxidation losses predominate. High-zinc brasses should be melted in oxidizing atmospheres and low-zinc brasses in neutral atmospheres.—J. W. D.

The Melting of Thick Brass Castings. Anon. (*Z. ges. Giesserei-Praxis : Das Metall*, 1931, **52**, 117–118).—For the successful melting of heavy brass castings, the following precautions must be observed : (1) close control of the raw materials, (2) use of a good covering material, (3) careful use of preheaters, (4) the metal must never be melted in the preheaters, (5) the brass must not boil, (6) it must not be kept in the furnace longer than necessary, (7) the additional metals must be kept handy, (8) deoxidize with 15% phosphor–copper, never with any other metal, (9) remove all slag very carefully before pouring.—J. H. W.

XVI.—FURNACES AND FUELS

FURNACES

Vacuum Casting [of Platinum]. H. T. Reeve (*Metals and Alloys*, 1931, **2**, 184–185).—Apparatus for melting and casting platinum *in vacuo* using a 35 kva. Ajax-Northrup H.F. induction furnace is described and illustrated. A long silica tube with a second tube sealed at right angles to its upper part is placed inside the furnace coil; the upper end of the tube is closed with a fused-on transparent silica plate and the lower part is held tightly by a brass collar to a rubber stopper through which pass the tube connecting with the vacuum pump and a movable rod which serves to support a quartz pedestal holding the melting crucible and to move the crucible into position for casting. The side tube contains a graphite or nickel mould and is closed by a large rubber stopper which is held against the end by the action of the vacuum inside the tube. The melting crucible may be made from fused zirconia powder which has been ground through 100–200 mesh in an iron mill and extracted with hydrochloric acid to remove iron; the dry powder is tamped into a quartz crucible around a small block of platinum coated with several layers of ashless filter paper to allow for shrinkage, and the lining is then sintered by heating the platinum to 1700° C. in the induction furnace. Alternatively an alundum crucible may be used provided that it has previously been fired at 1600° C. for some time in an oxidizing atmosphere. To melt platinum *in vacuo* in this furnace the metal is placed in the zirconia or alundum crucible supported on the quartz block inside the coil and the vacuum tube with side-arm is placed over the crucible; the pump is started and the rubber stopper held against the end of the side-arm until it adheres tightly, pumping is continued until the pressure is reduced to 1–2 mm., and the current is then switched on. Melting of 20 oz. of platinum takes only 3–4 minutes, the crucible is then pushed up the vacuum tube by means of the rod and lifting gear until the lip is in position against the mould for pouring, and the whole of the furnace is then tilted slowly about a hinged foot to cast the metal into the mould. The vacuum can be broken immediately the casting has solidified. Platinum ingots cast in this way can be drawn down to wire 0·003 in. in diam. in one continuous operation.—A. R. P.

Modern Electrically Heated Aluminium Melting Furnace. —— Kirchrath (*Metallbörse*, 1930, **20**, 2731–2732, 2779–2780).—Two types of resistance furnaces of the reverberatory type for melting aluminium are described and illustrated diagrammatically. In one type coils of Nichrome wire in longitudinal channels in the roof serve as heat radiators and in the other bands of chromium–nickel alloy serve to heat thin carborundum plates which act as heat radiators. The oxidation losses are reduced to a minimum owing to the stationary atmosphere in the furnace. The average current consumption is 550 kw.-hr./ton, corresponding with a thermal efficiency of 50–60% compared with an efficiency of 25% for fuel-fired furnaces.—A. R. P.

Electric Furnaces. A. W. Sibilev (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (2), 262–286).—[In Russian.] A detailed description, illustrated with numerous photographs and diagrams, of the present designs and practice of electric furnaces, both for melting and heat-treatment of metals and alloys, in America. The information has been obtained mainly during S.'s tour of inspection of non-ferrous and ferrous metallurgical works in U.S.A. and also from published data.—M. Z.

New Electric Furnaces. E. Fr. Russ (*Electrochem. Soc. Preprint*, 1932, April, 109–113).—The Russ induction furnace has been successfully applied to large-scale melting of non-ferrous metals at a decided saving in energy as compared with melting in small units. The hearth-type furnace for aluminium melting consumes 450 kw.-hr. per ton of metal. Electric annealing in the induction furnace has been commercially applied to copper and brass strip up to 120 cm. wide and 3 mm. thick. For brass strip the total annealing and pickling consumes 110 kw.-hr. per ton.—S. G.

The Electric Furnace in the Patent Office. Joseph Roszman (*Electrochem. Soc. Advance copy*, 1932, April, 101–108).—The U.S. Patent Office is a branch of the Department of Commerce, which was created by Congress for the purpose of granting patents to inventors for new and useful inventions. The actual work in examining and passing patent applications is performed by a corps of patent examiners, who carefully study the applications to determine their novelty as well as to see that all legal provisions as required by the patent laws are complied with. An important duty of the patent examiner is also to determine whether an application for a patent filed by an inventor accurately and fully describes an invention of sufficient utility and originality to be patentable. In order to be able to determine the novelty of any given invention and to facilitate searches in prior patents, nearly 2,000,000 U.S. patents have been classified into about 300 main classes, each class in turn being subdivided into smaller related sub-classes. The Patent Office possesses two sets of these classified patents. One set is used solely by the examiners in their rooms, and the other set is in the search room, where it may be consulted by the public. The U.S. Patent Office is constantly revising its patent classification as any given field of investigation grows and expands in new directions, or entirely new fields of invention develop. No separate class existed for electric furnaces until 1931, when about 2000 patents relating to the electric furnace were gathered together and classified into official class 13—Electric Furnaces. It is the purpose of this paper to present the outline and definition of this class and its sub-classes, on account of its practical interest and value to those interested in the commercial development of the electric furnace.—S. G.

