METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

1932 APRIL Part 4

I.—PROPERTIES OF METALS

(Continued from pp. 145–150.)

The Appearance of Small Amounts of Gases and Oxides in Aluminium and Aluminium Alloys, their Detection and Removal. R. Sterner-Rainer (*Z. Metallkunde*, 1931, 23, 274–279; discussion, 279–282).—Methods for the detection and determination of gases and oxide in aluminium and its light alloys are briefly reviewed and a simple new method devised by S.-R. is described. The various precautions for the avoidance of gas absorption in foundry practice as proposed by numerous investigators are discussed, and it is concluded that all these methods are uneconomic. A new method for the purification of aluminium by means of a mixture of carbon tetrachloride, manganous chloride, and ammonium difluoride equal to only 0·1% of the weight of the metal gives satisfactory results. The cost of this treatment is less than R.M. 0·01 per kg.—M. H.

Thermal Insulating Properties of Aluminium and their Applications. —— de Biran (*Chaleur et Ind.*, 1928, 9, (103), 413–417).—The theory of the cooling of surfaces by radiation is outlined. Compared with a perfectly black surface, the emissions by polished and matte aluminium sheet are 0·052 and 0·07, respectively, at 30° C.; these ratios rise to 0·06 and 0·08 at 100° C., and to 0·07 and 0·09 at 200° C. For aluminium powder the ratio is of the same order, but for aluminium paint it is about 0·25–0·30, and this figure, although apparently high, is only about 30% of that of most other paints, which as regards emissivity resemble black bodies. The reflective power of aluminium paint for visible radiation is about 0·80–0·85, and is thus of the same order as that of white paint, but for heat radiation the reflective power is as high as 0·9–0·95. The application of these considerations in the use of aluminium foil and paint for a variety of purposes is described, and other advantages of aluminium are briefly noted.—H. F. G.

Macroscopic and Lattice Expansion of Bismuth Single Crystals. Alexander Goetz and R. C. Hergenrother (*Phys. Rev.*, 1931, [ii], 38, 2075–2077).—A note. The lattice expansion of single crystals of bismuth has been measured at temperatures from 20° to 260° C. by an X-ray determination of the spacing of the (111) plane. The expansion is quite regular throughout, in contrast to the work of Roberts (*Proc. Roy. Soc.*, 1924, [A], **106**, 385; this *J.*, 1925, **33**, 298) in which the ordinary macroscopic method showed a marked fall in the coefficient of expansion above 230° C. Below 230° C. the results of Roberts are in close agreement with those of G. and H., and the discrepancy at high temperatures is probably the result of changes in the secondary block structure of the crystals, which are revealed by the macroscopic method, but do not affect the atomic spacing within the blocks. The present results confirm the relation between sp. heats and coeffs. of expansion in anisotropic metal crystals proposed by Grüneisen and Goens (*Physikal. Z.*, 1923, **24**, 506; this *J.*, 1925, **34**, 380; *Z. Physik*, 1924, **29**, 141; this *J.*, 1926, **35**, 496).—W. H.-R.

Anomalous Diamagnetism of Bismuth. R. N. Mathur and Mulkh Raj Varma (*Indian J. Physics*, 1931, 6, 181–192).—It has been confirmed that bismuth sols and very fine bismuth powders (1–10μ) are much less diamagnetic than the crystalline metal; the diamagnetism falls increasingly with increasing fineness and with duration of powdering, but after the powder is boiled with tartaric acid solution (in which the metal is insoluble and the oxides are soluble) the value for the crystalline form is practically re-attained. The effect is therefore largely due to formation of oxide during powdering, and it is significant that there is no X-ray evidence that bismuth loses its crystalline structure during powdering. This view is confirmed by the observations that during powdering the bright crystalline appearance vanishes, a gradual change of colour takes place, and that the powder does not completely amalgamate when rubbed with mercury, whereas bismuth amalgamates readily. The fall of diamagnetism when bismuth is powdered under toluene or paraffin is relatively small. Similar phenomena have been observed with antimony. —H. F. G.

Photoelectric and Thermionic Emission from Cobalt [Allotropic Forms of Cobalt]. Alvin B. Cardwell (*Phys. Rev.*, 1931, [ii], 38, 2033–2040).—The photoelectric emission from cobalt of purity greater than 99·9% was studied during a thorough outgassing and after a stable condition had been attained, when thermionic emission–temperature curves were also taken. By means of slow and rapid cooling the cobalt was obtained in both allotropic forms, and the following constants were determined: hexagonal cobalt (produced by slow cooling) has threshold wave-length between 2757 A. and 2967 A., the work function being 4·12 ± 0·04 v.; for face-centred cubic cobalt the threshold is between 2967 A. and 3022 A., the work function being 4·25 ± 0·08 v. The thermionic emission curves show changes in direction which indicate that a transformation occurs in the neighbourhood of 850° C., but the nature of this is obscure. The transformation from hexagonal to face-centred cubic cobalt occurred at about 570° C. for specimens which had not been outgassed.—W. H.-R.

A Review of Work on Gases in Copper. O. W. Ellis (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. 478, 1932, 1–28).—This is a very comprehensive discussion of the present position with regard to the solubility of gases in copper, and leads to the general conclusion that the solution of the problem as to the composition of those gases is not yet in sight. There are great divergences of opinion with regard to the solubility of carbon monoxide and the behaviour of nitrogen and of sulphur dioxide; E. believes that these gases are not as innocuous as some would have us believe. The work of Sieverts and of Iwasé is briefly described and their conflicting opinions are discussed. The incidence of Allen's work and its general agreement with that of Sieverts are next reviewed. E.'s experiments on the decomposition of steam by molten copper are ranged with those of Allen. The theoretical aspects of the production of "tough-pitch" copper and the influence of overpoling are also considered. There is a further discussion of experimental results dealing with the gases evolved from copper when cooling from the liquid state and also with the gases which have been extracted from solid copper. Finally an outline is given of the work by various investigators on the gases found under varying conditions in the alloys of copper.—W. A. C. N.

Mechanical Properties of Copper. A. Krupkowski (*Rev. Met.*, 1931, 28, 529–545, 598–609, 641–660).—(I.)—K. analyses the phenomena accompanying the tensile test and establishes equations representing all the dimensional changes. The relationships so found are satisfactorily verified by the results obtained on a copper test-piece. The calculated values are slightly lower than those obtained by experiment, and the reason for this is found in the increase in volume of the metal and in the difficulty in accurately fitting together the fractured portions. Detailed analysis of the phenomena which occur in the tensile test permits determination of variation of mechanical properties as a function of cold-working by drawing through dies, up to the limit of uniform elongations. Results obtained by calculation agree well with those of experiments on drawn wires. The inflexions observed by

Alkins and Johnson are not shown in the curves obtained by K., who attributes them to the influence of secondary factors. (II.)—Experimental work on the heat liberated during deformation showed that the temperature of the test-piece increased with distance between the marks forming limits of the test-length, and that almost all the work of rupture is transformed into heat. Previous work on the tensile strength of copper as a function of temperature and in different gaseous media is reviewed. (III).—Tensile tests at high, normal, and low temperatures in air and other gases are described. With commercial electrolytic, *i.e.* remelted oxygen-bearing copper, the recrystallization temperature is 340° C. In neutral gases there are 2 ranges of temperature, the first extending from 150° to 500° C., and in this range the test-piece work-hardens during test. In the second range, from 500° C. upwards, recrystallization takes place, annealing occurs, and the ductility is very high. The oxidizing effect of air during heating to 800° C. for 1 hr. on mechanical properties is very slight. Coal gas and hydrogen lower the mechanical properties substantially. Experiments with unmelted cathode copper showed a drop in elongation and in reduction of area below 500° C., due to porosity of the metal. There was a marked drop in elongation and reduction of area when tests were made in hydrogen, and the results show that hydrogen has a harmful effect even on oxygen-free copper. Tests at low temperature show that copper remains malleable down to − 183° C. Hardness tests of annealed copper, made with balls of different diameters and variable loads, showed that the Meyer relationship $P = a \, . \, d^n$ is exact. The differences between the relationship based on the law of similitude and the values recorded in experiments are greatest for small balls. The Meyer hardness value represents the actual hardness of the subjacent metal, which is not the case with the Brinell number. The bottom of the impression is not cold-worked uniformly, but is more severely cold-worked at the centre, and the hardness decreases towards the edges with the angle of inclination to the horizontal plane.—H. S.

Fatigue Tests in Shear of Three Non-Ferrous Metals [Copper, Brass, Duralumin]. H. F. Moore and R. E. Lewis (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (II), 236–242).—See this *J.*, 1931, **47**, 369.—S. G.

The System PbO–Sb_2O_3 and Its Relation to Lead Softening. C. G. Maier and W. B. Hincke (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. **449**, 1932, 1–12).—In applying data for the vapour pressure of pure antimony trioxide to the commercial processes of lead softening, certain anomalous conditions appeared. By treating lead bullion containing 1% antimony at 1300° F. (704° C.) no appreciable volatilization of the latter occurred, and a scum of mixed oxides containing 15–20% antimony and 65–60% lead was formed; at 1400° F. (760° C.) in the presence of petroleum coke, much volatilization occurred and a scum of oxides containing 60–65% antimony and 10% lead was produced. The system containing the oxides of lead and antimony was therefore studied, the melts being made in an atmosphere of hydrogen. Thermal, vapour pressure, microscopical, and chemical evidence is adduced. Mixtures with less than 43·4% lead show a simple eutectic diagram with a eutectic at 539° C. and 21·5% lead oxide. There is a second rather ill-defined eutectic at 575° C. and 74% lead oxide. Above 70% lead oxide the antimony trioxide is oxidized still more, metallic lead is formed, and the mixture becomes vitreous. It is shown that antimony trioxide is volatilized rapidly only at a composition the lead content of which corresponds with something less than the compound PbO,Sb_2O_3. The applications of the data newly developed are discussed in relation to lead softening.—W. A. C. N.

On the Supposed Allotropy of Lead. Washirō Eda (*Sci. Rep. Tôhoku Imp. Univ.*, 1931, [i], **20**, 715–725).—[In English.] The hardness of polycrystalline lead quenched at different high temperatures shows an abrupt increase at about 200° C., but that of single-crystals of lead increases gradually with rise of temperature. Measurements of electrical resistance and thermal and X-ray analyses reveal no indication of allotropic change at high temperatures. It is concluded that lead shows no allotropic change between 20° and 300° C. The change in hardness at 200° C. is probably a secondary effect, due to the state of aggregation of the crystals.—E. S. H.

Physical Properties of Single-Crystal Magnesium. P. W. Bridgman (*Proc. Amer. Acad. Arts. Sci.*, 1932, 67, 29–41).—The following physical constants have been determined for single-crystals of pure magnesium. Thermal e.m.f. for the parallel and perpendicular directions against copper: $E_{\perp} = 1{\cdot}65 \times 10^{-6} t + 12{\cdot}5 \times 10^{-9} t^2 - 3{\cdot}8 \times 10^{-11} t^3$; $E_{\parallel} = 1{\cdot}85 \times 10^{-6} t + 24{\cdot}3 \times 10^{-9} t^2 - 7{\cdot}7 \times 10^{-11} t^3$, where t is the temperature in ° C. Elastic constants in abs. C.G.S. units: $s_{11} = s_{33} = 20{\cdot}4 \times 10^{-13}$, $s_{13} = s_{12} = -5{\cdot}2 \times 10^{-13}$, $s_{44} = 87{\cdot}8 \times 10^{-13}$. Thermal expansion $\parallel$ to the axis $= 27{\cdot}1 \times 10^{-6}$, $\perp$ to the axis $= 24{\cdot}3 \times 10^{-6}$. The results are discussed with regard to the fact that the structure of magnesium is very nearly that of close-packed spheres. Under hydrostatic pressure magnesium behaves like a cubic crystal, but this is not so for the complete reaction to tension. The anisotropy of the coeff. of thermal expansion is remarkable in view of the behaviour under pressure. Discrepancies between the present values and those of Goens and Schmid (*Naturwiss.*, 1931, 19, 376; see this *J.*, 1931, 47, 418) are discussed.—W. H.-R.

The Hall Effect in Solid Mercury. James T. Serduke and Thomas F. Fisher (*Phys. Rev.*, 1931, [ii], 38, 1922).—Abstract of a paper read before the American Physical Society. Various investigators have studied the Hall effect in mercury, especially in the liquid form. In the liquid form the results are uncertain and subject to doubt. In the solid form Fenninger in 1914 found the Hall constant to be not larger than 0·000011. The present investigators developed a method of obtaining a mercury strip 14 cm. long, 2 cm. wide, and of various thicknesses down to 0·006 cm., and have measured the Hall effect and resistivity in solid mercury at a temperature of about − 60° C. The conclusions are that in this case the Hall effect is negative and the constant has a value of − 0·00078 ± 10%. The Hall constant is independent of field strength, current density, and thickness of specimen. No definitely measurable longitudinal effect, *i.e.* change in resistivity with magnetic field, was found.—S. G.

Some Photoelectric Properties of Mercury Films. Duane Roller, W. H. Jordan, and C. S. Woodward (*Phys. Rev.*, 1931, [ii], 38, 396–400).—Films of pure mercury were deposited slowly in a high vacuum on an oxidized iron plate, and the photoelectric properties were examined. As the films increased in thickness the photoelectric current produced by the lines 2537, 2653, and 2700 A. increased to a maximum, and then fell to a final constant value. At the point of maximum sensitivity the threshold was approximately 2750 A., and the final value for a thick layer was 2730 ± 15 A.; this did not change when the mercury melted, indicating that the thresholds for liquid and solid are the same. These results are in marked contrast to those for alkali metal films, in which the thresholds change considerably during the formation of the film.—W. H.-R.

Photoelectric and Thermionic Properties of Palladium. Lee A. Dubridge and W. W. Roehr (*Phys. Rev.*, 1932, [ii], 39, 99–107).—The photoelectric and thermionic emission from pure palladium were studied during an extended outgassing process. The final value of the threshold frequency was 2486 A., and the results were in good agreement with Fowler's theory, the application of which gave the true work function as 4·97 ± 0·01 v. (= 2486 A.). For wave-lengths near the threshold the photoelectric emission increases greatly with temperature. The thermionic work function for the clean metal was 4·99 ± 0·04 v., and the value of the constant A in the Richardson equation

$I = AT^2e^{-L/T}$ was very nearly 60 amp./deg.^{2}cm.^{2}, with a maximum deviation of 30% from this value (cf. Dubridge, *J.*, this volume, p. 219).—W. H.-R.

Magnetic Properties of Platinum. Different Varieties. Influence of Field. Passage from one State to Another. Paule Collet and G. Foëx (*J. Phys. Radium*, 1931, **11**, 290–308).—The coeff. of magnetization of very pure platinum have been measured with an accuracy of 0·2%. Four different specimens gave at low temperatures (down to − 180° C.) the moments 8, 9·5, 11, and 13 magnetons. At temperatures above the ordinary, in an intense field, the moment was 8 magnetons in each case. The moment is decreased by 0·5 magneton by cooling in a field of 30,000 gauss. With increase of field from 6000 to 14,000 gauss the moment at low temperatures decreases from 13 to 10 magnetons.—E. S. H.

Effect of the [Nature of the] Support upon the Variation with Temperature of the Electrical Resistance of Thin Platinum Films. G. Baintner (*Z. Physik*, 1932, **73**, 691–699).—The temperature coeff. of thin platinum films sputtered cathodically on glass supports is shown to depend on the nature of the glass, and the differences are attributed to the different deformations of the films in the respective cases.—J. S. G. T.

The Photoelectric Properties of the Surface of Potassium which has been Exposed to the Action of Atomic Hydrogen. S. G. Ryzhanov (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki* (*Journal of Experimental and Theoretical Physics*), 1931, [A], **1**, (2–3), 83–92).—[In Russian.] On exposing potassium to the action of atomic hydrogen the photoelectric sensitivity rises to 30–40 times its normal value, then falls to a constant which is independent of the time of treatment and is less than the normal.—N. A.

The Photoelectric Properties of Tantalum. Alvin B. Cardwell (*Phys. Rev.*, 1931, [ii], **38**, 2041–2048).—The photoelectric properties of tantalum were studied after careful outgassing, very severe treatment being required in order to obtain stable conditions. After 1000 hrs. at temperatures up to 2200° K., an apparently stable condition was reached in which the application of Fowler's theory gave the true threshold wave-length (*i.e.* the value at the absolute zero) as 2742 A. (4·50 v.). Further treatment up to 2500° K. gave a final stable condition with a true threshold of 2974 A. (4·15 v.). In the apparently stable condition, for wave-lengths near the threshold, there is a great increase in the emission with increasing temperature. In the stable condition this effect is very sensitive to the exact wave-length, diminishing with decrease in wave-length, until at about 300 A. shorter than the threshold value, the effect is reversed, and the emission decreases with rise of temperature. Curves showing the variation of the photoelectric current with temperature are plotted for different wave-lengths.—W. H.-R.

Effect of Surface Changes on the Photoelectric Emission of Silver and Gold. T. E. Clarke (*Phil. Mag.*, 1932, [vii], **13**, 624–632).—It is shown that the photoelectric emission of a metal in the absence of a strong accelerating field can be used to indicate changes in the adsorbed gas layer on the metal surface. —J. S. G. T.

Influence of Annealing on the Resistance of Single-Crystal Tellurium. M. N. Bogomolov (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki* (*Journal of Experimental and Theoretical Physics*), 1931, [A], **1**, (1), 21–25).—[In Russian.] Electrical conductivity measurements of single-crystal tellurium after annealing at various temperatures showed that 2 modifications, α and β, exist. The α-form is stable at low, and the β-form at high, temperatures. Transition from one modification to the other is very slow, and specimens of single-crystal tellurium consist of the α-modification with a small admixture of β.—N. A.

On the Question of the Allotropy of White Tin and the Equilibrium Diagram of the System Cadmium–Tin. Yosiharu Matuyama (*Sci. Rep. Tôhoku Imp.*

Univ., 1931, **20**, 649–680; and (in Japanese) *Kinzoku no Kenkyu*, 1932, **9**, 1–23).—[In English.] Investigations of electrical resistance, thermal expansion, thermo-e.m.f., and thermal and X-ray analyses have failed to reveal the existence of the supposed modification of tin at high temperatures. The eutectoid of the system tin–cadmium at 130° C. is not caused by the transformation of tin. The equilibrium diagram of the system tin–cadmium has been revised on the side rich in tin.—E. S. H.

The Determination of the Photoelectric Threshold for Tungsten by Fowler's Method. A. H. Warner (*Phys. Rev.*, 1931, [ii], **38**, 1871–1875).—The photoelectric threshold for tungsten has been determined using (*a*) a tungsten filament, and (*b*) a surface prepared by evaporation after thorough outgassing. The latter method was more accurate, and the value obtained from the intensity curves by the method of R. H. Fowler (*Phys. Rev.*, 1931, [ii], **38**, 45; see *J.*, this volume, p. 219) was 2720 A. = 4·54 v. at 0° K., and is in complete agreement with the value (4·54 v.) found by Dushman (*Phys. Rev.*, 1925, [ii], **25**, 338) from thermionic data.—W. H.-R.