XVII.—REFRACTORIES AND FURNACE MATERIALS

Refractory Materials for Electric Furnaces. Alfred B. Searle (*Met. Ind. (Lond.)*, 1931, 39, 435–437).—Cf. this *J.*, 1931, 47, 119, 307, 619. The most suitable refractories for electric furnaces used for melting various metals and their alloys are discussed. Tin and its alloys have such low melting points that they are usually melted in iron vessels, but when an electric furnace is used. as in smelting, the lining is usually magnesite brick, although chromite and fireclay bricks are also suitable. For melting aluminium, either a resistance furnace with an iron pot or an inductance with a fritted or graphite–fireclay crucible is used; furnaces for melting aluminium alloys are lined with fireclay with and without plumbago. For smelting zinc, electric furnaces are not usually used in England, and, in any case, no lining appears to be completely satisfactory. For melting zinc alloys, ordinary firebricks or, better, bricks made of aluminous clay are used. Linings suitable for zinc alloys are, in general, suitable for copper alloys.—J. H. W.

Refractory Materials for Electric Furnaces. Alfred B. Searle (*Met. Ind. (Lond.)*, 1931, 39, 483–484).—Although bullion does not produce corrosive slags, these may be formed in the later stages of melting when lead is used. Bone-ash, marl, and magnesia are used to absorb the lead oxide and for refining the bullion, fireclay, magnesite, or silica bricks are used. In high-fre-

quency furnaces for simple fusion of bullion, graphite or plumbago crucibles are used. Furnaces for electrolyzing magnesium are lined with unfused electrolyte and those for melting magnesium and its alloys with fireclay or magnesite. The linings for furnaces used for melting sundry metals and metalloids such as antimony and sodium must each be chosen according to the specific requirements of the individual cases.—J. H. W.

Refractory Materials for the Induction Furnace (continued). R. J. Sarjant (*Fuel Economist*, 1931, 7, (74), 67–70).—Cf. this *J.*, 1931, 47, 619. Tests of crucibles made of magnesite, zircon ball-clay mixtures, silica, magnesia–zircon mixtures are briefly discussed. Methods of finishing the top of the lining of coreless induction furnaces are referred to, and future developments in induction furnace linings are briefly discussed.—J. S. G. T.

Foundry Refractories. Jas. R. Allan (*Trans. Bull. Amer. Found. Assoc.*, 1931, 2, (12), 569–576; discussion, 577–584).—Deals with refractories for malleable iron furnaces.—S. G.

Zircon Bricks for Metallurgical Furnaces. W. Herrmann (*Feuerfest*, 1931, 7, 146–147).—In metallurgical furnaces zircon bricks are very resistant to acid slags at temperatures up to above 1800° C., and their resistance to basic slags is greater than that of other bricks. They are readily attacked only by ferrous silicate slags.—v. G.

Use of Magnesite in Furnaces Fusing Copper in the Krassny Vyborjets Works. D. D. Voieikov (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1930, 5, 1039–1048; *Ceram. Abs.*, 1932, 11, 36).—[In Russian.] The advantage of magnesite over Dinas brick, clay, and quartz is its resistance to basic slag in fusion. It was used with success for walls and arches in furnaces refining copper. Its weak points are its sensitivity to temperature changes and dilatation. Dilatation of magnesite occurs in a continuous manner, but only during cooling. The apertures must therefore be carefully luted and the furnace cooled slowly when work ceases. An experiment was made to combine magnesite with Dinas brick. An intervening layer of chromite was found unnecessary. To assure strength, the furnace walls were slightly inclined. The thickness of the walls was equal to two bricks : a magnesite brick in the interior, then a half Dinas brick, and a half clay brick.—S. G.

Note on " Carborundum " as a Refractory for Melting Standard Gold Alloy. C. R. Robson (*Ann. Rep. Royal Mint* (*Lond.*), 1929, 60, 132).—Report of the Assayer of the Melbourne Branch of the Royal Mint. Pots for melting standard gold in an electric furnace were lined with carborundum and 10% clay. After many melts, the alloy was found to have penetrated into the lining and the metal recovered was a purplish-grey colour and very brittle after remelting. It was found to contain 0·14% silicon. Another charge kept molten for 8 hrs. for each of 2 days and cooled in the pot was also too brittle to roll and contained 0·07% silicon. It appears that 0·04% silicon in standard gold renders it unfit for rolling. The mechanism by which the silicon is introduced into the alloy in the furnace is discussed.—J. H. W.

Special Refractories for Use at High Temperatures. Wm. H. Swanger and Frank R. Caldwell (*Met. Ind.* (*Lond.*), 1932, 40, 149–152, 199–200).—Abstract of *U.S. Bur. Stand. Research Paper* No. 327. See this *J.*, 1931, 47, 619.—J. H. W.

Refractory Jointing Cements. A. T. Green, F. Wheeler, and H. Booth (*Gas J.*, 1931, 196, (Suppt. Oct. 28), 24).—22nd Report of the Refractory Materials Joint Committee of the British Refractories Research Association. The refractoriness-under-load test has been applied to study the temperature range at which contraction of a jointing cement becomes appreciable, and thus to define the temperature limits of its structural stability.—J. S. G. T.

Progress in Refractory Materials. Anon. (*Manchester Guardian Commercial*, 1931, 9, (24), 290; *Ceram. Abs.*, 1932, 11, 36).—A general account is

given of the recent progress made in magnesite refractories. The properties of magnesite brick of various compositions have been studied, showing that certain properties of the brick are those of the bond rather than those of the magnesia. The results of recent researches are summarized, particularly those of Hirsch on the softening range under load and of Miksch and Salmang on the slag-resisting properties of magnesite.—S. G.

The Possibility of Sillimanite Minerals as Refractories. Frank H. Riddle (*Trans. Electrochem. Soc.*, 1931, **59**, 35–50).—See this *J.*, 1931, **47**, 622, and following abstract.—S. G.

Examination of Refractory Products.—VI.–VIII. Marcel Lépingle (*Rev. mat. constr. trav. pub.*, 1931, (260), 87–89B; (261), 105–107B; *Ceram. Abs.*, 1931, **10**, 782).—Methods are given for testing the resistance of refractories to chemical agents and to fluxes. The " Dortmund Union " is recommended for determining which tests are absolute, which give relative or partial results, and which are only qualitative.—S. G.

Methods for the Evaluation of Refractories. L. Belladen and C. F. Becchi (*Met. italiana*, 1930, **22**, 870–877; *C. Abs.*, 1930, **25**, 5532).—The methods of analysis for refractories have not been satisfactorily standardized. *Determination of SiO_2* : two evaporations and subsequent filtrations are necessary, but the intermediate ignition to 110° or 150° C. is of no help. Either H_2O or HCl is satisfactory in washing the precipitate, but the use of $HClO_4$ causes loss of SiO_2. *Al_2O_3* : NH_4 salts in moderate excess do not interfere in Al_2O_3 determinations. The Al_2O_3 is washed with *neutral* NH_4NO_3 solution. Large amounts of alkali salts do not interfere. The solution should not be boiled after precipitation, as this makes the subsequent filtration more difficult. The method of Wöhler, Chancel, and Carnot gives excellent results, the precipitate filters rapidly, but ignition of the precipitate must be prolonged. *Fe_2O_3* : the best gravimetric determination consists in converting to FeS and then roasting this to Fe_2O_3. The Zimmermann–Reinhardt is the best volumetric method. *TiO_2* : the colorimetric method is preferred. *CaO and MgO* : when present in small amounts, as is usually the case, precipitation with $(CO_2H)_2$ in the presence of either methyl orange or phenol blue is satisfactory, no MgO being occluded. *Alkalis* : the method of J. Laurence Smith is recommended. With the above methods a very rapid method for the analysis of refractories is outlined.—S. G.

Tests on Refractories. Ch. Meurice (*Ind. chim. belge*, 1930, **1**, 203–212, 253–268; *Ceram. Abs.*, 1932, **11**, 34).—The most important tests are dilatation and deformation under load. Fusing tests are made on samples shaped like Seger cones made from powder of the sample mixed with starch. It is important to increase the temperature progressively from 5° to 10° per minute, beginning at 1400° F. (760° C.), to obtain constant results. Theoretically, there are 2 softening points in the SiO_2–Al_2O_3 system : one at 1545° C., the other at 1810° C. In practice these points are lowered by impurities. The beginning of softening is not noticeable during the heating of a refractory because the fusible ingredients are generally present in small quantities, and consequently the sample does not lose its shape. In fusing tests under load the beginning of the liquid phase corresponds with the beginning of the deformation of the sample. The degree of firing of silicate materials can be ascertained from the dilatation tests because of variations of the dilatation of silica. This test is made on the Chevenard dilatometer. It is possible to determine the varieties of SiO_2 present in the brick from the anomalies in the firing curve. The amount of swelling or shrinkage after firing indicates the degree of firing and whether or not the quartz is totally transformed. Silica bricks show a strong anomaly at 250° C. (tridymite and cristobalite) and resist changes in temperature well between 1500° C. and 250° C., but will break when they are suddenly cooled from 250° to 100° C. (the heat of a match may suffice). A

well-fired silica brick must have a density of 2·35; that of industrial products varies from 2 to 2·3. Quartz has a density of 2·65, cristobalite 2·32, and tridymite 2·26. Cold compression tests are seldom made. Heat tests are important for products having to bear heavy loads. Stability to chemical and fusing agents is ascertained by heating the brick in the presence of slag or corrosive products to which the brick will be exposed. The coeff. of thermal conductivity is given by the formula, $K = \dfrac{Q \times E}{T_1 - T_2}$; where Q is the quantity of heat transferred per second through the wall per unit of surface, E is thickness, and T_1 and T_2 are exterior and interior temperatures. There is no good method for making this determination.—S. G.

High-Temperature Tensile Tests on Refractories. J. N. Chesters and W. J. Rees (*Refract. J.*, 1931, **7**, 475–479).—Read before a joint meeting of the Shef-field Branch of the N.A.C.M. and the Refractories Association. Apparatus is described whereby refractory materials may be heated to 1500° C. in a molybdenum wire-wound furnace under a tensile load of 8 or 15 lb./in.² and their breaking temperatures determined. The materials include magnesite, magnesite cement, mixtures of magnesite and chrome, magnesite and zircon, zircon, ball clay, and certain cupola-lining materials. The results on mag-nesite show that the commercial materials tested had a breaking temperature between 1400° and 1500° C. under a load of 15 lb./in.². This temperature indicates the softening temperature of the material bond. A 50 : 50 mixture of magnesite and chrome was found to have a breaking temperature higher than either magnesite or chrome. Where intercrystallization occurs, as, for instance, in silica brick, the breaking temperature is nearer to the fusion point of the brick than in the case of material whose bonding depends on a less refractory cement.—J. H. W.

The Thermal Expansion of Some Refractory Oxides. James Bliss Austin (*J. Amer. Ceram. Soc.*, 1931, **14**, 795–810).—The thermal expansion of crystals of α-alumina, magnesite, chromite, mullite, and zircon and of a mass of fused zirconia have been measured up to 1000° C. The results are exhibited in tables and in graphical form.—S. G.

Tentative Method of Control Test for Resistance of Fire-Clay Brick to Thermal Spalling Action (C 38–31 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1931, 282–283).—This method of control test is intended for determining the comparative resistance of high-duty fire-clay brick to spalling action by subjecting them to repeated rapid temperature changes. It is not to be used as a suitability test, as experience has shown that results obtained in this control test are not comparable with results obtained in service on the same brand of brick. This test is of value, however, as a control test in main-taining the uniformity of fire-clay brick in so far as spalling is concerned.

—S. G.