The Vectorial Photoelectric Effect in Thin Films of Alkali Metals. Herbert E. Ives (*Phys. Rev.*, 1931, [ii], **38**, 1209–1218).—A theoretical investigation of the vectorial photoelectric effect. [*Note by abstractor.*—When polarized light falls at high angles on specular alkali metal surfaces, the photoelectric emission for light with the electric vector parallel to the plane of incidence (‖ light) is greater than when the electric vector is perpendicular thereto (⊥ light), and the ratio is much larger than would be predicted from the optical absorbing powers of the metal for the two conditions.] It is assumed that the photoelectric effect for thin films of alkali metals on platinum is proportional at any wave-length to the electric intensity just above the platinum. This is calculated from the known optical constants of platinum by computing the intensities of the wave patterns formed by the interference of the reflected and incident beams. Calculations are made for both ‖ light and ⊥ light at various angles of incidence, and a very high ratio is found for the intensities for the two planes of polarization in agreement with the facts. The conclusion reached is that the vectorial effect is predominantly an optical phenomenon.—W. H.-R.

The Photoelectric Effect from Thin Films of Alkali Metal on Silver. Herbert E. Ives and H. B. Briggs (*Phys. Rev.*, 1931, [ii], **38**, 1477–1489).—Thin films of alkali metals were deposited in a vacuum on polished plates of silver and platinum, and a study was made of the photoelectric emission under the influence of polarized light of different wave-lengths, and at varying angles of incidence. The results are complicated, the emission–wave-length curves showing maxima and minima. These may be explained by assuming (1) that the photoelectrons come entirely from the alkali metal, and (2) that the effective light density is that at the metal–vacuum surface. Experiment shows (Ives and Johnsrud, *J. Opt. Soc.*, 1927, **18**, 374) that the presence of thin alkali metal films does not appreciably affect the condition of the light reflected by the metal plate, and hence the intensity in (2) can be calculated from the refractive index and extinction coeff. of the underlying metal (Ives, *Phys. Rev.*, 1931, [ii], **38**, 1209, see preceding abstract). The essential phenomenon is the formation, above the reflecting surface, of an interference pattern, the phase and amplitude of which depend on the optical constants of the metal, and vary with the plane of polarization and angle of incidence. Since the emission from alkali metals in bulk is of the same order, this also may be due to electrons coming only from the top layer of atoms.—W. H.-R.

Element 87 [Physical Properties of the Alkali Metals]. C. F. Graham (*Science*, 1931, **74**, 665–666).—Curves are given in which the atomic volumes, melting points, boiling points, specific heats, and wave-lengths of maximum specific photoelectric sensitiveness of the alkali elements are plotted against the atomic numbers. By extrapolation of these the constants for the newly discovered element 87 can be predicted tentatively.—W. H.-R.

Solidification of Metals. Anon. (*Aluminium Broadcast*, 1930, 2, (17)).—A report of an open discussion held by the London Local Section of the Institute of Metals.—J. C. C.

Influence of Gases on Metals and Influence of Melting in Vacuo. Wilhelm Rohn (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. **470**, 1932, 1–8).—This is a general discussion of (1) the condition of gases in metals; (2) causes of gases in metals, (3) melting *in vacuo*; and (4) advantages and practical applications of vacuum melting. Gases are present in metals principally in their simple form, and as oxides. Sulphur may also be considered a gas, as in most cases it is in the form of vapour at melting temperature. By far the major part of the gases found by analysis result from a continuation of chemical reactions that were uncompleted during the original melting process. On melting *in vacuo* the maximum evolution of gas does not occur so soon as the whole charge is liquid, but continues to increase for a considerable period. This appears to show that the gases result from chemical reactions which are more complete under vacuum conditions. The improvement of metals and alloys by melting *in vacuo* is confirmed by the increased values obtained in the notched-bar and fatigue tests. For ordinary practice vacuum melting is at present too expensive. Starting with hot metal, however, and attempting only the final refining operation in the vacuum furnace, the extra cost is considerably reduced.—W. A. C. N.

The Plastic Distortion of Metals. G. I. Taylor and H. Quinney (*Phil. Trans. Roy. Soc.*, 1931, [A], **230**, 323–362).—If an increasing load is applied to a metal of low elastic limit (*e.g.* copper) plastic flow occurs when the elastic limit is exceeded. If the load be removed and then re-applied, plastic flow occurs below the maximum load attained during the first loading, but is very small until the previous maximum load is reached, when the flow increases rapidly. This fact may be used to compare the strengths of the material at different stress distributions. Thus to compare tension and torsion, one may first load the specimen until the extension has some definite value, and then remove the load and begin twisting, when the torque angle curve will show a sudden increase at the point corresponding with the previous maximum load in tension. After defining plastic strength in this way, the essential problems are: (1) the particular function of the stress components which must rise to a certain value before plastic flow begins; and (2) the relationship between the plastic distortion produced and the type of the applied stress. These have been investigated by experiments on hollow tubes submitted simultaneously to torsion and to direct tensile load. Apparatus is described for determining the internal change of volume of the tube under these conditions by filling it with a liquid. As regards (1), von Mises' hypothesis, that the sum of the squares of the principal shear stresses must rise to a given value before plastic distortion begins, is confirmed for tubes of annealed copper and aluminium. Mohr's hypothesis, that the maximum shear stress determines the beginning of plastic flow independently of the other components of shear stress, is not confirmed. For mild steel von Mises' hypothesis is in better agreement with the fact than Mohr's, but the error is greater, possibly owing to anisotropy of the material. As regards (2), for any given material the ratio of any pair of principal shear stresses is a definite function of the ratio of the corresponding shear strains, and according to von Mises' second hypothesis these ratios are equal to one another, as can be proved for a viscous fluid. This is not confirmed for copper, aluminium, or steel, but is confirmed for tubes of glass at high temperatures. Tubes of lead and cadmium behaved in a way intermediate between that of copper or iron and that of glass, but the error was larger owing to anisotropy of the material.—W. H.-R.

Recent Researches on Plasticity.—I. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 25–27).—A review, referring particularly to the work of Taylor and Quinney, *Phil. Trans. Roy. Soc.*, 1931, [A], **230**, 323–362, see preceding abstract, and of Lodé, *Z. Physik*, 1926, **36**, 913.—R. G.

On the Change of the Modulus of Rigidity in Different Metals Caused by Cold-Working. Tadashi Kawai (*Sci. Rep. Tôhoku Imp. Univ.*, 1931, **20**, 681–709; and (in Japanese), *Kinzoku no Kenkyu*, 1932, **9**, (1) 38–56).—[In English.] The change of the modulus of rigidity due to cold-working has been determined for copper, aluminium, nickel, 70 : 30 brass, 60 : 40 brass, Swedish iron, Armco iron, and mild steel. In aluminium and brass the rigidity decreases continuously with cold-working; in copper, iron, and steel it decreases rapidly at first and slowly thereafter as the cold-working increases; in nickel the rigidity increases rapidly at first, reaching a maximum, and then decreasing gradually. The results were confirmed by annealing the cold-worked specimens, when the reverse changes occurred. At 800° C. nickel recovers the value it had before cold-working. The changes are attributed to the combined effect of three factors: (1) internal stress, which causes the rigidity to increase; (2) rotation of the crystal grains, causing a decrease of ridigity; and (3) refining of the size of the crystal grains, which causes the rigidity to increase.—E. S. H.

Hardening of Metals by Rotating Magnetic Fields. Edward G. Herbert (*Heat Treating and Forging*, 1931, **17**, 1118–1120; and *World Power*, 1931, **16**, 274–277).—Reprints from *Proc. Roy. Soc.*, 1931, [A], **130**, 514–523. See this *J.*, 1931, **47**, 196.—J. H. W.

Increasing the Fatigue Strength of Metals and Alloys. Anon. (*Machinery* (*Lond.*), 1930, **36**, 200).—Brief editorial note of a process in which the ultimate fatigue strength is raised by subjecting the metal to dynamic stresses which are below the initial fatigue limit. The method is said to be especially effective with aluminium and magnesium alloys.—H. F. G.

Damping Capacity of Materials. G. S. von Heydekampf (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (II), 157–171; discussion, 172–175).—See this *J.*, 1931, **47**, 373.—S. G.

The Nature of the Metallic State. A. Eucken (*Z. Metallkunde*, 1931, **23**, 293–296, 329–334).—A lecture to the Deutsche Gesellschaft für Metallkunde in which the general methods and principles for the quantitative theoretical identification of the metallic properties are classified into thermodynamical and kinetic-statistical methods (classical theory and older and modern quantum theory). The following typical metallic properties are discussed from the point of view of these theories: sp. heat, electrical conductivity, thermal conductivity, Wiedemann–Franz–Lorenz number, ferromagnetism (Heisenberg's theory), cohesion of the metal atoms.—M. H.

Atomic Heat of Crystalline Substances at Constant Pressure. Yositosi Endō (*Rep. Aeronaut. Res. Inst., Tôkyô Imp. Univ.* (*Tôkyô Teikoku-Daigaku Kôkû-Kenkyûzyo-Hôkoku*), 1931, **6**, (71), 71–82; *C. Abs.*, 1931, **25**, 4454).—[In English.] By operating on the electrical energy of the ions of the crystal lattice, and employing Debye's formula for C_v, the formula is derived: $C_p/C_v = 1 + [9\delta\gamma^2T/Na(n-1)](4\cdot186 \times 10^7)\{C_v + [18\cdot0(\theta/T)/(e^{(\theta/T)} - 1)]\}$, where θ is the Debye constant, N is Avogadro's number, δ is the lattice constant for the absolute temperature T, and a, n, and γ are constants characteristic of the substance. The calculated values are compared with experimental data for aluminium, lead, copper, gold, and carbon (diamond). At room temperature the agreement is better than 1%, except in the case of carbon (diamond).—S. G.

New Investigations relating to Electrolytic Valve Action. III.—The Dielectric Constant of the Al_2O_3 Valve Deposit. IV.—Current Mechanism in the Valve Deposits. A. Günther-Schulze and Hans Betz (*Z. Physik*, 1932, **73**, 580–585, 586–601).—In continuation of previous work (see this *J.*, 1931, **47**, 324) G.-S. and B. investigate the mechanism of electrolytic valve action shown when a large and a small electrode are immersed in a suitable electrolyte and connected to a source of a.c. The metals aluminium, bismuth, antimony, tantalum, tungsten, and zirconium are investigated.—J. S. G. T.

The Constant Ratio between the Thermal and Electrical Conductivities of Metals. A. Grebel (*Chaleur et Ind.*, 1929, **10**, 569–571).—Consideration of existing data shows that in general the ratio of the electrical conductivity to the thermal conductivity of metals is constant. The theoretical basis of this relationship is examined. Although with rise of temperature the two conductivities alter in different senses, the ratio always diminishes.—H. F. G.

On the Definition of Specific Electrical Resistance and its Temperature Coefficient. H. von Steinwehr (*Z. Metallkunde*, 1931, **23**, 313–314).—The relations between the different units of measurement of specific electrical resistance are discussed.—M. H.

Modern Theories of the Electrical Conductivity of Metals. P. G. Lapinsky (*Uspehi Fizicheskih Nauk* (*Progress of Physical Science*), 1927, **7**, (1), 47–68; (3–4), 289–300).—[In Russian.] Cf. this *J.*, 1927, **38**, 394, and 1931, **47**, 427. A review of the most important theoretical papers on electrical conductivity of metals published during the last 15 years.—N. A.

On the Conductivity of Pressed Metal Powders. O. Kantorowicz (*Ann. Physik*, 1932, **12**, 1–51).—Further details of work the results of which have already been published (see this *J.*, 1931, **47**, 197). Pressures up to 4200 atm. have been used.—v. G.

New Ideas on the Electrical Conductivity of Metals. Marcel Boll (*Rev. gén. Sci.*, 1931, **42**, 367–370).—After reviewing the theories of Drude and Lorentz, neither of which could be experimentally proved, the statistical theory of Fermi, based on quanta considerations and using Pauli's "exclusion principle," is outlined. From the conceptions built up by Fermi, Sommerfeld elaborated a theory based on the assumption that the speed of the electrons which are responsible for metallic conduction does not depend on the temperature.—W. P. R.

Superconductivity at High Frequencies [Tin, Lead]. J. C. McLennan, A. C. Burton, A. Pitt, and J. O. Wilhelm (*Nature*, 1931, **128**, 1004).—Tin and lead become superconducting with currents having frequencies of the order of 10^7 per second. The transition temperatures are progressively lowered as the frequency is increased.—E. S. H.

Regions of Reversed Magnetization in Strained Wires. Irving Langmuir and K. J. Sixtus (*Phys. Rev.*, 1931, [ii], **38**, 2072).—A note. Previous work (Sixtus and Tonks, *Phys. Rev.*, 1931, [ii], **37**, 930; this *J.*, 1931, **47**, 371) on the propagation of large Barkhausen discontinuities showed that a phase boundary could be made to move along a wire in which the two phases separated by the boundary were distinguished by a direction of magnetization, which was axial, but of opposite sign. To obtain propagation the main field, H, has to exceed a critical value H_0. A method has been devised in which small stopping coils are used to oppose H, and in this way the discontinuity can be stopped, and its size can be varied by adjusting the coils, and its shape determined ballistically. A nucleus of known size and shape can thus be obtained, and its behaviour studied under different conditions. A detailed report is to be published shortly.—W. H.-R.

Diamagnetism and the Colloidal State. S. Ramachadra Rao (*Indian J. Physics*, 1931, **6**, 241–259).—The diamagnetic susceptibilities χ of colloidal particles of bismuth, antimony, and graphite have been determined by the Curie method. For bismuth and antimony χ diminishes as the particle size falls, at first slowly and then rapidly, until at about 0·5 μ it tends to a constant value. If the colloidal material is first washed with tartaric acid, which dissolves surface oxide, and then with alcohol and dried in a vacuum, χ increases, but it does not attain the value for the metal in bulk. Continued washing does not produce further increase of χ. For bismuth and graphite purified in this manner the relation between χ and $1/d$, when d is the particle size, is linear, *i.e.* an increase of surface area results in a proportionate decrease of χ. The effect is, therefore, real, although normally it is masked by oxidation effects; its origin cannot be fully explained, and various suggestions are discussed, especially that based on Richardson's theory of the existence in crystals of structure electrons.—H. F. G.

Diamagnetism in Metal Crystals. Alexander Goetz and A. B. Focke (*Science*, 1931, **74**, 603–604).—The work of G. and F. on the metamagnetism in bismuth crystals is briefly reviewed (cf. Goetz and Focke, *Phys. Rev.*, 1931, [ii], **38**, 1569; see *J.*, this volume, p. 66). General considerations of the results lead to the following predictions: (1) the crystal diamagnetism should decrease when the crystals become smaller than the secondary (Zwicky) units, and this is confirmed by measurements on colloidal particles of diamagnetic metals; (2) the diamagnetism should be affected by changes in internal surface, and this change has been observed by Bitter for deformed copper; (3) the electric conductivity should be affected in the same way as the crystal diamagnetism, and this has been observed by Honda for the average susceptibilities of polycrystalline material.—W. H.-R.

The Faraday Effect in Ferromagnetics. H. R. Hulme (*Proc. Roy. Soc.*, 1932, [A], **135**, 237–257).—The rotation of the plane of polarization of light transmitted through a very thin film of ferromagnetic material is shown, by mathematical analysis, to be proportional to the magnetization, in the region of saturation, and to increase with the wave-length of the light.—J. S. G. T.

Ferromagnetism and Electrical Properties. II.—The Interpretation of the Increase of Magnetic Resistance of Ferromagnetic Electronic Conductors. W. Gerlach (*Ann. Physik*, 1931, [v], **8**, 649–662).—The increase in resistance which occurs during the longitudinal magnetization of ferromagnetic wires (see this *J.*, 1930, **43**, 438; 1931, **47**, 197, 334, and the following abstract) is due to the rotation of the magnetic elementary cell from its natural crystallographic direction into the direction of the applied magnetic field.—v. G.

Ferromagnetism and Electrical Properties. III.—The Relation between Increase of Resistance and Magnetization [Nickel]. Kurt Schneiderhan (*Ann. Physik*, 1931, [v], **11**, 385–405).—An apparatus is described by means of which the resistance of nickel wires (99·964% nickel) can be measured in a longitudinal magnetic field at strictly constant temperatures up to 300° C. When the temperature along the wire is not constant, a thermo-e.m.f. is set up which reaches about 5×10^{-7} v. per ° C. at room temperature with saturation magnetization, and which decreases linearly with rise in temperature, reaching zero at the Curie point (351° C.). Up to 300° C. magnetization produces an increase in resistance the value of which is, in weak fields, independent of the temperature. As is the case with magnetization, saturation takes place in strong fields, and the value is then dependent on the temperature.—v. G.

An Effect Shown by Ferromagnetic Materials in Alternating Electromagnetic Fields. A. Esau and H. Kortum (*Z. Physik*, 1932, **73**, 602–619).—Ferromagnetic materials, more especially nickel, are found to execute torsional oscillations of their natural period if suitably mounted and subjected to alternating longitudinal magnetic fields. The amplitude of the oscillations depends only within very wide limits on the frequency of the exciting alternating field. The oscillations, which are just observed when the latter frequency is greater than the natural frequency of the specimen, attain a maximum with increasing frequency of the field and then decrease slowly. The effect is investigated in some detail.—J. S. G. T.

[A Method of] Rendering Visible Regions of Different Ferromagnetic Condition of a Solid. W. Gerlach (*Z. Physik*, 1932, **74**, 128–129).—G. points out that the method of v. Hámos and Thiessen, described in a previous paper (*Z. Physik*, 1931, **71**, 442; this *J.*, 1931, **47**, 582), is quite well known, and that their interpretation of the results is incorrect. References to the literature of the subject are given.—J. S. G. T.

The Emission of Positive Ions from Metals. H. B. Wahlin (*Phys. Rev.*, 1932, [ii], **39**, 183).—Abstract of a paper read before the American Physical Society. When a tungsten wire containing uranium dioxide was heated to a temperature of about 1800° C. three types of ions were observed by a magnetic deflection method, U^+, W^+, and an ion of mass 254 ± 2. This is probably UO^+. Assuming this to be the case, it seems more probable that an ion of mass 247 ± 2, which was observed when thoriated tungsten was heated and which has been reported earlier, is ThO^+. An investigation of the positive ions from copper and silver has shown that at a temperature just below and persisting above the melting point, ions of the metals themselves are emitted. This characteristic ion current is small compared with that due to alkaline impurities.—S. G.