Tentative Definitions of Terms Relating to Heat Transmission of Refrac-tories (C 71 –31 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1931, 284–285).—The terms defined are as follows : thermal conductivity; thermal resistivity; resistance; conductance; film resistance; surface coefficient; total resistance; transmittance; transmission.—S. G.

Tentative Revisions of A.S.T.M. Standards. Standard Definitions of Terms Relating to Refractories (C 71–31). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1931, 925).—Standard definitions published under the title " Tentative Definitions of Terms Relating to Heat-Transmission of Refractories " (C 71–31 T) are intended to be added to the present definitions. (See preceding abstract.)—S. G.

XVIII.—MISCELLANEOUS

My Impressions of the Second (Triennial) Empire Mining and Metallurgical Congress, Canada. W. Cochran-Carr (*Trans. N. of England Inst. Min. Mech. Eng.*, 1928, 78, (2), 72–82).—A general account.—H. F. G.

The Application of Physics to Metallurgy. H. W. Gillett and H. W. Russell (*Physics*, 1931, 1, 1–12).—The relation of physics to metallurgy, the science underlying the metal-working industry, and the need of men properly trained in physics to advance the science of metallurgy are outlined in a very readable article.—J. S. G. T.

The Story of Early Metallurgy.—VIII. R. T. Rolfe (*Met. Ind. (Lond.)*, 1931, 39, 459–460, 485–486).—Conclusion of the series. The distribution of European tin deposits and its influence on the principal trade routes from the Mediterranean are discussed.—J. H. W.

Analysis of Materials of the Middle Bronze Age. Wm. B. Meldrum and Arthur E. Palmer (*J. Chem. Education*, 1931, 8, 2171–2174).—An analysis of various metal articles found at Beth Shemesh, Palestine, is tabulated. These articles were mostly bronzes of Egyptian origin or manufacture, the copper coming from Sinai or Cyprus and the tin from the Phœnicians. The results of the analysis show that from the third to the eighteenth dynasty, no definite progress in the manufacture of bronzes seems to have been made. Photomicrographs show that the material, at least in some cases, was not cast, but forged at a temperature below 500° C.—J. H. W.

Recent Advances in Non-Ferrous Metallurgy. Anon. (*Metallurgia*, 1932, 5, 95–96, 135–136).—A survey of the metallurgical literature of the last 12 months indicates the trends of advance which have revealed themselves most distinctly. New and improved metals and alloys are considered, and reference is made to beryllium, to the new alloys of aluminium and of copper, to zinc and galvanizing, and to nickel-clad steel plate. Alloys for temperature service, both high temperature and low temperature, are also discussed, whilst testing methods such as the spectrographic analysis of metals and the industrial application of the X-rays are reviewed. Aspects of manufacturing processes such as casting practice, degasification, rolling mills, and bright annealing are considered; and the applications of non-ferrous metals in building and for decorative finishes and the use of mercury for power production dealt with. Reference is also made to hardening by rotating magnetic fields, the development of tungsten cutting tools, and to the welding of non-ferrous materials.
—J. W. D.

The Objectives of the Non-Ferrous Metal Industry [of U.S.S.R.] and Means of Obtaining Them. A. P. Serebrovsky (*Zvetnye Metally (The Non-Ferrous Metals)*, 1931, 6, (4), 432–443).—[In Russian.] A statistical analysis of the production of non-ferrous metals in the U.S.S.R. under the Five-Year Plan, together with the capital investment involved, extent of ore reserves, labour supply, &c. The annual percentage increases in output (actual and estimated) are given, together with the volumes of production for the 2 Five-Year periods 1928–29 to 1933 and 1934 to 1938, when the output of copper will rise from 33,500 to 1,015,000 tons; zinc from 2,900 to 490,000 tons; lead from 5,300 to 655,000 tons; aluminium from nil to 420,000 tons, and magnesium from nil to 41,000 tons.—M. Z.

Geographical Distribution of Non-Ferrous Metal Industry [of U.S.S.R.] and its Development in Conjunction with the Basic Chemical Industry. S. E. Pozin (*Zvetnye Metally (The Non-Ferrous Metals)*, 1931, 6, (8), 1072–1081).—[In Russian.] An analysis of the estimated regional production of non-ferrous metals in the U.S.S.R. under the Second Five-Year Plan (1933–37), and the

use of the by-products (notably sulphuric acid) in large-scale chemical works, which will be grouped close to metallurgical centres. It is contended that the location of production centres must, in accordance with Marx's and Lenin's theories, be dictated primarily by political and sociological considerations, and the alternative schemes prepared by certain foreign experts are sharply criticized as based on capitalist economics.—M. Z.

Problems of Priority for the Scientific and Research Work of the " Zvet-metzoloto " [Non-Ferrous and Noble Metals Trust, U.S.S.R.]. G. K. Shochanov (*Zvetnye Metally (The Non-Ferrous Metals)*), 1931, 6, (8), 1082–1086).—[In Russian.] A brief review of the scheme of forcing non-ferrous metal produc-tion under the First Five-Year Plan into 3 years, and the resulting greatly increased expansion under the Second Five-Year Plan (*e.g.* copper : 1930, 47,500 tons; 1932, 180,500 tons; 1937, 1,300,000 tons; aluminium : 1932, 9,000 tons; 1937, 545,000 tons; nickel : 1932, 1,500 tons; 1937, 45,000 tons). In order to achieve this, complete co-ordination of the following 3 sets of problems is necessary : (1) new construction; (2) current production; (3) future production. The " Zvetmetzoloto " has accordingly organized, under the Supreme Economic Council, a series of Institutes for Scientific Investigation and Research located in important industrial regions : (1) Eastern Siberia, existing Institute at Irkutsk, specializing in pyro- and hydro-metallurgy, copper, noble metals, and arsenic; (2) Ural, existing Institute at Sverdlovsk, specializ-ing in pyro-, hydro-, and electro-metallurgy, and electrolysis, chiefly for copper, zinc, platinum, light metals, and arsenic; (3) Western Siberia, to be located at Tomsk, and to specialize in concentrates, mixed ores, and the rare elements; (4) Central Asia, to be located at Tashkent, and to specialize in pyro- and hydro-metallurgy, chiefly for zinc, lead, and the noble metals; (5) Moscow, existing Institute, specializing in all non-ferrous metals and alloys, light alloys, metal coatings, corrosion, and substitution of one metal for another; (6) Leningrad, existing Institute, specializing in light metals and in the application of non-ferrous metals to the industries of the Leningrad region; (7, 8, and 9) Kazakstan (at Alma-Ata), Caucasus (at Tiflis), and Ukraine are to be organ-ized. It is concluded that large sums must be granted for these Institutes and an extensive supply of foreign literature assured, in order to avoid unneces-sary repetition of work already carried out abroad. Emphasis is laid on the need of subordinating all research to the requirements of production and of eliminating any work which has no immediate practical object.—M. Z.

Main Lines of Standardization of Non-Ferrous Metals and Alloys [in U.S.S.R.]. N. N. Muratch (*Zvetnye Metally (The Non-Ferrous Metals)*, 1931, 6, (3), 375–378).—[In Russian.] A review of the results achieved up to date and the future programme of the Department of Technical Control and Standards of the " Zvetmetzoloto " (Non-Ferrous and Noble Metals Trust). Standardization is carried out and certificates are issued in accordance with 4 basic groups : (*a*) classification of metals and alloys (system of marks); (*b*) standardization of geometrical dimensions; (*c*) standardization of quality (technical properties); (*d*) standardization of testing methods (mechanical and chemical). Complete standardization can be achieved only if all 4 groups are included. Before 1930, the number of standard certificates issued was : (*a*) 7; (*b*) 3; (*c*) 29; (*d*) 0; total 39. In 1930 : (*a*) 4; (*b*) 9; (*c*) 2; (*d*) 12; total 27, whilst a further 20—(*a*) 0; (*b*) 11; (*c*) 4; (*d*) 5—were carried over for final drafting in 1931. The actual total is somewhat less than the above, as certain certificates have been included in more than one group. Up to the present, the main work has been carried out in the field of pure metals, copper alloys, and Koltchugalumin, but the requirements of intensive industrializa-tion demand extension over a very wide range. Difficulties arise owing to the numerous types of new alloys and plant received from abroad, so that some of the approved standard certificates (notably for copper–zinc alloys)

are under revision. It is intended to issue 90 certificates in 1931, covering most of the non-ferrous metals and copper alloys, together with the chief types of shaped products and technical properties of 80% of the total output. The 1932 programme includes more than 160 certificates. At present, the work is receiving little support from the principal consuming organizations.

—M. Z.

The Removal of Antimony in the Pyrogenic Refining of Blister Copper. G. G. Zapevalov and A. D. Pogorelov (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (4), 493–494).—[In Russian.] Attempts were made to purify blister copper from the Allaverdy smelts of its high antimony content (0·01%) by a double refining process in a reverberatory furnace. The second refining process, however, increases the amount of antimony removed only by about 5%, the final standard copper containing about 0·006% antimony. Since the maximum permissible antimony content in copper suitable for rolling is 0·004%, it is concluded that Allaverdy copper must be refined electrolytically.—M. Z.

The Removal of Antimony, Arsenic, Nickel, and Cobalt from Blister Copper. L. I. Tchelyshev (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (9), 1225–1226).—[In Russian.] The refining of copper pyrogenically to a degree of purity similar to electrolytic is described. Antimony and arsenic can be removed by firing the copper in furnaces with a basic lining. The oxides of antimony and arsenic unite exothermally with copper oxide to give the copper salts, which are removed as slag. In an acid lining furnace this method results in a great loss of copper, and it is therefore better to remove the metals as Sb_2S_3 and As_2S_3 by adding the calculated quantity of copper sulphide to the melt. By this method the antimony content may be reduced to almost nil and the arsenic to 0·0025%. Nickel and cobalt can be reduced to 0·004% by cautious oxidation of the molten copper, followed by a final reduction by the addition of copper phosphide.—M. Z.

The Evolution of the Sword [Bronze Swords]. J. A. Mountfort (*Army Ordnance*, 1930, **11**, 128–130).—Bronze weapons replaced those of copper in about 2000 B.C. Straight and leaf-shaped bronze swords were used by the Assyrians.—H. F. G.

The Supplementary Plate of Fine Gold. S. W. Smith (*Ann. Rep. Royal Mint (Lond.)*, 1929, **60**, 54–55).—Report of the Chief Assayer. The preparation and establishment of a fine gold trial plate involve 3 separate sets of considerations : (1) the actual chemical manipulation of refining the gold, (2) melting and rolling the gold, and (3) establishing the degree of purity of the plate. The refining has already been described (*Ann. Rep. Royal Mint*, 1904, **34**, 72–73). Melting is effected in a rectangular silica mould fixed vertically in a gas furnace. Solidification was allowed to proceed by gradually reducing the gas and sharply and continuously tapping the top of the mould. This avoided piping and the contamination caused by casting into dressed iron moulds. On solidification, the mould was broken, any adhering silica being removed from the ingot by immersing it in hydrofluoric acid. The rolls were especially polished and a small " pilot " ingot of fine gold was first passed through them. The assaying procedure followed the usual course, except that greater attention was given to the weighing (in parts per 100,000), to the proportion of silver and copper used, to the annealing of the cornets (in silica instead of platinum cups), and to the parting operations. The results obtained were supplemented by spectroscopic tests and by observing the temperature of annealing, which should be just over 100° C.—J. H. W.

Systematic Recovery of Lead from Residues. Anon. (*Metallbörse*, 1930, **20**, 2329–2330).—Schemes for the recovery of lead from dross, waste, and scrap metals and alloys by smelting, reverberatory–refining, liquation, and pot-refining are outlined.—A. R. P.