The Analysis of Photoelectric Sensitivity Curves for Clean Metals at Various Temperatures. R. H. Fowler (*Phys. Rev.*, 1931, [ii], **38**, 45–56).—The effect of temperature on photoelectric emission from clean metals with light of frequency near the threshold value is discussed from the point of view of the Sommerfeld theory. The experimental curves for gold, silver, and tantalum (except for a change of slope with temperature in the emission–wave-length curve of tantalum) are in satisfactory agreement with the hypothesis that, near the threshold, the photoelectric sensitivity, or number of electrons emitted per quantum of light absorbed, is to a first approximation proportional to the number of electrons per unit volume of the metal the kinetic energy normal to the surface of which, augmented by $h\nu$, is sufficient to overcome the potential step at the surface. Two forms of the theory are presented, and are used to develop a graphical method enabling all the curves near the threshold to be used in determining the threshold value without arbitrary extrapolation. The alternatives differ by about 1%, which represents the present error in the threshold values, which are as follows:—silver $\lambda_0 = 2600$ or 2580 A.; gold, $\lambda = 2510$ or 2500 A.; tantalum $\lambda_0 = 2990$ or 2970 A.—W. H.-R.

Temperature Dependance of Photoelectric Effect in Metals. L. A. Young and N. H. Frank (*Phys. Rev.*, 1931, [ii], **38**, 838–839).—A Note. A modification of the equation of R. H. Fowler (*Phys. Rev.*, 1931, [ii], **38**, 45; see preceding abstract) is suggested.—W. H.-R.

A Further Experimental Test of Fowler's Theory of Photoelectric Emission. Lee A. Dubridge (*Phys. Rev.*, 1932, [ii], **39**, 108–118).—The theory of Fowler (*Phys. Rev.*, 1931, **38**, 45, see abstract above) is discussed, and applied to recent photoelectric data (cf. preceding abstract). The theory indicates that the photoelectric threshold frequency is sharply defined only at the absolute zero. At room temperature the lack of sharpness is slight, and the ordinary extrapolation values give the "true threshold," ν_0 (*i.e.* the value at the absolute zero) with but little error, but at high temperatures the difference is serious. It is meaningless to discuss the "temperature variation of the photoelectric threshold," since the "true threshold" is not dependent on temperature, whilst the "apparent thresholds" obtained by extrapolation methods are too indefinite to permit of discussion. The experimental values for the temperature changes are completely accounted for by the change in energy of the electrons according to the Fermi–Dirac statistics. An alternative method is described permitting ν_0 to be determined from photoelectric–

temperature curves for one single frequency, and complete confirmation of Fowler's equation is obtained.—W. H.-R.

Some Remarks on the Theory of the Photoelectric Effect [Selective Photoelectric Effect in Metals]. J. Frenkel (*Phys. Rev.*, 1931, [ii], 38, 309–320).—Theoretical. The third section of this paper discusses recent theories of the selective photoelectric effect in metals. The theory of Tamm and Schubin (*Z. Physik*, 1931, **68**, 97) is criticized as regards its application to the selective effect. The general idea of R. H. Fowler (*Proc. Roy. Soc.*, 1930, [A], **128**, 123–130), ascribing the selective effect to a selective transparence of the metals surface layer for electrons of a particular velocity normal to the surface, is correct. The exact potential energy curve in the surface layer assumed by Fowler is unnecessary, and alternatives are discussed which lead to a series of maxima and minima in the relations connecting the transition coeff. D with the initial energy W. Pronounced selective transparence is to be expected only in metals the surface layer of which, naturally, or as the result of adsorption, has a suitable thickness corresponding with the wave-length difference $\lambda_1 - \lambda_2$, where λ_1 is the wave-length of the free electrons within the metal after absorption of the quantum $h\nu$, and λ_2 the wave-length outside the metal.—W. H.-R.

Some Remarks on the Theory of Photoelectric Effect in Metals. Ig. Tamm (*Phys. Rev.*, 1932, [ii], 39, 170–172).—A reply to criticism by Frenkel (*Phys. Rev.*, 1931, 38, 309; see preceding abstract) of the theory of Tamm and Schubin (*Z. Physik*, 1931, 68, 97).—W. H.-R.

Effect of Electric Fields on the Emission of Photo-Electrons from Oxide Cathodes. W. S. Huxford (*Phys. Rev.*, 1931, [ii], 38, 379–395).—The photoelectric emission from the barium–strontium oxide cathodes used in radio receiving tubes has been investigated. The coatings studied were prepared by spraying mixtures of barium–strontium carbonates on to a nickel base, followed by suitable heat-treatment. Some measurements of thermionic emission were also made. The photoelectric threshold frequencies decreased with increase in accelerating potential according to the relation $\nu = \nu_0 - bE^{1/2}$, where ν_0 is the zero-field threshold, and E the electric field at the cathode surface. The lack of saturation in both photoelectric and thermionic emission from this type of cathode is probably due to a decrease in work functions with increase of accelerating potential. Good agreement was obtained between the photoelectric and thermionic work functions, suggesting that both types of emission come from areas of low work function in the outermost surface layers of the coating, and not from activated layers at the surface of the core metal.—W. H.-R.

Phenomena in Oxide-coated Filaments. II.—Origin of Enhanced Emission. J. A. Becker and R. W. Sears (*Phys. Rev.*, 1931, [ii], 38, 2193–2213).—Describes experiments to test the different theories regarding the emission of electrons from oxide-coated filaments. The results are complex, but the main conclusions are: (1) the active layer is at the outer oxide surface, the activity depending on the concentration of barium and oxygen on this surface, and also on the amount of metallic barium dispersed through the oxide; (2) the core material does not directly affect the emission, but greatly affects the ease with which free barium is produced by heat-treatment or electrolysis; (3) the thermionic electrons originate in the oxide just beneath the adsorbed barium; (4) most of the current through the oxide is carried by electrons, and a small portion by barium and oxygen ions. Most of the results refer to barium–strontium oxide coatings on cores of Konel metal (an alloy of nickel, cobalt, iron, and titanium).—W. H.-R.

Thermionic Emission from a Plane Electrode. Russell S. Bartlett (*Phys. Rev.*, 1931, [ii], 38, 1566–1577).—Differences exist between the calculations of the space charge theory of Waterman and Bartlett, and the experimental data in connection with the thermionic work function. A possible cause is that the calculations referred to plane electrodes, whereas most experiments involved co-axial cylinders. B. has made experiments with plane electrodes of nickel, and finds the same results as in the cylindrical electrode case; the experimental error is rather large.—W. H.-R.

Photoelectric Efficiencies in the Extreme Ultra-Violet. Carl Kenty (*Phys. Rev.*, 1931, [ii], **38**, 2079–2080).—A preliminary note. The photoelectric efficiencies of nickel, iron, Constantan, and graphite in the extreme ultraviolet radiations of neon and argon are all of the same order of magnitude, but are considerably higher than the efficiencies in the near ultra-violet. —W. H.-R.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 151–159.)

A New Aluminium Light Alloy " Chlumin." Ichirô Iitaka (*J. Soc. Mech. Eng., Japan* (*Foreign Edn.*), 1930, **33**, 203–208).—[In English.] A fuller account than is given in *Proc. Imp. Acad. Tokyo*, 1931, **7**, 161–164 (see *J.*, this volume, p. 11). A new aluminium alloy Chlumin containing chromium and small percentages of magnesium and iron has a density of 2·71. Its resistance to sea-water corrosion is superior to commercial pure aluminium and to other light alloys. It casts easily without requiring any special process (such as modification) for manufacture, machines well, and withstands severe water pressure. In its cast condition it has a tensile strength of 17·4–22·0 kg./mm.^{2} (11–14 tons/in.^{2}) and a good elongation. It is stated to be more easily worked than Duralumin, which it equals in its mechanical properties and surpasses in its resistance to sea-water corrosion. It is used in the form of castings, forgings, wires, and plates.—J. W. D.

Equilibrium Relations in Aluminium–Cobalt Alloys of High Purity. William L. Fink and H. R. Freche (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. **473**, 1932, 1–10).—This is an investigation of the aluminium end of the aluminium–cobalt system using aluminium which had been electrolytically refined. The few previous researches are reviewed. Cobalt was introduced into the alloys by means of an intermediate alloy or by chemically pure cobaltous chloride which was readily reduced by the aluminium. A eutectic containing 1·45% cobalt and 98·55% aluminium was observed. By dissolving away the aluminium from furnace-cooled samples and analyzing the crystals left behind, a compound having the formula Co_2Al_9 was indicated. Thermal analysis of alloys containing up to 3·22% cobalt revealed that none of them showed more than two arrests, that there was no arrest at 550° C., and that the eutectic temperature was about 657° C. The hypereutectic liquidus was determined by analysing the melt in equilibrium with the precipitated crystals of Co_2Al_9. By extrapolation, the eutectic composition was, by this method, put at 1·0% cobalt and 99% aluminium. The solid solubility of cobalt in aluminium is less than 0·02% at 655° C.—W. A. C. N.

An Investigation of the Influence of Iron on Duralumin. W. Kroenig (*Z. Metallkunde*, 1931, **23**, 245–249).—The tensile strength, elongation, and Brinell hardness have been determined of 2 mm. Duralumin sheet with an iron content of (*a*) 0·22%, (*b*) 0·52%, (*c*) 0·93%, (*d*) 1·10%, and (*e*) 1·50% after quenching from 500°, 510°, 520°, 530°, and 540° C., and after subsequent ageing at room temperature. The deleterious effect of iron on the mechanical properties of Duralumin is greater the higher the quenching temperature, *e.g.* age-hardened specimens of (*a*) and (*e*) have a tensile strength (in kg./mm.^{2}) of 44·3 and 38·5 after quenching from 500° C. and of 47·4 and 38·1 after quenching from 540° C. The elongation of age-hardened (*a*)–(*c*) is 19·5–22·5% for all quenching temperatures and that of (*d*) and (*e*) about 18–19%. The increase in the tensile strength produced by ageing is almost independent of the iron content, whereas the increase in Brinell hardness is smaller the higher the iron content. These results and micrographical examination indicate that iron reduces the solid solubility of copper in aluminium, but does not hinder the precipitation of $CuAl_2$ from the supersaturated solid solution during ageing.—M. H.

Duralumin and Light Alloys of High Strength. A Résumé of Present Knowledge. Anon. (*Aluminium Broadcast*, 1930, **2**, (15)).—A lengthy summary of a series of papers published in *Rev. Aluminium*, 1929. See this *J.*, 1930, **43**, 448–449.—J. C. C.

Equilibrium Relations in Aluminium–Copper–Magnesium and Aluminium–Copper–Magnesium Silicide Alloys. E. H. Dix, Jr., G. F. Sager, and B. P. Sager (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. 472, 1932, 1–13).—This is part of a general research into the effect of the various constituents in Duralumin-type alloys. It refers particularly to the influence of small quantities of magnesium and magnesium silicide, especially on the solubility of copper, in alloys containing electrolytically refined aluminium. Conventional methods were used for determining the solidus and the solid solubility of the copper. The addition of 0·5% magnesium slightly reduces the solid solubility of copper, although the form of the curve is not greatly altered. The $CuAl_2$ precipitated at lower temperatures is in a more highly dispersed form than the large particles of constituent found in specimens annealed at higher temperatures. The small variation in the solubility of the copper is not very significant in normal commercial alloys. The addition of about 1–3% magnesium silicide to aluminium–copper alloys does not decrease the solubility of the copper to any great extent. Any decrease which does occur, however, is probably compensated by the formation of Al–Cu–Mg–Si. This is contrary to Gayler's results.—W. A. C. N.

Non-Corrosive [Aluminium] Alloy. Anon. (*Aluminium Applications*, 1930, **2**, (8)).—A note. An aluminium alloy with copper 2, manganese 2, and nickel 2% remained bright after suspension for 10 months over bleaching liquid.—J. C. C.

The Preparation and Mechanical Properties of Aluminium–Copper–Silicon Alloys. Masaharu Goto, Sin-Ichi Fukuta, Sadao Horiguchi, and Tenji Nagai (*Rep. Aeronaut. Res. Inst., Tôkyô Imp. Univ.* (*Tôkyô Teikoku-Daigaku Kôkû-Kenkyûzyo-Hôkoku*), 1931, **6**, (73), 141–217; *C. Abs.*, 1932, **26**, 949).—[In Japanese, with German abstract.] Aluminium–copper–silicon alloys, such as Lautal, are much more easily cast and rolled than aluminium–copper alloys containing magnesium, such as Duralumin. Hardness and mechanical strength of the quenched aluminium–copper–silicon alloys or aluminium–copper alloys increase gradually in the course of ageing at room temperature, but the hardening is much less extensive than in the alloys containing magnesium. The properties of plate prepared from the aluminium–copper–silicon alloys are greatly improved by quenching and subsequent annealing. Suitable quenching and annealing temperatures are 500° C. and 125° C., respectively. Annealing time is also quite important, the best results being obtained with more than 10 hrs.' annealing. Hardness and strength are largely dependent on copper content, silicon content having little influence. Iron is harmful and should be kept below 0·5%, but 1–2% of manganese or zinc improves the properties of the alloys. Most of the internal strains produced by cold-working can be eliminated by annealing at 125° C.—S. G.

Resistance of Iron–Aluminium Alloys to Oxidation at High Temperatures. N. A. Ziegler (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. 450, 1932, 1–6).—The addition of aluminium increases the oxidation-resisting properties of iron. With 8% of the added metal the resistance is equal to that of 80 : 20 nickel-chromium alloy. No brittleness was noticed on forging these alloys, which is contrary to Hautman's observations. The carbon content does not appear to affect the results. Trials on a commercial scale have not yet been made. —W. A. C. N.

Alloys of Aluminium with Iron and Silicon. V. Fuss (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 30–32).—A summary of a paper by F. on the constitution of the aluminium-rich alloys, *Z. Metallkunde*, 1931, 23, 231. See *J.*, this volume, p. 11.—R. G.

[MG 7] A New Light Alloy. Anon. (*Engineer*, 1932, 153, 70).—See *J.*, this volume, p. 76.—W. P. R.

[M.G. 7] A New Structural Light Alloy. Anon. (*Metallurgia*, 1932, 5, 98). —A description of "M.G. 7," a new light alloy, abstracted from Memorandum No. 50, Intelligence Department, the British Aluminium Co., Ltd. See *J.*, this volume, p. 76.—J. W. D.

Hyblum Alloy. Tests by Research Laboratory. Anon. (*Aluminium Broadcast*, 1930, 2, (12)).—The advantages claimed for Hyblum, that it can be worked within a wide temperature range and that it does not work-harden rapidly, are considered to be outweighed by the fact that it is not susceptible to heat-treatment for increase of tensile strength.—J. C. C.

M.V.C. Aluminium–Silicon Alloy. L. E. Benson (*Metallurgia*, 1932, 5, 93–94).—A number of characteristic properties such as tensile strength, sp. gr., thermal and electrical conductivity, and thermal expansion of this alloy are given and compared with similar properties of other alloys. The influence of modification on the structure is illustrated by a series of photomicrographs. The influence of "pinholing" and resistance to corrosion are also discussed.—J. W. D.

Equilibrium Relations in Aluminium–Zinc Alloys of High Purity. William L. Fink and Kent R. Van Horn (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. 474, 1932, 1–11).—It has been considered desirable, owing to the fact that the usefulness of zinc in conjunction with aluminium depends on its high solid solubility in the latter metal, that an accurate determination of the solubility curve be made. Hardness, electrical conductivity, microscopic, and X-ray methods were used. Hardness measurements were sufficiently unreliable to render that method unsuccessful. Conductivity measurements at room temperature were vitiated by ageing. Microscopic examination was also inconclusive. The results of physical tests and of X-ray examination of the excess solute gave more reliable data at varying temperatures. The method gives reproducible results at room temperature, indicating that equilibrium is rapidly attained in specimens powdered from cold-rolled sheet. The results obtained are compared with those of previous investigators. At 25° C. the solid solubility of zinc in aluminium is given as 2·7%; at 250° C. it is 13·4%. —W. A. C. N.

V.L.W. Light Alloys. Anon. (*Aluminium Applications*, 1930, 2, (4). —Translation of a pamphlet issued by the Vereinigte Leichtmetall-Werke, dealing with Lautal, Skleron, Silumin, Constructal, and other V.L.W. alloys. Particulars are given of the shapes and sizes in which they are supplied, and their physical and chemical properties are tabulated. The necessity for careful calculation of stresses in designing structures is emphasized, the maximum safe stresses under various conditions are tabulated, and the principal fields of application reviewed. The design of rivets and bolts is also considered. The second half contains detailed recommendations for workshop practice in working these alloys. Included in these are (*a*) a table of smallest permissible bending radii for sheet; (*b*) profile drawings of all types of cutting tools; (*c*) working instructions for riveting, soldering, and welding; (*d*) description of frosting, plating, colouring, and other finishing processes; (*e*) details of methods and temperatures of heat-treatment.—J. C. C.

Aluminium Alloys Used in the Foundry. J. Douchement (*Rev. Mét.*, 1931, 28, 557–564).—Refers to alloys containing 10–12% of zinc, "L 5" alloy, alloys containing 4·5, 8, and 12% of copper, as well as "L 11," also aluminium–silicon alloys containing 5, 13, and 18–20% of silicon. Heat-treatment of casting alloys is discussed, and special reference is made to "Y" alloy, the alloys "RR 50," "RR 53," and Eutectal.—H. S.

Unknown Factors of Safety, in the Quantity and Processes of Transformation of Light Alloys. R. de Fleury (*Rev. Mét.*, 1931, 28, 610–616).—Brief mention is made of the various conditions and factors which tend to create uncertainty of properties in castings and in Duralumin.—H. S.

Alloys of Aluminium: Some Practical Effects of Research. George Mortimer (*Met. Ind.* (*Lond.*), 1932, 40, 69–74).—The melting, heat-treatment, and working of aluminium and its alloys present many problems, such as the formation of cavities, the care required in melting scrap, complicated heat-treatment, the ready formation of aluminium oxide, and the effects of corrosion. These problems have all been the subject of recent academic research and have been or are well on the way to being solved by this means.—J. H. W.

Equilibrium Diagrams of Some Alloys Rich in Cobalt. Uichi Hashimoto (*Kinzoku no Kenkyu*, 1932, 9, (2), 57–73).—[In Japanese.] By using a new method of thermal analysis, *i.e.* by taking cooling velocity curves, H. has studied the α–β-transformation of cobalt in the binary systems cobalt–carbon, cobalt–nickel, cobalt–iron, cobalt–manganese, and cobalt–aluminium. The new method has proved to be well adapted for such accurate determination. Not only the temperature, but also the nature of the transformation has been made clear by this method. For the determinations of the diagrams of the systems mentioned above, ordinary cooling curves were also taken, and, in some cases, X-ray photographs also.—S. G.

Copper–Beryllium Bronzes. J. Kent Smith (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. 465, 1932, 1–14).—The properties of various beryllium–copper alloys on age-hardening after quenching have been studied. Hardness figures show that a metastable condition, of which the range of stability is dependent on time at the given temperature, begins to be noted in copper containing 0·85% beryllium. At nearly 2%, constant conditions are reached. Copper–beryllium bronzes harden and strengthen by cold-work at rates greatly superior to those for copper. A tensile strength of 220,000 lb./in.^{2} was obtained by softening, heat hardening, and then cold-rolling a plate containing 1·91% beryllium. A short bibliography is appended.—W. A. C. N.