XIX.—BIBLIOGRAPHY

(Books marked * may be consulted in the Library.)

*Akimov, G. W. *The Gas Corrosion of Carbon Steel at High Temperatures.* [In Russian, with 1 p. English abstract.] (U.S.S.R. Scientific-Research Institutes of the Supreme Council of National Economy, No. 459; Transactions of the Central Aero-Hydrodynamical Institute, No. 90.) Roy. 8vo. Pp. 44, with 44 illustrations in the text. 1931. Moscow and Leningrad: Scientific-Research Department of the Supreme Council of National Economy. (Rbl. 1.20.)

*American Foundrymen's Association and American Society for Testing Materials. *Symposium on Malleable Iron Castings.* Held at joint meeting of the American Foundrymen's Association and the American Society for Testing Materials, Chicago, Ill., June 26, 1931. Med. 8vo. Pp. 122, illustrated. 1931. Chicago: American Foundrymen's Association, 222 W. Adams Street; or Philadelphia, Pa.: American Society for Testing Materials. (75 cents.)

*American Society for Testing Materials and American Society of Mechanical Engineers. *Symposium on Effect of Temperature on the Properties of Metals.* Held at a joint meeting of the American Society of Mechanical Engineers and the American Society for Testing Materials, Chicago, Ill., June 23, 1931. Med. 8vo. Pp. 829, illustrated. 1932. Philadelphia, Pa.: American Society for Testing Materials, 1315 Spruce Street, or American Society of Mechanical Engineers, 29 W. 39th Street. (Bound, $6.00.)

Abstracts of all the papers of non-ferrous interest have already appeared in the *Journal.* Contents: H. J. Kerr: "Trends in Engineering Requirements for Metals for the Power-Plant Industry"; R. C. Allen: "Steam Turbine Requirements at High Temperatures"; F. W. Martin: "Metallurgical Requirements for High Temperature Steam Piping"; E. S. Dixon: "Needs of the Oil Industry for Metals at High Temperature"; F. H. Rhodes: "Corrosion and Other Problems in the Use of Metals at High Temperatures in the Chemical Industries"; J. C. Woodson: "Engineering Requirements and Trends for Metals in the Ferrous Metal Industries"; R. E. Brown: "Engineering Requirements and Trends for Metals in the Non-Ferrous Roasting, Smelting, and Refining Industry"; A. L. Boegehold and J. B. Johnson: "Engineering Requirements in the Automotive Industry for Metals Operating at High Temperatures"; Clyde E. Williams: "Use of Metals at Elevated Temperatures in the Ceramic Industry"; R. W. Bailey, J. H. S. Dickinson, N. P. Inglis, and J. L. Pearson: "The Trend of Progress in Great Britain on the Engineering Use of Metals at Elevated Temperatures"; Pierre Chevenard: "The Mechanical Properties of Metals at Elevated Temperatures"; H. A. Anderson: "Zinc Alloys for High- and Low-Temperature Service"; R. L. Templin and D. A. Paul: "The Mechanical Properties of Aluminium and Magnesium Alloys at Elevated Temperatures"; E. R. Darby: "Properties of Bearing Metals at Normal and Elevated Temperatures"; Wm. B. Price: "Properties of Copper and Some of its Important Industrial Alloys at Elevated Temperatures"; A. P. Spooner and F. B. Foley: "High-Temperature Creep Properties of Wrought Carbon and Low-Alloy Steels"; R. A. Bull: "The Performances of Cast Carbon and Low-Alloy Steels in High- and Low-Temperature Service"; J. W. Bolton and Hyman Bornstein: "Effect of Elevated Temperatures on Certain Mechanical Properties of Grey Cast Iron and Malleable Iron"; R. H. Aborn and Edgar C. Bain: "The Wrought Austenitic Alloys"; N. B. Pilling and R. Worthington: "The Effect of Temperature on Some Properties of Iron–Chromium–Nickel Alloys"; C. A. Crawford and Robert Worthington: "Nickel and Nickel Alloys other than the Nickel–Chromium–Iron Group"; C. A. MacQuigg: "High-Chromium Steels for Extreme Service Conditions"; W. H. Swanger: "Properties of the Rare Metals for High-Temperature Service"; Oscar E. Harder: "Effect of Temperature on the Properties of Nitrided Alloys"; H. W. Russell: "Effect of Low Temperatures on Metals and Alloys"; Norman L. Mochel: "Thermal Expansion of Metals"; M. S. Van Dusen: "Note on Applications of Data on the Thermal Conductivity of Metals"; Lois F. McCombs: "Supplementary Bibliography on Effect of Temperature on Properties of Metals." (587 references, and author index to bibliography.) The discussions on the papers are fully reported, and the volume is carefully indexed.]

*American Society of Mechanical Engineers. *Mechanical Catalog, with Directory of Manufacturers of Industrial Equipment, Materials, and Supplies.* 1931–32. Twenty-first edition. 4to. Pp. 990, illustrated. 1931. New York : The Society.

Ashcroft, E. W. *Faraday.* Pp. 134. 1931. London : British Electrical and Allied Manufacturers Association.

*British Standards Institution. *British Standard Specification for Cored Solder, Rosin Filled.* (No. 441—1932.) Med. 8vo. Pp. 6. 1932. London : The Institution, 28 Victoria Street, S.W.1. (2s. 2d. post free.)

*British Standards Institution. *British Standard Specification for Soft Solders (Grades A, B, C, D, E, F, G, H, J, and K).* (Revised to February 1932.) (No. 219—1932.) Med. 8vo. Pp. 7. 1932. London : The Institution, 28 Victoria Street, S.W.1. (2s. 2d. post free.)

Britton, Hubert T. S. *Hydrogen Ions : their Determination and Importance in Pure and Industrial Chemistry.* Second edition, revised and enlarged. 8vo. Pp. 605. London : Chapman and Hall, Ltd. (25s. net.)