On the Mechanism of Eutectoid Change in Copper–Tin Alloys. Hiroshi Imai and Masami Hagiya (*Kinzoku no Kenkyu*, 1932, 9, (2), 85–96).—[In Japanese.] With a view to clarify the question of the mechanism of eutectoid change in the copper–tin alloys, the experimental results observed by means of thermal analysis and electrical resistance measurements are fully discussed. The most remarkable phenomena are those found in tempering the quenched specimens—namely, a heat evolution at 200° C., a decrease of resistance at 300° C., and then an increase at 400° C.; all these occur most remarkably in eutectoid alloys containing 27% of tin. Based on this, a mechanism of stepped transformation $\beta \rightarrow \beta' \rightarrow \beta'' \rightarrow \alpha + \delta$ is most probable. The changes in microstructure were also closely observed. The well-known martensitic structure, which appears in a hypo-eutectoid bronze quenched from higher temperatures, decomposes, by tempering at about 500° C., into finer crystals, which confirms the fact that it is a certain intermediate phase, probably β′. By tempering at 300°–350° C. there appears still more clearly a banded or laminated structure in the β ground-mass, which may be expressed as β″. The appearance of a grey structure between α and β, occurring frequently in a quenched specimen, and discussed on several occasions by Hoyt, Stockdale, and Hansen, is clearly explained on the basis of the above-mentioned β eutectoid transformation.—S. G.

Effect of Casting Temperatures and of Additions of Iron on Bearing Bronze (Cu 80; Sn 10; Pb 10). C. E. Eggenschwiler (*U.S. Bur. Stand. J. Research*, 1932, **8**, 67–77; *Research Paper* No. 401).—A study was made of the effect of different casting temperatures (1850°–2120° F.; 1010°–1160° C.) and of additions of iron (from 0 to 1·0%) on the hardness, structure, and resistance to wear, to pounding, and to single-blow impact of a bearing bronze containing copper 80, tin 10, and lead 10%. In general, increasing the casting temperature from 1850° to 2120° F. (1010°–1160° C.) increased the resistance to wear, increased the grain-size with only a slight effect on the distribution of the lead, and slightly decreased the Brinell hardness. The resistance to pounding was increased within the casting range 1900°–2000° F. (1038°–1093° C.) and the notch toughness decreased on the bronzes cast close to 2000° F. (1093° C.). Additions of iron exceeding 0·3% proved detrimental. Smaller additions of iron decreased the resistance to wear and increased the Rockwell and Brinell hardness. Additions of iron up to 0·1% increased the resistance to pounding. Increasing the iron content above 0·3% produced segregation of the lead particles, decreased the grain-size, and decreased the notch toughness.—S. G.

Wear and Mechanical Properties of Railroad Bearing Bronzes at Different Temperatures. H. J. French, S. J. Rosenberg, W. Le C. Harbaugh, and H. C. Cross (*Z. Metallkunde*, 1932, **24**, 42–44).—A translation, in abstract, of a paper in *U.S. Bur. Stand. J. Research*, 1928, **1**, 343–421; cf. this *J.*, 1928, **40**, 511. —M. H.

Tin in Alloys of the Gun-Metal Type. B. P. Selivanov and A. I. Schultin (*Sobshenia Vsesouznogo Instituta Metallov* (*Communications of the Pan-Union Institute of Metals*), **1931**, (3–4), 79–80).—[In Russian.] The brittle constituent (α + δ eutectoid) appears in tin-bronzes with 6% tin even on slow cooling; with increase of tin content and rate of cooling its amount rapidly increases, but annealing at 600°–700° C. for 4–6 hrs. causes it to be evenly distributed without segregation. The mechanical properties of bronze are also greatly influenced by gas bubbles and conchoidal flaws in the microstructure.—N. A.

The Static and Fatigue Properties of Brass. J. B. Kommers (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, 243–256).—See this *J.*, 1931, **47**, 376.—S. G.

The Influence of Third Metals on the Constitution of Brass Alloys. IV.—The Influence of Aluminium. A Contribution to the Knowledge of the Ternary System Copper–Zinc–Aluminium.—I. O. Bauer and M. Hansen (*Z. Metallkunde*, 1932, **24**, 1–6).—Cf. this *J.*, 1929, **42**, 451; 1930, **43**, 469; 1931, **47**, 12–13, 140–141. Earlier investigations on the constitution of the ternary system are critically reviewed.—M. H.

Nickel-Brass—Special Brasses. Anon. (*Z. ges. Giesserei-Praxis*: *Das Metall*, 1932, **53**, 12).—Under the name nickel–brass come all copper–zinc alloys containing copper 45–55, zinc 35–45, and nickel 10% maximum. For the same copper content, the nickel is equivalent to several per cent. zinc, with the result that the strength is raised slightly and the elongation considerably. On the other hand, with constant zinc content, the copper replaced by nickel effects a considerable increase in the strength and only a small increase in the elongation. The colour of these alloys becomes whiter as the nickel content increases until with 10% nickel it is pure white. Nickel is used in brasses containing aluminium or manganese, and the mechanical properties of alloys containing aluminium 2·89 and nickel 2·96% and aluminium 0–2, nickel 2–5·2, and manganese 1·5–2%, are given.—J. H. W.

Antifriction Alloys with a Magnesium Base. A. M. Botchvar and F. A. Lunev (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (9), 1135–1139).—[In Russian.] The possibility of preparing light anti-friction alloys by using magnesium as a basis was examined. Alloys of magnesium with gold, silver, cadmium, and thallium were rejected as too costly, and those with copper, antimony, zinc, tin, aluminium [?], and lead as too heavy, since from their equilibrium diagrams it appeared that the structure required for antifriction properties could be obtained only with a low magnesium content (40–50%). From a study of the equilibrium diagrams it was considered that the binary magnesium–silicon and magnesium–calcium alloys, and the ternary magnesium–silicon–calcium, might possess the required structure. In the system magnesium–silicon, the eutectic Mg + Mg_2Si lies at 1·4% silicon, and it was anticipated that suitable alloys might exist near this point. Alloys containing 1·68–3·21% silicon were found to possess a suitable Brinell hardness (29·9–39·8), and melting point (650°–700° C.), and to be easily capable of taking a high polish. Alloys of magnesium and calcium were found to be entirely unsuitable, owing to the peculiar matting properties of the crystals of the compound Ca_3Mg_4, and their inflammability when cut. The ternary alloys show a eutectic Ca_3Mg_4 + Mg with which are solid solutions of the compound Mg_2Si: a suitable structure appears at 1·99% silicon, 13·8% calcium, when magnesium, the compound Mg_2Si, and the eutectic Ca_3Mg_4 + Mg are all present. These alloys, however, were too hard (Brinell hardness 75–85) and brittle for use as antifriction alloys, besides having a slight tendency to catch fire on cutting. Thus only magnesium–silicon alloys containing 2–4% silicon could be considered suitable, and these will require further mechanical tests. The paper is illustrated by photomicrographs and diagrams.—M. Z.

Transformational Characteristics of Iron–Manganese Alloys. Howard Scott (*Trans. Amer. Inst. Min. Met. Eng., Iron Steel Div.*, 1931, 284–300; discussion, 301–306).—See this *J.*, 1931, 47, 653.—S. G.

The Equilibrium Diagram of Iron–Manganese–Carbon Alloys of Commercial Purity. E. C. Bain, E. S. Davenport, and W. S. N. Waring (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. 467, 1932, 1–24).—Deals with the constitution at equilibrium of a series of 36 alloys limited by 1·5% carbon and 15% manganese—a range including most of the manganese steels. Attention is specially centred on the ordinary transformations in the solid state. A solid three-component diagram is presented.—W. A. C. N.

On the Solidification Shrinkage of Carbon Alloys of Manganese, Nickel, and Cobalt. Kotarô Honda, Yosiharu Matuyama, and Tadatugu Isobé (*Sci. Rep. Tôhoku Imp. Univ.*, 1931, [i], **20**, 594–598).—Cf. this *J.*, 1931, **47**, 141. [In English.] Measurements with the thermobalance have shown that pure manganese and its alloy with carbon contract during solidification, whilst nickel and cobalt alloys, which form a eutectic with carbon, expand. The density of carbon is so small compared with that of nickel or cobalt that when carbon dissolved in these metals separates during solidification, an expansion occurs, whilst pure nickel and cobalt contract under the same conditions. The result of these two opposing effects may be positive, as actually observed. The following percentage changes of volume on solidification were determined: pure manganese − 4·50, manganese–carbon − 1·60, nickel–carbon + 2·06, cobalt–carbon + 2·03.—E. S. H.

The Appearance of Ferromagnetism in the System Manganese–Nitrogen. Robert Ochsenfeld (*Ann. Physik*, 1932, (v), 12, 353–384).—On annealing manganese in nitrogen at temperatures above 1000° C., up to 12 atomic-% of nitrogen is absorbed, all of which is evolved on melting the metal. Specimens containing nitrogen are ferromagnetic owing to the presence of a solid solution of nitrogen in γ-manganese which is stable at room temperature. The lattice is expanded by 2–3% by absorption of nitrogen. On heating, the magnetism decreases, and finally disappears at 510° C., but reappears on cooling. The remanence and coercivity are remarkably large. Manganese containing 25% boron is also ferromagnetic, but alloys with hydrogen and carbon are not magnetic.—v. G.

Mercury as a Dispersing Medium. The Colloidal Nature of Iron Amalgam. M. A. Rabinovitch and P. Zhivotinsky (*Zhurnal Fizicheskoy Khimii* (*Journal of Physical Chemistry*), 1930, **1**, (4–5), 523–531).—[In Russian.]—N. A.

The Hall Effect in Tellurium Amalgams. P. I. Wold and J. M. Hyatt (*Phys. Rev.*, 1930, [ii], **36**, 375).—Abstract of a paper read before the American Physical Society. Certain aspects of the study of the Hall effect in crystalline materials suggested an attempt to make tellurium–mercury alloys. Amalgams were obtained of about 30% tellurium which were plastic when fresh, but which became, in a few hours, quite hard and very friable. The plastic amalgam was placed in a mould as quickly as was feasible, and measurements on the Hall effect, the specific resistance, and the longitudinal effect were started. The Hall effect commenced with very small values and built up steadily for 2 or 3 days. The Hall constants, after such time, were as high as 0·9, which is from 100 to 500 times the value when the amalgam was ½ hr. old. The authors are not aware of any previous case in which the Hall effect has grown with time when temperature was constant, and as a new phenomenon it seems to be of special interest. X-ray crystal photographs were taken of a sample of the amalgam as soon after making as possible, and photographs taken within 1 hr. show crystalline structure apparently as strongly as when 2 days old. The longitudinal effect started with very low values and increased steadily in about the same way as the Hall effect.—S. G.

On the Cause of the High [Magnetic] Permeability in the Air-Quenched Permalloy. Kōtarō Honda (*Sci. Rep. Tôhoku Imp. Univ.*, 1931, [i], **20**, 731–735).—[In English.] Cf. this *J.*, 1931, **47**, 269. The high magnetic permeability of Permalloy is attributed to the preservation of the high permeability in the vicinity of the critical point of the alloy by a rapid cooling in air. The permeability can be increased by passing an alternating current through the test wire.—E. S. H.

Rheostat Materials from Ternary Alloys of Iron, Nickel, and Manganese. M. M. Romanov (*Trudi Instituta Metallow* (*Transactions of the Institute of Metals*,) 1931, **1**, (27), 195–203).—[In Russian.] Alloys with varying quantities of iron and nickel and 6·08–15·84% manganese can all be cold-worked with ease. Their hardness and specific electrical resistance increase with increase of manganese content, the latter rising from 75·27 to 106·9 microhms/cm.^{3} at 25° C. Work-hardness is eliminated by annealing at 800° C. for 1 hr. The following alloys have the smallest temperature coeff. of electrical resistance: (1) carbon 0·18, iron 43·6, nickel 42·8, manganese 14·17%; (2) carbon 0·32, iron 52·0, nickel 32·0, manganese 15·84%; (3) carbon 0·31, iron 40·1, nickel 45·3, manganese 14·59%. Wires of these alloys are fairly resistant to atmospheric oxidation up to 500° C.—N. A.

The Alloys of Silver, Copper, and Zinc. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 5–7).—A review of the results of recent investigations on the silver–copper–zinc system, referring to published work by Ueno, *Mem. Coll. Sci. Kyoto Imp. Univ.*, 1929, [A], **12**, 347 (this *J.*, 1930, **43**, 482), and *Anniversary Volume dedicated to M. Chikashige*, **1930**, 77 (this *J.*, 1931, **47**, 524), and by Leroux and Raub, *Z. Metallkunde*, 1931, **23**, 58–63 (this *J.*, 1931, **47**, 203). The alloys of this system are finding increased use as brazing solders.—R. G.

Composition Limits of the Alpha–Gamma Loop in the Iron–Tungsten System. W. P. Sykes (*Trans. Amer. Inst. Min. Met. Eng., Iron Steel Div.*, **1931**, 307–311; discussion, 311–312).—See this *J.*, 1931, **47**, 525.—S. G.

Heat-Resisting Alloys. N. F. Bolchovitinov (*Vestnick Ingenerov i Tehnikov* (*Messenger of Engineers and Technologists*), **1931**, (12), 586–591).—[In Russian.] Survey of the literature.—N. A.

Heat-Resisting Alloys. J. Ferdinand Kayser (*Found. Trade J.*, 1931, **45**, 412 and 414).—Abstract of a paper read before the Newcastle Branch of the

Institute of British Foundrymen. Describes the properties required of heat-resisting alloys and how certain of the nickel–chromium and nickel–chromium–iron alloys fulfil these requirements.—J. H. W.

Thermoelectric Properties of Ferromagnetic Substances. L. F. Bates (*Phil. Mag.*, 1932, [vii], **13**, 393–412).—A marked change is found in the thermoelectric power of manganese arsenide when the substance passes from the ferromagnetic to the paramagnetic state, some specimens exhibiting positive, and others negative, Thomson coeffs. A rod of the pure substance at the ferromagnetic critical point (about 42·2° C.) gives a negative Thomson coeff. It follows from the free electron theory of ferromagnetism due to Dorfmann and Jaanus that the specific heat of the substance should decrease at this temperature; this is confirmed by calorimetric measurements.
—J. S. G. T.

Dilatometric Analysis and Quality of Metallurgical Products. P. Chevenard (*Rev. Mét.*, 1931, **28**, 565–574).—All the physico-chemical transformations of alloys, the majority of structural changes, such as recrystallization after cold-work and disappearance of internal stress, influence the dilatation curves. Whatever their intensity, rapidity, or slowness, these phenomena can be studied quantitatively and in a simple manner by the dilatometric method.
—H. S.

On the Investigation of Rapid Thermal Changes in Metal Alloys by a Thermal Method. N. W. Geveling (*Vestnick Ingenerov i Tehnikov* (*Messenger of Engineers and Technologists*), **1930**, (1), 25–30).—[In Russian.] For the investigation of rapid thermal processes a fibre galvanometer (oscillograph) must be used, whilst the alloy itself must form the hot-junction of the thermocouple.—N. A.

III.—CORROSION AND PROTECTION

(Continued from pp. 160–163.)

CORROSION

Measurement of Electric Currents in and Insulation of Aluminium Vats and Storage Tanks. W. Schrempp (*Woch. Brau*, 1931, **48**, 179–183; *J. Inst. Brewing*, 1931, **37**, 3830).—Cf. this *J.*, 1930, **44**, 540–543, and 1931, **47**, 380. There are two kinds of electric currents to be considered as possible causes of corrosion of aluminium vessels, *viz.* stray currents from electric wiring (d.c. system) escaping to earth owing to defective insulation, which is often due to moisture, and galvanic currents due to electrolytic action between different metals in contact with the same liquid. The latter are much the more dangerous sources of corrosion. S. discusses the conditions under which both types of current occur, how to distinguish them and measure them separately, and how to prevent them. Their measurement does not require expensive instruments; S. uses a relatively cheap form of galvanometer, known as the Universal Mavometer, which, in combination with suitable resistances, will cover from 0·04 to 200 m.amp. In fermentation rooms stray currents from wiring are occasionally responsible for corrosion, but a much more frequent cause is galvanic action between vat walls and attemperating coils or between vat walls and metal supports. Local electrolytic action may easily be set up if alkaline or salt water is allowed to penetrate between the vat walls and the metal supports, and corrosion due to purely chemical action is also possible with badly insulated vats. In the storage cellar cases of galvanic action are much less common, and corrosion due to stray currents from wiring is practically excluded. Where corrosion occurs it is most frequently due to the mechanical or chemical action of dripping water.—S. G.

The Corrosion of Duralumin as Affected by its Chemical Composition. W. O. Kroenig (*Z. Metallkunde*, 1932, **24**, 44–45).—Abstract from *U.S.S.R. Sci. Res. Dept. Supreme Council Nat. Econ.*, No. 440; *Trans. Central Aero-Hydrodynamic Inst.*, No. 72, 1931, 1–99; cf. this *J.*, 1931, **47**, 380–382.—M. H.

Corrosion of Aluminium Alloys. E. Maas and W. Wiederholt (*Aluminium Applications*, 1930, **2**, (8), and (9)).—Translated from *Korrosion und Metallschutz*, 1929, **5**, 265–270. See this *J.*, 1930, **43**, 493.—J. C. C.

Corrosion of Iron and Aluminium in Duffek's Apparatus. N. P. Lapin (*Korrozia metallov* (*Corrosion of Metals*). *First Pan-Union Conference on Corrosion, Moscow, Nov.* 1–6, 1929; *Transactions of the Institute of Applied Mineralogy*, **1931**, 46–50).—[In Russian.] Tests carried out on iron and aluminium in Duffek's apparatus showed the latter's complete suitability for rapid determination of the corrosion of these two metals.—N. A.

The Influence of Contact with Other Metals on the Corrosion of Aluminium and its Alloys. G. W. Akimow (*Korrozia metallov* (*Corrosion of Metals*). *First Pan-Union Conference on Corrosion, Moscow, Nov.* 1–6, 1929; *Transactions of the Institute of Applied Mineralogy*, **1931**, 155–178).—[In Russian.] Cf. this *J.*, 1931, **47**, 433.—N. A.

The Action of Beer on Copper.—Idoux (*Brass. Malt.*, 1931, **21**, 198–201; *J. Inst. Brewing*, 1931, **37**, 581).—Experiments are described in which plates of pure copper, thoroughly cleaned and of known surface area, were immersed in beer in bottles for a week at 25° C., the beer being in one case at p_H 4·5 and in the other p_H 4·0. It was found that the degree of acidity of the beer had no effect on the amount of copper dissolved, which was proportional to the surface exposed and amounted on an average to 500 mg. per m.^{2} per month at the above temperature. Experiments made at the storage temperature gave analogous results, the rate of corrosion being approximately halved, partly because of the lower temperature and partly owing to the formation of a protective scale on the metal. With regard to haze production in beer, copper in the cuprous state is much more liable to give trouble than cupric copper, owing to its low solubility. The addition of 1 mg. per litre will cause an immediate haze, whilst it will require 2 or 3 days for haze to develop in beer containing as much as 10 mg. per litre of copper as a soluble cupric salt. It follows that the addition of reducing agents to a copper-containing beer will produce a haze in the majority of cases, and bisulphite should never be added to beer which is likely to contain copper in appreciable amount. The formation of a copper haze after considerable lapse of time is often due to the slow reducing action of the maltose in the beer. The reaction of the beer does not affect the haze until it becomes more alkaline than usual (p_H 4·8–5), when the haze tends to clear. The reason why beer which has been in contact with copper for days in the fermenting vessel seldom contains more than traces of the metal is to be found in the reducing character of the fermenting liquor, which causes early precipitation of the copper in the cuprous state, and the entrainment of this precipitate by the nitrogenous matter which separates from solution during this period. In the storage tanks these conditions are no longer operating, and more copper is likely to go into solution. It has been found inadvisable to add metabisulphite to unpasteurized beer containing more than 1 mg. of copper per litre. For beers which are to be pasteurized it becomes particularly important to avoid copper in solution, since quantities in excess of 0·1 mg. per litre will cause a protein haze to appear at some time after pasteurization.—S. G.

The Failure of Boiler Fusible Plugs. W. E. Warner (*Power House*, 1931, **25**, (5), 54).—Premature failure due to corrosion is noted. In one case, in which failure occurred after only 18 months' service, the threads were completely severed from the base of the plug, which was heavily scaled on the water side. Little corrosion had taken place on the water side of the plug, but the furnace side was badly corroded and covered with a deposit of copper carbonate 12·6%, copper sulphate 44·1%, and zinc sulphate 20·1%, the remainder being solids from the boiler feed-water. The corrosion was attributed to the action of the flue gases in combination with traces of water which had penetrated through a crack in the plug to the furnace side. In another case a gun-metal plug had corroded because it was in contact with steel plates and an alkaline water. Care to prevent leakage of water, and frequent inspection of plugs, are urged.—H. F. G.

Accelerated Corrosion Test of Sprayed Molten Metal Coatings Applied on Steel in a SO_2–CO_2–Air Atmosphere. Leopold Pessel (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (II), 294–303).—The relative resistance of various sprayed molten-metal coatings, applied on steel, against the attack of the corrosive agents occurring in flue gases was determined in an apparatus in which this attack is considerably accelerated and in which uniform corrosion results are obtainable. Sprayed molten lead coatings were found to be practically unattacked. Twenty-two other metals and metal combinations, applied in sprayed molten form, indicated lack of suitability for service under conditions similar to those developed in this apparatus.—S. G.

The Erosion of Steam Turbine Blades. F. W. Gardner (*Engineer*, 1932, **153**, 146–203).—The erosion of turbine blades is caused chiefly by the impact of small water droplets which lie in the path of the blades moving at high velocity. If the velocity of the moving blades is high enough, the force of impact is sufficiently great to cause local deformation of the metal, and as the leading edge is exposed to a constant repetition of such blows, the surface gradually disintegrates. It appears that the maximum pressure which can be attained by such impacts is of the order of 40 tons/in.^{2}, with a blade velocity of 1000 ft./second. A high degree of hardness is therefore essential if the material of the blade is to resist corrosion, and even a Brinell number of 600 does not give complete immunity from erosion. Photomicrographs of ferrous and non-ferrous materials which have suffered erosion are given, and also details of the experimental apparatus used for determining the suitability of a wide range of materials for turbine blading.—W. P. R.

Corrosion of Cracking Equipment. I. E. Bespolov (*Reports of the Conference on Cracking Hydrogenation, Grozny*, 1931, **1**, 358–377; *C. Abs.*, 1932, **26**, 1105).—[In Russian.] Strips of steel, iron, cast iron, tin, aluminium, brass, Babbitt metal, copper, and lead were exposed to the action of hot vapours of cracked petrol and the decrease in weight was determined. It was found that lead is most easily attacked, followed by copper, Babbitt metal, cast iron, brass, tin, iron, and steel. Lead is more severely attacked by lighter petrol fractions, whilst copper is less resistant to heavier fractions. All the metals mentioned except copper and brass are attacked less by liquid than by vapour. Under conditions of storage, untreated cracked petrol attacked copper and lead to a very noticeable extent. Refined cracked petrol attacked cast iron most, then brass, aluminium, and iron. Changes occurring with unrefined cracked petrol when stored with various metals were: without metal, slight yellowish colour; with copper, gradually increasing green coloration accompanied by separation of gum; with brass, same as with copper but to a smaller extent; with lead, the petrol brightened gradually, acquiring a slightly greenish tint and an ethereal odour; with cast iron it gradually turned distinctly yellow and large quantities of gum separated. Other metals did not have much effect. Refined petrol had the same tendencies, but to a much smaller extent. Tables show the action of various metals on a number of Russian refined and unrefined petrols. Sulphur does not affect the stability of petrol.—S. G.

Location and Study of Pipe Line Corrosion by Surface Electrical Measurements. C. and M. Schlumberger and E. G. Leonardon (*Amer. Inst. Min. Met. Eng. Tech. Publ.* No. **476**, 1932, 1–24).—The causes of electrical phenomena which accompany the oxidation of pipe lines are very similar to the so-called "spontaneous polarization" with reference to metallic ore bodies. Investigation of the latter has, for the most part, been on a theoretical basis. A method has been devised for the study of the direction of currents flowing from pipe lines, with a view to the investigation of pipe corrosion problems in confined areas where excavation is difficult. The results obtained by the new method are discussed, following a preliminary review of the process of corrosion itself and of previous investigations into pipe-line corrosion. These have been conducted principally by studying the intensity of currents flowing through the pipes, and by measuring the resistivity of the ground between fixed points. The new process employs methods akin to those evolved for the geodetic survey of natural ore bodies, by means of observed potential differences. A profile of potentials is plotted along the pipe line with distances as abscissæ and potential variations as ordinates.—W. A. C. N.

The Effect of Phosphoric Acid on Alloys (Preliminary Communication). O. I. Vehr and M. M. Romanov (*Sobshenia Vsesouznogo Instituta Metallov* (*Communications of the Pan-Union Institute of Metals*), **1931**, (8), 65–73).—[In Russian.] Materials suitable for plant for handling phosphoric acid of concentrations up to 60% and at temperatures up to 75° C. are nickel–chromium alloys (containing from 15% chromium and 10% nickel), V4A steel, and aluminium–bronze, both with and without the addition of manganese. Both types of bronze, as well as a third variety containing iron, are also relatively resistant to boiling 60% acid. For plant exposed to phosphoric acid fog, certain copper–nickel alloys and aluminium–bronzes can be used; the former are also useful, together with nickel–chromium alloys, in the case of gaseous acid. For handling liquors from phosphate manufacture at room temperatures, plant constructed of lead, lead–antimony alloy, V4A steel, and nickel–chromium alloys are suitable.—N. A.

Corrosion of Metals Caused by Inflammable Liquids under Storage Conditions. S. P. Uspensky (*Korrozia metallov* (*Corrosion of Metals*). *First Pan-Union Conference on Corrosion, Moscow, Nov.* 1–6, 1929; *Transactions of the Institute of Applied Mineralogy*, **1931**, 204–213).—[In Russian.] Cf. this *J.*, 1931, **47**, 545.—N. A.

A Modern Theory of Corrosion, and Methods of Testing Metals for their Resistance to Chemicals. N. A. Isgarischev (*Korrozia metallov* (*Corrosion of Metals*). *First Pan-Union Conference on Corrosion, Moscow, Nov.* 1–6, 1929; *Transactions of the Institute of Applied Mineralogy*, **1931**, 7–25).—[In Russian.] I. considers that the electrochemical theory of corrosion is the best, as it demonstrates the true nature of the various phenomena and affords an explanation for a large number of individual facts. The phenomena of corrosion and methods for protection against it are examined in the light of this theory.—N. A.

The Effect of Corrosion on the Useful Life of Articles and Methods of Counteracting it Based on Works Practice. I. A. Krylov (*Korrozia metallov* (*Corrosion of Metals*). *First Pan-Union Conference on Corrosion, Moscow, Nov.* 1–6, 1929; *Transactions of the Institute of Applied Mineralogy*, **1931**, 26–32).—[In Russian.] A review demonstrating the necessity of studying corrosion phenomena, and methods of counteracting them under works conditions.—N. A.

Influence of Water Composition on Stress Corrosion. D. J. McAdam, Jr. (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (II), 259–278).—The paper is divided into 5 parts. (I) Gives a brief resumé of previous work, an outline of continued investigation, and a description of methods and material. (II) New composite diagrams are presented representing corrosion of ordinary steels in calcium carbonate water. These diagrams confirm previous conclusions that the influence of stress range and cycle frequency on corrosion pitting of all these steels is practically the same. (III) The corrosion of steel in distilled water is discussed. The influence of stress range and cycle frequency on the corrosion of steels in distilled water is illustrated by diagrams. (IV) The effects of stress corrosion of steel in distilled water and in carbonate water are compared by means of superimposed diagrams. (V) A brief general discussion is given of stress corrosion. Comparison is made between diagrams for *Monel metal* and ordinary steels. Evidence indicates that the less generally corrodible of two metals in the same water (at low frequency and high stress) may suffer the greater damage. Other subjects discussed are: intercrystalline corrosion, and " determining factors " in stress corrosion.—S. G.

The Distribution of Corrosion. S. C. Britton and U. R. Evans (*Electrochem. Soc. Preprint*, **1932**, April, 123–137).—Specimens of iron and zinc, freshly immersed in salt solutions, commence to suffer attack preferentially at places where the primary, air-formed oxide-film is imperfect. Generally, however, on vertical specimens placed in stagnant solutions of sodium (or potassium) chloride (or sulphate), this primary distribution rapidly passes into a secondary distribution, dictated by differential aeration, in which there is one large unattacked area near the water line, with an (anodic) etched region at the bottom and near the cut edges. The state of the original primary film may have a somewhat more lasting effect on the distribution of corrosion in the case of specimens shaken in potassium sulphate solution, since the oxygen is then supplied to all parts of the specimen. Under stagnant conditions, the effect of the state of the primary film is usually transitory, but it may help indirectly to determine the final distribution of attack, since corrosion-products, descending from a weak spot in the primary film, screen other portions from oxygen and set up anodic attack over the part screened; also the effect of the cutting stress at the edges is still seen even in an advanced state of corrosion. Thus the factors determining the final distribution of attack are very numerous, but it is impossible to neglect the part played by (*a*) the state of the primary film, (*b*) differential aeration, and (*c*) the oxygen-screening caused where secondary corrosion-products settle on the surface; the importance of these three factors is doubtless greater under the conditions of the author's experiments than under the conditions observed by Bengough and his colleagues. Ammonium chloride attacks iron and steel more rapidly than sodium chloride, and the distribution is different, the corrosion being commonly most rapid at the water line. The action is probably electrochemical, but there are numerous anodic and cathodic areas close together, the lower cell-resistance explaining the more rapid attack. The fact that the secondary distribution commonly reached in sodium chloride (one large cathodic and one anodic area) is usually not reached in ammonium chloride, appears to be due to the weaker precipitating power of ammonia.—S. G.

Experimental Studies of the Corrosion of Metals. Marcel Prot and N. Goldwoski (*Génie civil*, 1932, **100**, 35–39).—Owing to the large number of factors which may affect the rate of corrosion of a metal, it is difficult to assign a definite " corrosion index " with extreme accuracy. P. and G. have developed a method which they claim does give a more precise value to the corrosion index of any metal. They take for their corrosion index the loss in weight of the metal under certain specified conditions. Of these the chemical composition, physical condition, and the character of the metal surface are important and should be reproducible. The first two conditions offer no particular difficulties, but it is not easy to reproduce the same surface condition of the test-pieces, and P. and G. point out the many disadvantages of a mechanically prepared surface. In the study of the corrosion of light alloys they adopt a chemical method of preparing the necessary reproducible surface conditions. As regards the corroding medium, it is important to know its chemical composition and the amount of dissolved gas, such as oxygen, which it contains. The initial p_H value may also have an important rôle to play in the rate of corrosion. An important factor is the ratio of the volume of the corroding medium to the metal. The amount of medium used in the test should be very large, a fact which is often ignored. The method adopted here consists of allowing a slow stream of corroding liquid to flow through a vessel in which the metal test-pieces are placed. The liquid, after passing over the metal, is filtered, and any precipitate obtained is added to the loss in weight which the metal undergoes after a specified time. A number of results are given which indicate to what degree of accuracy results may be reproduced.—W. P. R.

On Methods of Testing the Corrosion of Metals. E. Herzog and G. Chaudron (*Compt. rend.*, 1932, **194**, 180–181; and (abstract) *Génie civil*, 1932, **100**, 99).—It has been shown that the attack of sea-water on Duralumin produces severe local corrosion without appreciable alteration in weight of the specimen, but with a lowering of the elongation in tensile tests. The corrosion acts as an indicator, since the initial elongation of the metal is affected by drawing out the pin-holes. Local corrosion can be distinguished from uniform attack by considering the ratio of the decrease of the yield-point to the decrease of thickness of the specimen. In the case of a specimen of Duralumin, local corrosion by $NaCl + H_2O_2$ gave a value of 20 for this ratio; $NaCl + O_2$ under a pressure of 30 kg. a value of 10, $NaCl + O_2$ with alternate immersion, one of 40, and a uniform attack by 5% NaOH solution a value of 1·1.—J. H. W.

Methods of Investigating Corrosion and the Elaboration of a Standardized System of Mass Testing. 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**, 214–233).—[In Russian.] The modern methods of testing metals for corrosion are described, and a detailed account is given of the system worked out by the Central Aero-Hydrodynamic Institute (C.A.H.I.).—N. A.

On Methods of Investigation of the Corrosion of Metals. E. W. Zechnovitzer (*Sobshenia Vsesouznogo Instituta Metallov* (*Communications of the Pan-Union Institute of Metals*), **1931**, (1–2), 45–49).—[In Russian.] An examination of the various methods of studying the corrosion of metals leads to the conclusion that no single one of them is capable of giving a complete characterization of the substance under investigation. It is necessary, therefore, always to employ several methods.—N. A.

Corrosion Testing with Tödt's Corrosimeter. G. Gollnow (*Z. Metallkunde*, 1931, **23**, 315).—According to Tödt, the current intensity is a direct measure of the corrosion. The sample and a noble metal, *e.g.* platinum, are dipped into the corroding agent and the current intensity is determined by means of a highly-sensitive galvanometer graduated directly in loss in weight of iron/day/m.^{2}. By the use of the apparatus the behaviour of two different samples under the same conditions can be compared and the resistance of protective layers tested (cf. this *J.*, 1928, **40**, 548; 1929, **41**, 486).—M. H.

An Apparatus for the Automatic Registration of the Corrosion of Metals with Time. W. W. Skortchelletti and A. I. Shultin (*Sobshenia Vsesouznogo Instituta Metallov* (*Communications of the Pan-Union Institute of Metals*), **1931**, (7), 88–92).—[In Russian.] To obtain continuous time–loss of weight curves an apparatus termed a "corrosiograph" has been constructed. The method of operation is as follows: the specimen is cleansed of all grease, weighed, and suspended (if the nature of the corroding medium allows) on a horse hair underneath a glass globe fitted with a tube (*i.e.* a form of areometer). The whole is then immersed in the corroding fluid, the depth of immersion being regulated by the introduction of mercury into the globe. The globe rises or sinks as the specimen either loses or gains in weight. If the tube is of uniform cross-section, the linear displacement of the apparatus is practically proportional to the change in weight of the specimen. The movements of the apparatus cause a mirror to rotate, which reflects a pencil of light on to a rotating drum of light-sensitive paper. An automatic record of the changes in weight of the specimen can thus be obtained, the time being given by the rate of rotation of the drum, and the change in weight by the vertical displacement of the light spot.—N. A.

PROTECTION

Protection of Metal Parts of Aircraft against Corrosion. H. Sutton (*J. Roy. Aeronautical Soc.*, 1932, 36, 1–23; (also summaries) *Metallurgist* (Suppt. to *Engineer*), 1931, **7**, 172–173; and *Metallurgia*, 1931, **4**, 201–202).—Reference is made to modern methods of protection of steels, including organic protectives, zinc, cadmium, and nickel electro-deposits, coatings produced by the hot-diffusion or Sherardizing type of process. Treatments suitable for protection of steels against oxidation at elevated temperatures are mentioned, and the results of a number of comparative tests are given. Organic protectives for use on light alloys and Alclad, and recent developments in anodic oxidation treatment are described, and reference is made to the protection of marine aircraft parts. Recent developments in the protection of magnesium alloys are described.—H. S.

Methods of Preservation of Alloys and Steels against Deterioration by Atmospheric Agencies. Edm. de Winiwarter (*Bull. Soc. chim. Belg.*, 1931, **40**, 269–283).—Describes methods of plating with nickel, cobalt, and chromium, and discusses the value of the plates as a protection against atmospheric corrosion.—A. R. P.

Anodic Treatment of Aluminium. Edwin Joyce (*Monthly Rev. Amer. Electroplaters' Soc.*, 1931, **19**, (1), 16–21; discussion, 21–26).—An account of the production of protective films on aluminium and its alloys by anodic treatment in a chromate bath.—A. R. P.

The New Dipping Process of the Forschungsinstitut, Gmünd for the Protection of Silver and Silver-Plated Wares against Tarnishing. Anon. (*Oberflächentechnik*, 1931, **8**, 207–208).—Claims are made for a dipping process which provides an invisible tarnish-resisting film on silver surfaces. No details of the process are given.—A. R. P.

Coatings in the Food Industries. Fr. zur Linde (*Werksleiter*, 1931, **5**, 440–443).—Coatings resistant to corrosion and suitable for use in the food industry are mentioned *inter alia*.—v. G.

Aluminium Plating. Anon. (*Engineering J.*, 1929, **12**, 446).—An account of the desirability of perfecting a method for the electrodeposition of aluminium, and a note of the research carried on by the Engineering Foundation. Although electroplating with solutions of the ordinary aluminium salts does not appear feasible, organic aluminium compounds of low melting point offer some prospect of success, and satisfactory deposits, on the laboratory scale, have actually been obtained.—H. F. G.

Aluminium-Plated Iron. Anon. (*Compressed Air Mag.*, 1931, **36**, (3), 3437).—A method of plating iron with aluminium secures actual inter-metallic penetration, with production of a thick coating of an aluminium–iron "compound." This coating is a useful protective against corrosion, but investigations are in progress to discover methods of increasing its elasticity and flexibility.—P. M. C. R.

Metal Protection and Alloys Resistant to High Temperatures. Walter Obst (*Oberflächentechnik*, 1931, **8**, 41–42).—Cf. this *J.*, 1931, **47**, 457. The Alitieren process can be used for the protection of nickel and copper and their alloys against scaling at high temperatures. The aluminium alloy film formed on the surface of the metal is destroyed by furnace atmospheres containing sulphur compounds in the presence of reducing substances and by coke ash above 700° C.—A. R. P.

Coating Objects with Aluminium. The Metallization Process. Anon. (*Aluminium Applications*, 1930, **2**, (8)).—Some applications of the metal spray and of the aluminizing process (in which a sprayed aluminium coating is alloyed with a steel base by heating in a reducing atmosphere) are enumerated.—J. C. C.