*Casberg, Carl H., and Schubert, Carl E. *An Investigation of the Suitability of Soy Bean Oil for Core Oil.* (University of Illinois Bulletin No. 235, Engineering Experiment Station.) Med. 8vo. Pp. 20, with 7 illustrations. 1931. Urbana, Ill. : University of Illinois. (15 cents.)

*Coker, E. G., and Filon, L. N. G. *A Treatise on Photo-Elasticity.* Imp. 8vo. Pp. xviii + 720, with 14 plates and numerous illustrations in the text. 1931. Cambridge : at the University Press. (50s. net.)

Demand, Léon. *Nouveau lexique technique allemand–français et français–allemand. Exploitation des mines, métallurgie, industries textiles.* Pp. 306. 1931. Paris : Ch. Béranger. (112.50 francs.)

*Department of Overseas Trade. *Guide to the Services of the Department of Overseas Trade.* Cr. 8vo. Pp. 15. [1932.] London : Department of Overseas Trade, 35 Old Queen Street, S.W.1. (Gratis.)

Dick, James E. *Refractory Cement.* Salem, Mass. : Salem Iron Foundry Co.

*Engel, Niels. *Untersuchungen über die Stahlhärtung.* (Ingeniørvidenskabelige Skrifter A. Nr. 31.) Sup. Roy. 8vo. Pp. 190, with 8 plates, and 90 illustrations in the text. 1931. København : Danmarks Naturvidenskabelige Samfund, I Kommission Hos G.E.C. Gad, Vimmelskaftet 32. (10 kr.)

*Engineer, The. *Directory and Buyers Guide,* 1932. Demy 8vo. Pp. 260. 1932. London : *The Engineer,* 28 Essex Street, W.C.2.

*Gerlach, Walther, and Schweitzer, Eugen. *Foundations and Methods of Chemical Analysis by the Emission Spectrum.* Being the authorized Translation of " Die chemische Emissionsspektralanalyse." Med. 8vo. Pp. 123, with 53 illustrations. 1931. London : Adam Hilger, Ltd., 24 Rochester Place, Camden Rd., N.W.1. (12s. 6d. net.)

Hodgen, Joseph Dupuy. *Practical Dental Metallurgy.* Revised by G. S. Milberry and J. S. Snell. 1932. London : Kimpton. (18s. net.)

Houghton Research Staff. Compiled by. *Practical Metallurgy for Engineers.* Third edition. Pp. 435. Philadelphia, Pa. : E. F. Houghton and Co. ($3.00.)

Javet, E. *Agenda Dunod. Chimie.* 51 édition. Pp. xliv + 606. 1932. Paris : Dunod. (Relié, 20 francs.)

*Kolthoff, I. M. *Die Massanalyse.* Unter Mitwirkung von H. Menzel. Teil 2.—*Die Praxis der Massanalyse.* Zweite Auflage. Pp. xi + 612, with 23 illustrations. 1931. Berlin : Julius Springer. (Geh., R.M. 28 ; geb. R.M. 29.40.)

*McBain, James William. *The Sorption of Gases and Vapours by Solids.* Demy 8vo. Pp. xii + 577, with 151 illustrations. 1932. London : George Routledge and Sons, Ltd. (25s. net.)

*Martin, L. C., and Johnston, B. K. *Practical Microscopy*. (Blackie's "Technique" Series.) Cr. 8vo. Pp. vii + 116, with 10 plates and numerous figures in the text. 1931. London, Glasgow, and Bombay : Blackie and Son, Ltd. (3s. 6d. net.)

Meyer, Hermann. *Lehrbuch der allgemeinen mechanischen Technologie der Metalle*. Pp. 332. Leipzig : Max Jänecke. (Gch. M. 6 ; geb. M. 7.20.)

*Nederlandsch Instituut voor Documentatie en Registratuur. *Repertorium Technicum. International Bi-monthly Bibliography of Books and Articles appearing in Periodicals on Technical and Allied Subjects*. [Mimeographed.] 4to Volumen I. Fasc. No. 5. Pp. 292–399. Fasc. 6. Pp. 400–507. 1931. Den Haag : Nederlandsch Instituut voor Documentatie en Registratuur, Carel van Bylandtlaan. (£3 per annum.)

*Norton, F. H. *Refractories*. Roy. 8vo. Pp. x + 594, with numerous illustrations. 1931. New York : McGraw-Hill Book Co., Inc. ; London : McGraw-Hill Publishing Co., Ltd. (36s. net.)

Pavlov, M. A. *Metallurgical Furnaces*. [In Russian.] Third enlarged edition. Pp. 103, with 22 drawings and 159 figures. 1931. Leningrad : State Scientific-Technical Bookshop. (Rbl. 2.50.)
  [The book is divided into three parts : (1) Description of furnaces. According to his classification, P. describes furnaces for (a) hard fuel, (b) liquid fuel, (c) hard pulverized fuel, (d) gas fuel, and (e) working without heat, e.g., furnaces for the calcination of sulphur ores, converters, and soaking pits. (2) Utilization of heat in furnaces. P. describes how to calculate the coefficient of utilization for shaft, reverberatory, crucible, and gas furnaces and converters. (3) The selection of a furnace and the determination of its dimensions.]

Pichon, G. *Nouvelle méthode d'essais industriels des métaux*. Pp. 24. 1932. Nancy : Impr. des arts graphiques.

Refractories. *High-Temperature Mortars*. Philadelphia, Pa. : General Refractories Co.