Factors Affecting the Efficiency of Cadmium Plating as a Rust Preventive. S. Wernick (*Indust. Chemist*, 1931, **7**, 358–361).—A summary of recent work. —E. S. H.

Hot-Tinning and Tinning with Tin Paint. Karl Kilthau (*Apparatebau*, 1931, **43**, 123–125; *Z.V.d. Kupferschmied.*, 1931, **43**, 172–173).—A general discussion.—M. H.

Tinning without Heat. James E. Noble (*Power House*, 1931, **25**, (7), 22). —A description of the method of tinning cast iron, copper, brass, &c., by applying zinc chloride solution to the cleaned surface and then rubbing on an amalgam of tin.—H. F. G.

Wire Galvanizing Processes. Geoffrey K. Rylands (*Wire and Wire Products*, 1931, **6**, 474–475, 486–488).—Fourth paper of a discussion on Hot-Galvanizing *versus* Electrogalvanizing (cf. *J.*, this volume, pp. 30–31). The results of the Preece test (dipping in copper sulphate solution), the wrapping test, dipping and wrapping test, percentage of coat; stripping test (sulphuric and hydrochloric acids), uniformity of coat and of micro-examination of 5 special samples of electro-galvanized wire and a specimen of " Crapo " (hot-galvanized wire) are given and the conclusion is reached that this last is a superior product. Criticism by L. D. Whitehead of R.'s previous contribution is answered and the relative bonding of the zinc coating in the 2 processes is discussed from the results of photomicrographs.—J. H. W.

The Process of Zinc Coating Steel Wires. A. D. Turnbull (*Engineering J.*, 1930, **13**, 553–558).—A fairly detailed account of the production of wiped wire, unwiped wire, and annealed, galvanized wire. Ammonium chloride is preferable as a flux to zinc chloride, as the free acid usually present in the latter forms ferric chloride which is carried over into the zinc bath; 4% of iron in the bath will render it useless for high-grade work. Cadmium in the zinc bath reduces the adherence of the deposit; lead is not harmful, and may be added at intervals to precipitate dross to the bottom of the bath. Chemical and mechanical tests for galvanized wire are described. The use of such wire as telephone and telegraph wire is expected to be discarded soon in favour of copper, bronze, and copper–cadmium wires.—H. F. G.

Keeping White Rust from Zinc-Coated Products. Wallace G. Imhoff (*Iron Age*, 1932, **129**, 232–235).—Zinc-coated products undergo an air-moisture oxidation, the resulting deposit being composed of ZnO, OH, and CO_3. The conditions under which this " white rust " forms are easily avoidable. The precautions necessary to effect this are the exercise of proper care and supervision during and after galvanizing and covering the galvanized material with grease or varnish. These methods are further discussed.—J. H. W.

The Protection of Iron against Corrosion by Galvanizing. N. A. Isgarischev (*Korrozia metallov* (*Corrosion of Metals*). *First Pan-Union Conference on Corrosion, Moscow, Nov.* 1–6, 1929; *Transactions of the Institute of Applied Mineralogy*, **1931**, 33–45).—[In Russian.] This paper was published, after the Conference, in *Korrosion u. Metallschutz*, 1930, **6**, 156–161. Cf. this *J.*, 1930, **44**, 551.—N. A.

Selected Bibliography on the Embrittlement of Structural Steel in Galvanizing. Samuel Epstein and B. N. Daniloff (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 224–237).—Prepared under the sponsorship of the Utilities Research

Commission of Chicago, and revised for Sub-Committee A–5, of the A.S.T.M., on Corrosion of Iron and Steel.—S. G.

Notes on the Enamelling of Copper Wire. Roger Campredon (*Caoutchouc & Guttapercha*, 1931, 28, 15764–15768; *C. Abs.*, 1932, 26, 859).—A review and discussion of present problems.—S. G.

Notes on the Manufacture of Enamelled Copper Wire. II.—Influence of the Nature of the Copper in the Enamelling Operation. Roger Campredon (*Caoutchouc & Guttapercha*, 1931, 28, 15804–15805).—S. G.

Advantages of Oxide Films as Bases for Aluminium Pigmented Surface Coatings for Aluminium Alloys. R. W. Buzzard and W. H. Mutchler (*U.S. Nat. Advisory Cttee. Aeronautics, Tech. Notes* No. 400, 1931, 1–16).—Protective coatings on aluminium alloys are divided into the 3 groups: (1) oxide films; (2) non-metallic coats such as paints, varnishes, &c., and (3) metallic coatings superimposed by electrodeposition or mechanical processes. The present paper deals with the anti-corrosion results obtained after applying a combination oxide-varnish coating to an aluminium alloy of the Duralumin type. The oxide film was produced anodically in a 3% chromic acid electrolyte and the varnish was made by adding 2 lb. of "aluminium–bronze" powder to 1 gall. of spar varnish vehicle. Three brush coats were applied, the specimens being air dried for 48 hrs. after each application. Intermittent immersion and salt-spray tests were employed. Laboratory and external exposure tests showed that the use of the aluminium pigmented spar varnish afforded greater protection to previously anodically treated aluminium surfaces than that of similar varnishings on merely grease-free surfaces. Diagrams, photomicrographs, generous tables of results and a bibliography accompany the paper.
—W. A. C. N.

Protection of Aeronautical Materials by Paints and Varnishes. G. Dixmier (*Rev. Mét.*, 1931, 28, 690–694).—Reference is made to impermeability, flexibility, adhesion, and inflammability of the films of the protectives used in French aircraft practice, more especially in regard to the standards required and methods of testing.—H. S.

The Relation between Corrosion and Paint. W. H. J. Vernon and L. A. Jordan (*Chem. and Ind.*, 1931, 50, 1050–1057).—The formation of naturally-acquired protective films on metals is discussed, particularly with regard to the stability and self-healing properties of the film. These films, of oxide or other compound, have an intimate bond in the molecular sense with the underlying metal; a factor which is absent in artificially applied films of paint. The criterion of a satisfactory paint film is the degree of lateral continuity combined with a sufficient degree of impermeability. The effects of the paint vehicle and the thinner on these properties are considered. The chemical or electrochemical nature of the pigment may also determine the protective quality of the paint, and 3 types of material are recognized according to whether they (1) inhibit, (2) have no effect, or (3) stimulate corrosion. The first group includes red lead and other "passivating" pigments, the second includes many "inert" pigments and ferric oxide, and the third comprises graphite, lamp-black, and certain metallic pigments under certain conditions, in which these pigments can act cathodically. Consideration is also given to the conditions of painting and of preparing the work, particularly with regard to mechanical adherence, and the danger of entrapping electrolytes under the paint film is pointed out. The paint film may then act as a semi-permeable membrane, through which water may be forced osmotically from the outside. Bituminous paints are discussed briefly.—E. S. H.

IV.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 161–165.)

Macrography of the Bearing Metals. L. Sliwowski (*Przegląd Techniczny*, 1931, **70**, (1), 13–17).—The best reagent for detection of the primary crystallization of bearing metals is ammonium polysulphide. Time of immersion in the cold reagent should be 20–30 minutes. The brown sediment on the surface of the sample can be removed by rubbing with a wad under the water. Babbitt metal rich in copper is conveniently etched by a 1 : 1 mixture of hydrogen peroxide and ammonia (*d* 0·88).—Z. J.

The Structure of Metals and Alloys, Micrography and X-Ray Spectroscopy. A. Portevin (*Génie civil*, 1932, **100**, 93–118).—Microscopic and X-ray spectroscopic examination of metallurgical products have resulted in notable advances, amongst which may be mentioned the following: (1) considerable improvement in properties of cast irons; (2) a more perfect understanding of the heat-treatment of aluminium, which has allowed certain generalizations to be made on the heat-treatment of a variety of other alloys; (3) the development of alloys of extreme hardness: (4) the use of alloys with exceptional magnetic properties.—W. P. R.

On the Art of Metallography. Francis F. Lucas (*Trans. Amer. Inst. Min. Met. Eng., Iron Steel Div.*, 1931, 11–44).—See this *J.*, 1931, **47**, 534, 582.—S. G.

The Trend of X-Ray Analysis in Metallurgy. L. Pickup (*Metallurgia*, 1932, **5**, 177–179).—A review of the applications of X-ray analysis in metallurgy shows that considerable advance has been made in such problems as the true mechanism of rolling, the controversy of the β and β′ phases in brass, solid solutions, and the definition of intermetallic compounds. X-ray investigations indicate that rolling tends to orientate certain crystal planes in definite directions relative to the direction of rolling, and also that there are no crystallographic differences between the β and β′ phases of brass, so far as size and form are concerned. In the mechanism of solution such points as space dimensions, limits of solubility, and the mode of entry of a foreign atom into a lattice structure have been experimented with, and it has been shown that solution is either interstitial or substitutional. The solution of up to 8% of aluminium in copper, and of 8% of magnesium in aluminium, and of the copper–nickel alloys are all types of substitutional solution. Investigations on inter-metallic compounds have been either by photographs from samples in powder form, or by reflections from a rotating single-crystal, and the latter method has shown marked advantages over the former, due to the fact that no ambiguity is encountered as regards the unit size, and that crystal forms can be determined for which it is not possible to construct graphical curves, which are necessary for powder photographic analysis. The lack of application of this second method to the determination of metal crystal structures is due to the difficulties encountered in preparing true single-crystals of the metallic phase. The results of such analysis has been to suggest that some so-called "inter-metallic" compounds are more probably solid solutions, or at least modifications.—J. W. D.

On the Crystalline Structure of Thin Films of Metals. Zofja Debińska (*Sprawazdania i Prace Polskiego Towarzystwa Fizycznego* (*Comptes rendus des Séances de la Société polonaise de Physique*), 1931, **5**, 365–370).—[In Polish with French summary.] Thin films of platinum and gold deposited by cathodic sputtering on quartz and mica at — 80° to — 180° C. are not crystalline, but become so when heated at 250°–300° C. (platinum) or 200°–250° C. (gold); the crystals are so oriented that the [111] direction is perpendicular to the surface on which the metal is deposited. The formation of crystals appears to be dependent only on heat, whether produced locally by the sputtering or later by annealing the film.—A. R. P.

Texture of Rolled Metal and its Alteration in Relation to the Degree of Deformation. E. F. Bachmetev (*Zhurnal Tehnicheskoi Fiziki* (*Journal of Technical Physics*), 1931, 1, (2–3), 184–191).—[In Russian.] Cf. this *J.*, 1931, 47, 535. The alteration in the orientation of the crystal grains of Duralumin and aluminium after rolling has been studied by X-ray analysis, the changes in mechanical properties being also determined. Deformation up to 30% does not give a regular orientation, but a characteristic definite structure appears between 30 and 70%. The greater the degree of deformation, the greater the number of metal crystals which are oriented. The axis of the texture is defined by the angles it makes with the directions [100], [010], and [001]. Above 70% deformation the texture axis gradually approaches the direction [111], although it does not completely reach it even with a deformation of 99·6%.—N. A.

An X-Ray Study of the Nature of Solid Solutions [Aluminium–Silver]. Robert T. Phelps and Wheeler P. Davey (*Phys. Rev.*, 1931, [ii], 38, 1919).—Abstract of a paper read before the American Physical Society. See *J.*, this volume, p. 164.—S. G.

[Report on] Crystallography. J. D. Bernal and W. A. Wooster (*Ann. Rep. Prog. Chemistry*, 1931, 28, 262–321).—Includes a summary and bibliography of the X-ray crystal analysis of metallic systems carried out during 1930 and 1931.—E. S. H.

Methods of Focussing X-Rays. W. P. Linnik and W. E. Lashkariev (*Ukrainski fizichni zapiski* (*Ukrainian Physical Notes*), 1926, 1, (1), 5–8).—[In Russian.] The problem of focussing X-rays by reflection from the surface of a crystal may be solved by applying the surface of revolution of a logarithmic spiral, at the focus of which the source of radiation is placed. A partial focussing can be secured by means of a mica plate bent into a cylindrical form. The possibility of constructing an X-ray spectrograph with a large number of crystals is demonstrated.—N. A.

Chamber of a Debye–Scherrer X-Ray Diagram for Specimens of all Shapes. W. E. Lashkariev and S. D. Gerzriken (*Ukrainski fizichni zapiski* (*Ukrainian Physical Notes*), 1928, 2, (1), 37–38).—[In Russian.] The chamber is in the shape of a quadrant. The specimen to be examined can be of any shape, provided one side is flat. This side is fixed to the wall of the chamber at the point of entrance of the X-ray pencil and forms one of the sides of the third slit, the other side of which is formed by a special tin plate. The angle θ is determined graphically, for which purpose the chamber is calibrated by means of a pure chemical compound. By this method the necessity of introducing corrections, as in the case of cylindrical specimens, is obviated.
—N. A.

V.—ANALYSIS

(Continued from pp. 166–170.)

[Report on] Analytical Chemistry. J. J. Fox and B. A. Ellis (*Ann. Rep. Prog. Chemistry*, 1931, 28, 179–211).—Recent developments in the detection, separation, and determination of metals are summarized. The sensitivity of precipitation reactions, the applicability of nephelometric methods, and the use of arc and spark spectra in the determination of metals in alloys are discussed.—E. S. H.

Annealing in Gold Bullion Assay. Its Effect on Surcharge. Robert Law (*Ann. Rep. Royal Mint* (*Lond.*), 1928, 59, 89–90).—Report of the Chemist and

Refiner of the Melbourne Branch of the Royal Mint. Gold bullion assays receive 3 annealings: (1) when the gold–silver button has been flattened; (2) after the gold–silver fillet has been rolled; (3) after parting. Experiments were carried out wherein either or both the first and second annealings were omitted, and it was found that omitting the second annealing causes a very high surcharge, that omitting the first annealing has little effect on the surcharge, and that annealing at too low a temperature gives irregularities. The high surcharges were found to be due to retention of silver, the loss of gold being greater.—J. H. W.

Observations on the Correct Sampling of Coinage Alloys of Gold and Silver for the Purposes of Assay. S. W. Smith (*Ann. Rep. Royal Mint* (*Lond.*), 1930, 61, 55–60).—Report of the Chief Assayer. "Cuts" taken from gold coinage bars (91·66% fine) may be misleading. "Dip" sampling, however, offers many difficulties, and "cuts" or drillings are used with suitable precautions. These have the advantage that results may be checked on subsequent occasions. There is a slight impoverishment of gold on the extreme outer portions of the ingots, and cuts must not be too shallow. The distribution of gold across the section of a rolled fillet is shown graphically. Segregation in 50 : 50 silver–copper alloys is serious, and still more so in the quaternary alloy now used for Imperial silver coinage, and "cuts" are entirely untrustworthy. In these cases, "dip" samples granulated in water are taken. The direction in which segregation takes place in silver alloys (enrichment at the outer parts in the case of alloys containing more than 72% silver and at the centre in higher grade alloys), is illustrated, and it is shown that the effects of gravity, which can be demonstrated by artificial conditions, are overshadowed by the effects of the chilling surfaces of the chill moulds.—J. H. W.

The Preparation and Reproducibility of the Quinhydrone Electrode. J. Livingston R. Morgan, Olive M. Lammert, and Margaret A. Campbell (*Electrochem. Soc. Preprint*, **1932**, April, 199–220.)—A method is given for the preparation of quinhydrone half-cells which can be used as secondary standards with great precision. The solutions suggested are either $0{\cdot}1M$-hydrochloric acid, or a mixture of $0{\cdot}01M$-hydrochloric acid and $0{\cdot}09M$-potassium chloride, saturated with quinhydrone. The optimum conditions for the preparation of the half-cell are described and criteria given for its correct behaviour. Results are given on the reproducibility in these solutions for the half-cell prepared with platinum, platinum–iridium alloys, platinum–rhodium alloys, 24-k. gold, gold-plated platinum, and graphite of different sizes, ages, and compositions, when the solutions are stirred in air and with hydrogen. For extreme precision, platinum foils immersed in solutions stirred with nitrogen give the best results; for ordinary precision, platinum or gold wires, or foils, or lead pencil cores give identical potentials even in unstirred solutions. Emphasis is placed on the fact that while under optimum conditions the quinhydrone electrode is easily reproducible with great precision, under many given conditions it is extremely capricious, and that therefore it is to be recommended more generally as a secondary standard than as a working electrode. A full bibliography is appended.—S. G.

On the Reactions of Several Metallic Ions in the Presence of Organic Acids. Shin' Ichirô Hakomori (*Sci. Rep. Tohoku Imp. Univ.*, 1931, [i], 20, 736–763).—[In English.] The reactions of Mo, Ti, V, Fe, Al, Cu, Ni, Co, U, Be, Pb, Zr, and Mn in the presence of oxalic, citric, malic, or succinic acid were studied by means of absorption spectra, electrical conductivity, ultra-microscopic measurements, and colorimetry. H_2MoO_4 gives a yellow coloration with H_2O_2, the intensity of which is increased by the presence of citric, tartaric, or succinic acid. On the whole, no specially useful analytical reactions are noted, but the cases where the formation of complex compounds occurs between metallic salts and the organic acids investigated are tabulated.—E. S. H.

The Cathode-Ray Tube in the X-ray Spectroscopic Analysis of Columbium and Tantalum. Gorton R. Fonda (*J. Amer. Chem. Soc.*, 1932, **54**, 115–122).—A description of the application to the analysis of Ta and Nb mixtures of the cathode-ray method, in which the sample is excited directly by the electron beam (Coolidge cathode-ray tube). Good agreement with chemical analysis was obtained. The intensity of the Ta and Nb lines, as registered in oxides, is not disturbed when the metals are present in tantalite as acid salts.—R. G.

Tentative Revisions of A.S.T.M. Standards. Standard Methods of Chemical Analysis of Manganese–Bronze (B 27–19). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 1052).—S. G.

Tentative Methods of Chemical Analysis of Silver Solders (B 81–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 722–731).—See this *J.*, 1931, **47**, 489.—S. G.

The Quantitative Separation of Germanium and Arsenic. Harold J. Abrahams and John Hughes Müller (*J. Amer. Chem. Soc.*, 1932, **54**, 86–94).—As and Ge are associated in Ge-bearing minerals. The separation studied depends on the selective precipitation of As by H_2S from solutions containing both elements, in the presence of a controlled amount of free acid. Small amounts of As can be separated in one estimation but large quantities require a retreatment to recover co-precipitated Ge.—R. G.

Volumetric Determination of Aluminium. F. Vieböck and C. Brecher (*Arch. Pharm.*, 1932, **207**, 114–124).—Direct titration of Al salts with alkali is rendered unsatisfactory through the adsorption of electrolytes by the precipitated $Al(OH)_3$. This precipitation may be prevented by the addition of a large excess of a soluble tartrate. The procedure recommended consists in treating the Al solution with $NaNH_4$ tartrate and $BaCl_2$. The soluble complex BaAl tartrate formed is neutral to phenolphthalein. The addition of KF liberates an amount of KOH equivalent to the Al present. This decomposition is not immediate, but requires several minutes for completion; excess of $BaCl_2$ is inhibitive and should be removed by K_2SO_4. The liberated KOH is treated with excess of 0·1*N*-H_2SO_4 and the excess is titrated back with 0·1*N*-KOH.—E. S. H.

Determination of Aluminium. Formation of Lithium Aluminate. J. T. Dobbins and J. P. Sanders (*J. Amer. Chem. Soc.*, 1932, **54**, 178–180).—The method described is superior to the hydroxide estimation of Al. To the solution to be tested, excess of $LiCl_2$ and phenolphthalein are added. Dilute NH_4OH is added to give a faint pink colour (balanced as necessary with dilute HCl). A voluminous flocculent precipitate of $LiH(AlO_2)_2,5H_2O$ is formed, which filters and washes readily. After washing free from chlorides, the precipitate is dried and ignited to constant weight as $2Li_2O_2,5Al_2O_3$. The most satisfactory results are obtained when the weight of aluminate is not more than 0·1 grm. The method is applicable under any conditions in which the NH_4OH method can be used.—R. G.

Remarks on the Quantitative Determination of Gallium. A. Brukl (*Z. anal. Chem.*, 1931, **86**, 92–94).—Ga precipitates should not be ignited in the presence of organic matter, as Ga_2O, which is volatile at 660° C., is liable to be formed; if a Pt crucible is used Ga metal may be produced and this forms a fusible alloy with Pt. Ga is best precipitated with cupferron or tannin, the precipitate collected on a porous crucible and redissolved in concentrated HNO_3, boiling with which destroys the organic matter; the solution is evaporated in a tared crucible and the residue ignited to Ga_2O_3 for weighing.
—A. R. P.

The Use of Bromate in Volumetric Analysis. VI.—The Determination of Iron Using Basic Mercuric Bromate. G. Frederick Smith and H. H. Bliss (*J. Amer. Chem. Soc.*, 1931, **53**, 4291–4297).—Cf. *J.*, this volume, p. 87. The titration solution added to the Fe solution in HCl just prior to determination of Fe by bromate consists of H_3PO_4, $CuSO_4$, and $(NH_4)_3AsO_4$. The $CuSO_4$ serves as catalyst for the Fe oxidation and the arsenate prevents interference from atmospheric oxidation. The H_3PO_4 serves to decolorize the solution when the reduced Fe is oxidized by the $HBrO_3$.—R. G.

Contribution to the Technique of Oxinate Precipitation. I.—Magnesium Precipitation: Titration of Excess [Precipitant]. Friedrich L. Hahn (*Z. anal. Chem.*, 1931, 86, 153–157).—The Mg solution (20 c.c. containing 5–100 mg. of Mg) is treated with 2–3 grms. of NH_4Cl, 2–3 c.c. of NH_4OH (*d* 0·88) and 20 c.c. of $(CH_3)_2{\cdot}CO$, heated to boiling, and treated with 8-hydroxyquinoline ("oxine") until the Mg is precipitated and the supernatant liquid remains yellow. After cooling, a further 10 c.c. of $(CH_3)_2{\cdot}CO$ are added, and the solution is diluted to 250 c.c. in a graduated flask; 100 c.c. are filtered, neutralized with $CH_3{\cdot}CO_2H$, treated with 5 c.c. of 5% $ZnSO_4$ solution, and evaporated on the water-bath to expel $(CH_3)_2{\cdot}CO$. The liquid is then acidified with 30 c.c. of HCl, an excess of $NaBrO_3$ is added to destroy the oxine, and the excess is determined iodometrically.—A. R. P.

On a Volumetric Method for the Determination of Potassium. —— Austerweil and —— Lemay (*Bull. Soc. Chim. France*, 1931, (iv), 49, 1541–1542).—The K is precipitated as cobaltinitrite, using as reagent a mixture of 800 grm. of 25% $Co(NO_3)_2,6H_2O$ solution, 1 kg. of 40% $NaNO_2$ solution, and 200 grm. of glacial $CH_3{\cdot}CO_2H$; 30–40 c.c. of the mixture are used for each test, and the solution is then diluted with one-third its volume of C_2H_5OH, heated for 30 minutes on the water-bath, allowed to cool for 1½ hrs., and filtered. The precipitate is dissolved in HCl, the NO_2 expelled by boiling, and the liquid exactly neutralized with NaOH. The Co is then precipitated with an excess of standard Na_2CO_3 and an aliquot part of the filtrate is titrated with HCl.—A. R. P.

Application of the Volhard Method to the Determination of Silver in Electrolytic Copper Refinery Slimes. F. de Chaves (*Anales Soc. españ. fís. quím.*, 1931, 29, 651–652; *C. Abs.*, 1932, 26, 937).—Heat slowly 0·5 grm. of powder with 5 grm. $KHSO_4$ and 0·5 grm. $NaNO_3$ in a porcelain dish until the mass is well melted and a quiet fusion is obtained. Cool, leach with 50 c.c. of hot H_2O, filter, add 30 c.c. of concentrated Cl-free HNO_3, 5 c.c. of $FeSO_4{\cdot}(NH_4)_3SO_4$ indicator solution, and titrate with NH_4CNS solution.—S. G.

A Gravimetric Method for the Estimation of Tin in Brasses and Bronzes. W. F. Pond (*Chemist-Analyst*, 1931, 20, (5), 5–6).—For alloys containing less than 6% Sn 4–5 grm. are covered with 25 c.c. of water and 25 c.c. of HNO_3 (*d* 1·42) are added; dissolution is allowed to complete itself without heating and the solution is then boiled for exactly 5 minutes. A further 25 c.c. of boiling water are added, boiling is continued for 25 minutes and the solution then kept at 95° C. for 30 minutes. The SnO_2 precipitate is collected on a double Whatman filter-paper No. 42, washed 3 times with 10% HNO_3, then twice with hot water, ignited, and weighed as SnO_2.—A. R. P.

Studies on Gravimetric Analysis by Means of the Thermobalance. VII.—Determination of Titanium, Tin, and Lead. Kaneyasu Murayama (*Nippon Kwagaku Kwai Shi* (*J. Chem. Soc. Japan*), 1930, **51**, 786–789; *C. Abs.*, 1932, **26**, 392).—[In Japanese.] By use of the thermobalance it was demonstrated that a constant weight of TiO_2 is obtained when it is heated above 750° C.; for $Ti_2P_2O_8$, above 650° C.; for SnO_2 from hydroxide, above 700° C. and from sulphide above 830° C.; sulphite of tin should be estimated as SnS_2 as the change from SnS to SnO_2 by ignition is incomplete. Ignition of PbO should be made between 600° and 800° C. An intermediate formation of Pb_3O_4 is obtained when $PbCO_3$ or PbO_2 is heated to form PbO. For PbO_2, ignition should be made below 270° C.; for $PbSO_4$, 600°–800° C.; for PbS, below 150° C.; for $Pb(IO_3)_2$, below 180° C.; for $PbCrO_4$, 570°–800° C., and for PbC_2O_4, 150°–290° C.—S. G.

Colorimetric Determination of Minute Quantities of Tungsten. A. Petrovskii (*J. Chem. Industry* (*Moscow*), 1930, 7, 905–907; *C. Abs.*, 1932, **26**, 393).—[In Russian.] The method depends on forming a pink or red colour by treating a solution containing 0·001–0·002 mg. of W per c.c. in the presence of HCl and H_3PO_4 with 3–5 grm. of powdered Pb. The W is reduced to the quadrivalent state. Ti and Mo cause interference.—S. G.

The Potentiometric Titration of Zinc with Potassium Ferrocyanide. Erna Brennecke (*Z. anal. Chem.*, 1931, **86**, 175–182).—Direct potentiometric determination of Zn with $K_4Fe(CN)_6$ at 70° C. gives results which are on the average 0·98% low. The error may be reduced to 0·73% by adding most of the $K_4Fe(CN)_6$ to the cold Zn solution, then finishing the titration at 65°–70° C. —A. R. P.

An Overlooked Source of Error in the Ferrocyanide Titration of Zinc. Bartholow Park (*J. Amer. Chem. Soc.*, 1932, **54**, 180–181).—Error may be introduced by interaction of ferricyanide produced in the ferrocyanide solution on standing, with H_2S. It is recommended that H_2S be passed into the Zn solution during standardization to compensate for the effect.—R. G.

VI.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

(Continued from pp. 170–173.)

An Improved Constant Temperature Device. L. M. Pidgeon and A. C. Egerton (*J. Sci. Instruments*, 1931, **8**, 268–269).—A modification of the apparatus previously described by E. (*J. Sci. Instruments*, 1930, **7**, 172). —W. H.-R.

An Apparatus for the Determination of a Hysteresis Curve. [Measurement of Intensity of Magnetization.] L. F. Bates (*J. Sci. Instruments*, 1931, **8**, 376–378).—Describes the measurement of the intensity of magnetization of a ferromagnetic rod by a null method in which the deflection of the needle system is maintained constant. No correction is needed for the torsion of the fibre, and a knowledge of the horizontal component of the earth's field is not required. The method has been used in determining the hysteresis curves of iron, steel, and Mumetal rods.—W. H.-R.

Combined Temperature and Humidity Recorder. Cambridge Instrument Co. (*Instrument World*, 1932, **4**, 218).—A combined temperature and humidity recorder covering the range of atmospheric temperatures and of humidities from 30% to 100% is briefly described. A mercury-in-steel thermometer is employed, and the humidity recording device comprises 2 strips of goldbeaters' skin which operate a pen mechanism.—J. S. G. T.

Electric Precision Gauge of Great Accuracy. Anon. (*Machinery* (*Lond.*), 1930, **36**, 181–182).—The movement of a diamond point, which makes contact with the work, causes a variation of the reluctance of a balanced differential a.c. circuit; this in turn is recorded by an ammeter. A movement of 0·0001 in. produces a deflexion of 1 in. of the needle.—H. F. G.

A New Self-Contained Apparatus for Crystal Analysis. R. A. Stephen (*J. Sci. Instruments*, 1931, **8**, 385–387).—Describes briefly a self-contained X-ray outfit for crystal analysis made by Messrs. Philips Lamps, Ltd., 145 Charing Cross Rd., London, W.C.2. This contains two tubes with copper and molybdenum anodes, respectively, and the camera can be used for both the Debye–Scherrer and Seemann–Bohlin methods. The essential point of the design is that the whole apparatus is contained in one case with safeguards against high tension and stray X-rays, whilst the adjustment is very simple.—W. H.-R.

VII.—PHYSICAL AND MECHANICAL TESTING AND RADIOLOGY

(Continued from pp. 171–175.)

New Data on the Equipment of Metal Testing Laboratories. N. F. Bolchovitinov (*Vestnick Ingenerov i Tehnikov* (*Messenger of the Engineers and Technologists*), **1931**, (7), 320–330).—[In Russian.] A description of modern laboratory equipment for mechanical, metallographic, and physical methods of testing.—N. A.

Tests of Welding and Weld Metal and their Interpretation. Aubrey F. Burstall (*Met. Ind.* (*Lond.*), 1932, **40**, 153–155, 175; discussion 195–196).—Abstract of a paper read before the Co-ordinating Committee (Birmingham Local Section of the Institute of Metals, Birmingham Metallurgical Society, and the Staffordshire Iron and Steel Institute). Classifies welding tests as non-destructive and destructive. In the former class are: (*a*) visual examination of the external appearance of the weld, (*b*) X-ray and γ-ray shadow photographs, (*c*) acoustic tests, (*d*) electrical and (*e*) magnetic tests. In the latter class are: (*a*) tensile and (*b*) bend tests. These several tests are described and their interpretation is discussed.—J. H. W.

A Study of Abrasion. Seizo Saito (*Sci. Rep. Tôhoku Imp. Univ.*, 1931, [i], **20**, 560–573).—[In English.] When the nature of contact is rolling with slippage between the contact surfaces, as in the Amsler universal wear-testing machine, a test-piece rotating at a higher speed is less worn than one rotating at a lower speed. When 2 test-pieces of different hardness are rotated the abrasion is less if the harder sample rotates more quickly and is greater if the reverse condition holds. When the powder produced by the abrasion is left between the contact surfaces the amount of abrasion is greatly increased—sometimes 100-fold.—E. S. H.

High Temperature Characteristics of Metals Revealed by Bending. Howard Scott (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (II), 129–156).—The curvature produced in an initially flat strip by heating it while bent to a known curvature is easily measured after release at room temperature. The acquired curvature is found from analytical considerations to be a measure of the plastic deformation which occurred at the test temperature. As the curvature change can easily be measured with high sensitivity and the testing equipment is simple, it offers an attractive means for investigating the plastic behaviour of metals at elevated temperatures. When this test method was applied to phosphor-bronze, a critical strain which corresponds with the strain at the proportional limit of the same material when tested in tension at moderate temperatures was easily recognisable and readily evaluated. At lower values of the applied strain, the plastic deformation was found to be proportional to the applied strain which corresponds with the load in the case of a tension test. This effect is, of course, small in magnitude at room temperature, but increases exponentially with temperature. These observations suggest the concept of a critical temperature below which the plastic deformation is less than some small fraction of the total strain. Several metals were compared on the basis of that critical temperature which appears to be a fundamentally important factor entering into the selection of metals for high temperature service. Whilst keeping the temperature and applied strain constant, the variation in plastic deformation with time was studied. After the first few hrs., and up to 100 hrs. at least, the plastic deformation increased logarithmically with time. The initial flow increased very much more rapidly with temperature than did the rate of flow after steady flow was established. These observations are consistent with tensile creep test results, and suggest that the bend test can provide results which are directly comparable with those of the creep test under equivalent conditions.—S. G.

On the Process of the Failure of Metals under Stress. Kameity Yuasa (*J. Soc. Mech. Eng. Japan* (*Foreign Edn.*), 1930, **33**, 95–112, 117–136).—[In English.] See this *J.*, 1930, **44**, 395.—J. W. D.

The Yield-Point and Initial Stress of Plastic Strain in Mild Steel Subjected to Uniform and Non-Uniform Stress Distributions. Gilbert Cook (*Phil. Trans. Roy. Soc.*, 1931, [A], **230**, 103–147).—Although the details of this paper refer to ferrous alloys, the following points are of general interest. (1) Apparatus is described for obtaining load-deformation diagrams in which the true resistance to deformation during overstrain is measured in (*a*) tension, (*b*) torsion, (*c*) flexure, and (*d*) the behaviour of thick-walled cylinders under internal hydrostatic pressure. In (*a*), (*b*), and (*c*) the methods are essentially to incorporate a " weigh-bar " of greater cross-section than that of the specimen, so that the weigh bar remains within its elastic limit during the whole of the test, and its deformation as recorded by mirrors can be used as a measure of the load on the specimen when the latter is yielding. Under (*d*) is included apparatus for maintaining high pressure in hollow cylinders, and a double extensometer for measuring the extensions of the cylinder on two diameters at right angles to each other; this last point is important, since, when the tube begins to yield, it may not remain cylindrical. (2) In the initial stages of overstrain, the load deformation diagrams follow the theoretical shape, and confirm the assumption that a lower stress exists in the overstrained parts than is required to start the yielding process. (3) The maximum shear stress at the initial yield point is higher in the non-uniform distributions than in simple tension; this is explained by the assumption of a surface layer with the same elastic properties as, but a higher elastic limit than, the interior. (4) The results are discussed in the light of the properties of the grain boundary material.—W. H.-R.

A Seven-Ton 50-Cycle Fatigue Testing Machine. B. P. Haigh and T. S. Robertson (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (II), 221–235).—A new model of the Haigh fatigue testing machine, redesigned in the light of several years' experience, is described. The new model has been designed particularly for tests of an engineering nature, on scale models of parts of machines and structures, *i.e.*, riveted or welded joints and screwed connections, but is serviceable also for testing specimens of standard shape. It is capable of 22,000 lb. maximum load with ranges up to 14,000 with a frequency of 3000 cycles per minute. The loads are applied as direct pull and push, and simple devices ensure that no bending or torsion is present during the test.—S. G.

Apparatus for Fatigue Tests. J. N. Morozov (*Sobshenia Vsesouznogo Instituta Metallov* (*Communications of the Pan-Union Institute of Metals*), **1931**, (3–4), 71–74).—[In Russian.] A description (with diagram) of an apparatus constructed in the Russian Institute of Metals, for carrying out fatigue tests by Wöhler's method.—N. A.

The Strike of the Hammer in the [Charpy] Notched-Bar Impact Test. F. Sauerwald (*Z. Metallkunde*, 1932, **24**, 6).—Experiments with low-carbon steel in the 75 kg.-m. pendulum impact machine have shown that an inexact strike of the hammer against the side of the specimen opposite to the middle of the notch has no appreciable influence on the results obtained which all lie within the usual limits of experimental error.—M. H.

Size of Specimens for the Charpy Impact Test. J. N. Morozov (*Sobshenia Vsesouznogo Instituta Metallov* (*Communications of the Pan-Union Institute of Metals*), **1931**, (1–2), 49–55).—[In Russian.] In notched-bar impact tests the fracture may be tough or brittle. In the first case the pendulum passes through freely, *i.e.* it meets with no resistance from the supports, except for some unavoidable friction, provided that the relations between its length *l*, its height of fall h, the distance between the supports L, and the angle of its knife edge α, are correctly adjusted. In practice, $L \geqslant l \sin \alpha/2 + 2h \cos \alpha/2$. With a brittle fracture the specimen is completely broken up, and for the free passage of the pendulum the additional condition, $L \geqslant 2h + \beta$, where β is the thickness of the pendulum, must be satisfied. To obtain good results both conditions should be satisfied in all cases, since the nature of the fracture cannot be predicted. Nomograms have been constructed from the above expressions for calculating the dimensions of the specimen for different values of L and α.—N. A.

Instrument for Cutting Notches in Charpy Specimens. J. N. Morozov (*Sobshenia Vsesouznogo Instituta Metallov* (*Communications of the Pan-Union Institute of Metals*), **1931**, (1–2), 56–58).—[In Russian.] A detailed description is given of an apparatus designed by M. for the accurate cutting of notches in Charpy specimens. The apparatus controls the direction of the tool, prevents its vibration, and ensures the correct positioning of the specimen during the operation.—N. A.

Experimental Investigation of Elasticity at Small Stresses. A. Jaquerod and O. Zuber (*Helv. Phys. Acta*, 1931, **4**, 360–361).—Changes in length of tensile test-pieces can be measured down to 10 mμ by means of the following device: at the lower end of the rod are fixed 2 coaxial cylinders the space between being filled with castor oil in which moves a cylinder which is joined to the upper end of the rod. The 3 cylinders form an electrical condenser the capacity of which changes with variation in the length of the rod. These changes of capacity can be measured very accurately by the use of a suitable circuit.—v. G.

Lateral Contraction of Test-Piece in Tension Tests. Rokuo Kuno (*J. Soc. Mech. Eng. Japan* (*Foreign Edn.*), 1930, **33**, 209–213).—[In English.] Abridged from the Japanese "Home Edition." As a result of experiments carried out on 4 steels, copper, and brass, a theory is advanced for the phenomenon which occurs at the yielding of a test-piece. It is stated that when the load reaches the yield point, the stress of some crystals in a layer where the stress is at a maximum causes sudden slip to a certain amount, and at the same time crystals in the same layer are more stressed and slip to a similar amount, and that slip in such crystals is followed by slip in neighbouring crystals, and thus slipping is propagated along the test-piece. If the property of the crystal is such that the angle between the axis of the crystal and the axis of the test-piece is in a certain range, a marked change at the yield point is obtained in the stress–elongation curve, but where the axis of the crystal and the axis of the test-piece do not incline in the proper range of angle, the change in the curve is less marked. A crystal of copper gives a curve of the latter type whilst an α crystal of brass gives a curve of the former type. Sudden contraction is propagated in steel in a regular manner, but in brass contraction is confused, probably due to the β crystals rupturing the interrelation of α crystals more than pearlite crystals do those of ferrite or cementite crystals.—J. W. D.