*Rolfe, R. T. Edited by. *Foundrywork and Metallurgy. A Practical and Authoritative Guide for Moulders, Patternmakers, and Apprentices*. Cr. 8vo. Part 19, pp. 1153–1216 (end of Volume V) ; Part 20, pp. 1217–1280 ; Part 21, pp. 1281–1344 ; Part 22, pp. 1345–1408 ; Part 23, pp. 1409–1463 (end of Volume VI, and of serial issue). Illustrated. 1931. London, Bath, Melbourne, Toronto, and New York : Sir Isaac Pitman and Sons, Ltd. (1s. per part.)
  [Contents of Parts 19–23 : Section XVI.—" Aluminium Alloy Castings ; their Manufacture, Properties, and Applications " (continued), by N. F. Budgen (pp. 1153–1164) ; Section XVII.—" Die-Casting," by A. H. Mundey (pp. 1165–1212). Index to Volume V (pp. 1213–1216) ; Section XVIII.—" Centrifugal Casting," by J. E. Hurst (pp. 1217–1280) ; Section XIX.—" Special Casting Production," by W. Scott (pp. 1287–1324) ; Section XX.—" Cast Iron Specifications and Testing," by R. T. Rolfe and J. Laing (pp. 1325–1394) ; Section XXI.—" Alloy Cast Irons," by R. T. Rolfe and J. Laing (pp. 1395–1457). Index to Volume VI (pp. 1458–1463). These parts end the serial issue.]

*Saltren-Willett, C. G. *Scientific Control in Steel and Tinplate Works*. (Swansea Technical College Metallurgical Society. General Meeting, February 20, 1932.) Demy 8vo. Pp. 22, with 10 illustrations. 1932. Swansea : Secretary, Swansea Technical College Metallurgical Society, Minymor, Crumlyn Burrows. (1s.)

Schimpke, Paul. *Technologie der Maschinenbaustoffe*. 6 Auflage. Pp. x + 348. 1931. Leipzig : Hirzel. (Nn. M. 13.50 ; Lw. nn. M. 15.)

*Schröter, W. *Das Rhenium*. Mit einer Einleitung von W. Noddack. (Sammlung chemischer und chemisch-technischer Vorträge. Begrundet von F. B. Ahrens. Herausgegeben von H. Grossmann. Neue Folge Heft 11.) Med. 8vo. Pp. 59. 1932. Stuttgart : Ferdinand Enke. (RM. 5.50.)

*Schumacher, Earle E., and Ellis, W. C. *Age-Hardening Copper–Titanium Alloys.* (Bell Telephone System Technical Publications, Monograph B–635.) Med. 8vo. Pp. 3. 1931. New York: Bell Telephone Laboratories, Inc.

[Reprint from *Metals and Alloys*, 1931, **2**, 111; see abstract, this *J.*, 1931, **47**, 653.]

*Shipowners, Shipbuilders, and Marine Engineers. *The Directory of Ship-owners, Shipbuilders, and Marine Engineers,* 1932. (Thirtieth year of publication.) Compiled under the direction of the Editor of *Shipbuilding and Shipping Record.* Demy 8vo. Pp. 832 + 87. 1932. London: The Directory Publishing Co., Ltd., 33 Tothill Street, S.W.1. (20s. net.)

*Shlougin, I. G. *The Investigation of Duralumin Rivets.* [In Russian, with 2 pp. English abstract.] (U.S.S.R. Scientific-Research Institutes of the Supreme Council of National Economy, No. 449; Transactions of the Central Aero-Hydrodynamic Institute, No. 81.) Roy. 8vo. Pp. 80, with 83 illustrations in the text. 1931. Moscow and Leningrad: Scientific Research Institutes of the Supreme Council of National Economy. (Rbl. 1.25.)

*Shoulgin, I. G. *The Investigation of Duralumin Wire.* [In Russian, with 1 p. English abstract.] (U.S.S.R. Scientific-Research Institutes of the Supreme Council of National Economy, No. 450; Transactions of the Central Aero-Hydrodynamic Institute, No. 83.) Roy. 8vo. Pp. 44, with 51 illustrations in the text. 1931. Moscow and Leningrad: Scientific Research Institutes of the Supreme Council of National Economy. (K. 75.)

*Smith, (Sir) Frank. *Chemistry and the Community.* (Institute of Chemistry of Great Britain and Ireland.) The Third S. M. Gluckstein Memorial Lecture, 1931. Demy 8vo. Pp. 22. 1932. London: Institute of Chemistry, 30 Russell Square, W.C.1.

*Society of Chemical Industry. *Reports of the Progress of Applied Chemistry.* Issued by the Society of Chemical Industry. *Volume XVI.*—1931. Demy 8vo. Pp. 742. 1932. London: Society of Chemical Industry, 46 and 47 Finsbury Square, E.C.2. (Members, 7s. 6d., post free; non-members, 12s. 6d., post free.)

[Reports of non-ferrous interest are: "Non-Ferrous Metals," by Alan R. Powell; "Electrochemical and Electrometallurgical Industries," by H. T. S. Britton and R. A. Robinson.]

*Tocher, J. F. *What is Probable Error?* Demy 8vo. Pp. 63, with 24 diagrams. 1931. London: Institute of Chemistry, 30 Russell Square.

Trelease, Sam F., and Yule, Emma Sarepta. *Preparation of Scientific and Technical Papers.* Pp. 117. Baltimore, Md.: Williams and Wilkins. ($1.50.)

*U.S. Department of Commerce, Bureau of Standards. *Zinc and its Alloys.* (Circular of the Bureau of Standards, No. 395.) Med. 8vo. Pp. iv + 214, with 126 illustrations. 1931. Washington, D.C.: Government Printing Office. (70 cents.)

[See abstract on p. 148 of this issue of the *Journal*. This publication should be in the hands of all interested in its subject.]

*Upthegrove, C., and Herzig, A. J. *The Effect of the Products of Combustion on the Shrinkage of Metal in the Brass Industry.* (Department of Engineering Research, University of Michigan, Ann Arbor. Engineering Research Bulletin No. 22.) Med. 8vo. Pp. vi + 66, with 33 illustrations in the text. 1931. Ann Arbor, Mich.: Director, Department of Engineering Research, University of Michigan. ($1.00.)

[See abstract on p. 196 of this issue of the *Journal*.]