Stages in the Development of Apparatus for Tension Testing Elongation of Metals. K. M. Juriev (*Sobshenia Vsesouznogo Instituta Metallov* (*Communications of the Pan-Union Institute of Metals*), **1931**, (5–6), 37–49).—[In Russian.] An examination of the designs of modern apparatus for making tension tests, leads to the conclusion that the construction of complicated machines for this purpose is irrational.—N. A.

Nikolaev's Apparatus for Determining the Hardness of Metals. N. A. Schaposchnikov and R. R. Syromiatnikov (*Sobshenia Vsesouznogo Instituta Metallov* (*Communications of the Pan-Union Institute of Metals*), **1931**, (5–6), 49–56).—[In Russian.] Nikolaev's apparatus is of the percussion type, similar to that of Schwartz, and enables approximate values for Brinell hardness to be obtained in testing materials under works conditions. To determine the Brinell hardness accurately by this method, a series of graphs must be obtained experimentally for every homogeneous group of materials. A correct alignment of the apparatus and specimen before making the test is highly important.—N. A.

New Hardness Testers. A. C. B. (*Instrument World*, 1932, 4, 195).—Brief particulars of the Rockwell direct-reading hardness tester that avoids depth readings under varying loads, and the Duroskop, dependent on the principle of a falling pendulum. The former comprises a press which registers a hardness number on a dial, dependent on the additional depth to which a test point or ball is driven by an additional heavy load. In the latter, a falling pendulum rebounds from the material under test, carrying with it a light pointer which remains at the highest point of rebound.—J. S. G. T.

RADIOLOGY

On a Heating Device for X-Ray Specimens. G. Wassermann (*Metallwirtschaft*, 1931, 10, 922–923).—X-Ray specimens can be heated up to 500° C. by directing a stream of hot gas on their surface.—v. G.

X-Ray Illumination of Castings. N. F. Bolchovitinov (*Liteinoe Delo* (*Foundry Practice*), 1931, (9), 15–16).—[In Russian.] A brief survey of published information.—N. A.

VIII.—PYROMETRY

(Continued from p. 175.)

A New Potentiometer Pyrometer. Thomas R. Harrison (*J. Sci. Instruments*, 1932, 9, 19–21).—Describes briefly a new recording potentiometer pyrometer for use with thermocouples which is made by the Brown Instrument Co., Philadelphia, Pa., U.S.A. This is a null type of instrument in which the galvanometer automatically operates a mechanism to rebalance the circuit for each change in e.m.f. The instrument has an automatic recorder, and also a humidity compensator to allow for expansion and contraction of the chart paper with changes in atmospheric humidity. Automatic control is obtained through mercury switches which will carry 50 amp. at 220 v. (60 amp. at 110 v.).—W. H.-R.

IX.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Continued from pp. 176–178.)

ELECTRODEPOSITION

The Production of Pure Aluminium and Aluminium Coatings by Electrolysis. W. O. Plotnikov, M. M. Graziansky, and M. S. Fortunatov (*Ukrainskii Khemichnii Zhurnal* (*J. Chim. Ukraine. Technical Part*), 1931, 6, (2), 33–48). —[In Ukrainian.] The production of pure aluminium by electrolysis under various sets of conditions and from different electrolytes was investigated, as well as the electrodeposition of pure aluminium coatings. The complex $AlCl_3 3NH_3$ is unsuitable as an electrolyte, since the compound AlN is formed. A satisfactory electrolyte has a composition between $2AlCl_3,NaCl$ and $3AlCl_3,2NaCl$. With increase of current density from 1 to 50 amp./dm.^{2}, the deposit progressively changes from white crystals to a grey sponge. The pure aluminium obtained contained iron 0·043–0·060, silicon 0·026, and sodium

0·01%, and showed a marked resistance to acids. In electrodeposited coatings, aluminium was found to cover any roughness of the surface and to take on a high polish. The maximum thickness of deposit obtained was 0·08 mm., with a current density of 1 amp./dm.^{2} at 200° C. The deposits showed a resistance to brine and water vapour corrosion, which compared favourably with that of rolled aluminium surfaces. They also withstood bending up to an angle of 45° without cracking or flaking off. The paper contains a number of photomicrographs.—M. Z.

New Cadmium Plating Process [Cadalux]. Anon. (*Brass World*, 1931, **27**, 256).—Short note. A new plating process, known as "Cadalux," developed by the Hanson–Van Winkle–Muning Co., Matawan, N.J., U.S.A., is said to produce a very bright cadmium finish, and a homogeneous and close-grained crystalline structure and to possess high throwing power and very accurate and simple solution control. An extremely high additional lustre, obviating the necessity for buffing or scratch-brushing, is said to be imparted by an acid treatment known as the "Nitri–Brite Dip."—J. H. W.

[Cadalux] Bright Cadmium Plating. Anon. (*Met. Ind.* (*Lond.*), 1932, **40**, 182).—See preceding abstract.—J. H. W.

Notes on the [" Einsinken "] Electrodeposition of Cadmium. Ernst Beutel and Artur Kutzelnigg (*Z. Elektrochem.*, 1931, **37**, 886).—Short note describing the electrodeposition of cadmium on 69 : 31 brass. Brass stampings were electrolytically plated with a thin coat of cadmium for a few minutes. The bath used was Pfanhauser's solution of potassium cyanide and cadmium potassium cyanide. The stampings that came out of the bath silver white in colour showed a gold tinge after only 17 hrs., and thereafter changed slowly until one place was quite yellow after 3 months. The diffusion of the cadmium into the brass is a fairly quick process. This diffusion is not observed in the case of deposits from fluosilicic acid solutions, probably owing to the much larger grain-size.—J. H. W.

The Stability of Cadmium Cyanide Plating Solutions. S. Wernick (*Trans. Electrochem. Soc.*, 1931, **60**, 129–140).—See this *J.*, 1931, **47**, 547, and following abstract.—S. G.

Discussion on Wernick's Paper on " The Stability of Cadmium Cyanide Plating Solutions." Colin G. Fink. L. R. Westbrook. S. Wernick (*Trans. Electrochem. Soc.*, 1931, **60**, 140–142).—Cf. preceding abstract. The electrode efficiency ratio of cadmium cyanide baths may be made to approach unity by increasing the cadmium concentration of the bath, hence it is preferable to work with more concentrated cadmium solutions than to decrease deliberately the anode efficiency. Much more trouble in continuous work is caused by decreasing cadmium concentration during use than by building-up of cadmium in the electrolyte. The objections to rapid commercial cadmium plating at high current densities can be overcome by using more concentrated cadmium solutions, a high content of free cyanide, and a greater anode area, and by adding nickel salt and an organic colloid to refine the grain-size.
—A. R. P.

The Control of Cyanide Copper Baths. Eugen Werner (*Oberflächentechnik*, 1931, **8**, 131–133).—Methods are given for the determination of copper, free cyanide, carbonates, and total cyanide in copper plating baths.—A. R. P.

The Electrodeposition of Ternary Alloys of Copper, Cadmium, and Zinc from Cyanide Baths. R. C. Ernst and C. A. Mann (*Electrochem. Soc. Preprint*, 1932, April, 153–184).—The theories and principles involved in the simultaneous electro-deposition of two metals from aqueous solutions are reviewed and extended to the co-deposition of the three metals copper, cadmium, and zinc. The electrolysis bath adopted consisted of the following salts in grm./litre: copper cyanide, 40·01 grm. (28·5 grm. copper); cadmium cyanide, 2·94 grm. (2·0 grm. cadmium); zinc cyanide, 36·14 grm. (20·10 grm. zinc);

potassium cyanide, 138·0 grm. (3·75% excess potassium cyanide). (Excess potassium cyanide refers to the amount of potassium cyanide in addition to that theoretically required to form the complex salts. This amount was required for complete solution.) It was desired to secure a deposit of a colour comparable to brass with approximately 60% copper, 20% cadmium, and 20% zinc. The electrolysis bath operating at 25° C. with a current density of 0·3 amp./dm.^{2} gave deposits of the approximate composition copper 62, cadmium 21, and zinc 17%. The effect of potassium cyanide, sodium bisulphite, sodium hydroxide, current density, temperature, and dilution on the composition, and properties of the cathode were studied in detail. The effect of these variables is summarized in tables and curves.—S. G.

Electrodeposition of Iron, Copper, and Nickel Alloys from Cyanide Solutions.—I. Lawrence E. Stout and Charles L. Faust (*Trans. Electrochem. Soc.*, 1931, **60**, 271–296).—See this *J.*, 1931, **47**, 548–549.—S. G.

Deposition of Brass from Thiocyanate Solutions. N. Thon and J. Pinilla (*J. Chim. Phys.*, 1931, **28**, 651–652).—A yellow deposit of brass is obtained by electrolysing a solution containing (in grm.-mol./l.) zinc thiocyanate 1·5, potassium thiocyanate 6·0, and cuprous thiocyanate 0·003–0·01, using platinum electrodes and a current density of 0·3 m.amp./cm.^{2}. When the solution contains 0·013 grm.-mol. of cuprous thiocyanate per litre the cathodic deposit is reddish, and is quite red when the amount is increased to 0·016. Using a brass anode, it is unnecessary to add cuprous thiocyanate to the solution, sufficient copper dissolving from the anode if the current density is maintained between 0·31 and 0·32 m.amp./cm.^{2}. At lower current densities a copper-rich brown deposit forms, and at higher current densities a zinc-rich grey deposit is obtained. A sample of the deposited yellow brass was found to contain copper 57% and zinc 43%.—E. S. H.

Cyanides in Relation to Gold and Silver [Plating] Solutions. E. J. Dobbs (*Trans. Electrochem. Soc.*, 1931, **60**, 113–116).—See this *J.*, 1931, **47**, 549.
—S. G.

The Measurement of the Hydrogen Ion Concentration in Electroplating Baths with Especial Reference to Nickel Baths. M. Willmer (*Oberflächentechnik*, 1931, **8**, 1–2).—The colorimetric and electrometric methods of determining the p_H of plating baths are described. In nickel baths results correct to ± 0·15 are obtained by the former method provided that 0·4 be deducted from the reading obtained to compensate for the colour of the solution. The quinhydrone method gives results correct to ± 0·05 if 0·05 be deducted from the readings to allow for the "salt error."—A. R. P.

Plant Practice for Nickel Plating Aluminium. Andrew V. Re (*Electrochem. Soc. Preprint*, **1932**, April, 139–141).—Satisfactory, thoroughly adherent electrodeposits of nickel on aluminium articles may be obtained by carefully cleaning the surface in an alkaline peroxide bath followed by a strong sulphuric–nitric acid bath, flashing with brass, and finishing with a standard nickel bath. The undercoat of brass greatly increases the uniform adhesion of the electroplate to the aluminium surface. Full directions of procedure are given.—S. G.

Plating on Zinc Die-Castings. E. A. Anderson and E. J. Wilhelm (*Metals and Alloys*, 1931, **2**, 336–340).—The castings are cleaned by cathodic treatment for ½–2 minutes in a boiling solution containing 6 oz./gall. of trisodium phosphate, rinsed in hot water, dipped for ½–1 minute in 1% hydrofluoric acid or 10% hydrochloric acid, and again rinsed in cold water; they are then nickel-plated in a bath containing 10 oz. of nickel sulphate crystals, 10–15 oz. of anhydrous sodium sulphate, 2–3 oz. of ammonium chloride, and 2 oz. of boric acid per gall. The bath is operated at 12–20 amp./ft.^{2} and in 20 minutes produces a plate 0·0003 in. thick with 20 amp./ft.^{2} at 24°–30° C. This thickness is sufficient for all practical purposes as a protection against corrosion; it may be reinforced, if desired, by a thin chromium plate produced from any of the ordinary commercial baths. Copper-plating of zinc-base die-castings is not satisfactory, as the copper slowly diffuses into the zinc on warming; at 100° C. copper 0·0005 in. thick is completely absorbed by zinc in 10 days.—A. R. P.

The Improvement of Metal Surfaces by Plating with Silver or Gold. K. Schuch (*Oberflächentechnik*, 1931, **8**, 195–199).—The composition of numerous silver and gold plating baths (not new) is given, together with methods of operating and replenishing the baths and of working up worn-out baths for the recovery of their precious metal contents.—A. R. P.

On the Effect of Mercury in Zinc Cyanide Plating Solutions. M. de Kay Thompson and W. E. Charles (*Trans. Electrochem. Soc.*, 1931, **60**, 123–127).—See this *J.*, 1931, **47**, 550, and following abstract.—S. G.

Discussion on Thompson and Charles's Paper on "The Effect of Mercury in Zinc Cyanide Plating Solutions." O. P. Watts (*Trans. Electrochem. Soc.*, 1931, **60**, 127).—Cf. preceding abstract. Grey cast iron cannot be successfully plated with zinc from cyanide solutions unless the free cyanide is kept at a very low concentration; there is no such difficulty, however, in zinc plating mild steel or wrought iron.—A. R. P.

New Electroplated Metal Alloys. Martin Willmer (*Oberflächentechnik*, 1931, **8**, 225–226, 235–238).—Recent work on the deposition of nickel–copper, nickel–iron, nickel–cobalt, and cadmium–silver alloys is described and discussed.—A. R. P.

Electroplating on Aluminium from Cyanide Solutions. Harold K. Work (*Trans. Electrochem. Soc.*, 1931, **60**, 117–121; discussion, 121–122).—See this *J.*, 1931, **47**, 550.—S. G.

The Definition and Determination of "Free Cyanide" in Electroplating Solutions. W. Blum (*Trans. Electrochem. Soc.*, 1931, **60**, 143–148; and *Met. Ind.* (*N.Y.*), 1931, **29**, 484–485).—See this *J.*, 1931, **47**, 551, and following abstract.—S. G.

Discussion on Blum's Paper on "The Definition and Determination of 'Free Cyanide' in Electroplating Solutions." Walter D. Bonner and S. Frederick Ravitz. J. A. Woolf. L. R. Westbrook. W. Blum (*Trans. Electrochem. Soc.*, 1931, **60**, 148–151).—Cf. preceding abstract. B. and R. state that *M*-sodium cyanide dissolves 0·5 equivalents of cuprous cyanide per litre and that the ratio of "bound cyanide" to copper in cuprocyanide complexes is 3 at all concentrations; the end-point in cyanide titrations is uncertain in the absence of iodide, and the more iodide added the less silver nitrate is needed for a titration, hence a measured standard quantity of iodide should be added in all titrations. L. R. W. points out that dilution of a sample of a plating bath may vitiate the titration of "free cyanide" owing to hydrolysis. J. A. W. states that when the solution contains both zinc and copper considerable difficulty is experienced in obtaining correct results for free cyanide. B. claims to have prepared an unstable solution containing CuCN and NaCN in the ratio 1 : 1·3.—A. R. P.

Cyanides in Metallurgy. M. R. Thompson (*Trans. Electrochem. Soc.*, 1931, **60**, 35–45).—See this *J.*, 1931, **47**, 629, and following abstract.—S. G.

Discussion on Thompson's Paper on "Cyanides in Metallurgy." G. H. Buchanan. Colin G. Fink. W. D. Bonner. M. R. Thompson (*Trans. Electrochem. Soc.*, 1931, **60**, 45–48).—Cf. preceding abstract. The statement that the common ion effect has proved useful only in electrodeposition from cyanide solutions is not correct; an acid tin sulphate bath gives highly crystalline deposits, but after addition of much sodium sulphate very smooth tin deposits are obtained. It is pointed out that very thick deposits of chromium may be obtained under suitable conditions and by appropriate heat-treatment they can be freed from brittleness; chromium-plated steel dies are used extensively for drawing seamless nickel tubes. In making cyanide copper baths the choice of copper salt is important; the chloride gives by far the best results. —A. R. P.

Progress in the Electroplating Industry (1931). E. A. Ollard (*Met. Ind.* (*Lond.*), 1932, **40**, 105–107).—The progress that has been made in electroplating during the past year is reviewed. The advance has been chiefly in the direction of mechanization of the electroplating shop, the introduction of emulsifying cleansers, the development of rhodium and palladium plating, and the standardization of chemicals. The future tendency in plating and the substitution of plating for alloys are discussed.—J. H. W.

Conveyor Working in the Plating Shop. Franz Schlesinger (*Maschinenbau*, 1931, **10**, 694–698).—The organization of a plating department in a motor-car factory is discussed and a description given of all the necessary apparatus. —v. G.

Round Table Discussion on Platers' Classes. H. Gilbertson. W. Blum. Albert Hirsch. George Gehling. George Hogaboom. S. P. Gartland. Walter Fraine (*Monthly Rev. Amer. Electroplaters' Soc.*, 1931, **18**, (10), 15–44). —A detailed account of work which has already been undertaken in various parts of America to improve the scientific education of the working electroplater and suggestions for improving and extending the scope of this work. —A. R. P.

The Determination of the Porosity of Electrodeposits. D. J. Macnaughtan (*J. Electroplaters' Depositors' Tech. Soc.*, 1930, **5**, 135–151).—Read at a joint meeting with the Faraday Society. See this *J.*, 1931, **47**, 42.—S. G.

The Control of Electroplating Solutions.—VII–XI. Samuel Field (*Met. Ind.* (*Lond.*), 1931, **39**, 397–398, 491–492, 591–592; 1932, **40**, 39–40, 131–132).—Describes the determination of the strength of alkalis; the estimation of cyanides by means of silver nitrate, and the estimation of mixed cyanides and of chlorides and carbonates; the determination of copper sulphate and copper in the acid copper bath. (See this *J.*, 1931, **47**, 666.)—J. H. W.

Correcting Engravings by Projected Electrolyte. William E. Bailey (*Met. Ind.* (*N.Y.*), 1931, **29**, 344–345).—By spraying on to the surface of copper engraving blocks a solution containing 150–200 grm./l. of copper sulphate and 50–100 grm./l. of sulphuric acid and making the block the anode, raised parts may rapidly be worn down. When the block is the cathode, copper may be rapidly deposited on any desired part. Dissolution and deposition occur only close to the point of impingement, hence by using a double throw switch it is possible to wear away or build up the block in any desired manner. —A. R. P.

The Use of Metallic (Electronic) Rectifiers in Electroanalysis and Electrodeposition of Metals. S. P. Gvozdov (*Vestnick Elektropromishlenosti* (*Messenger of Electrical Industry*), 1931, (10), 493–494).—[In Russian.] In an attempt to replace accumulators, which possess numerous serious disadvantages, in the electrodeposition of metals, experiments have been carried out on the use of a.c. with metallic rectifiers, giving a pulsating d.c. Good results were obtained in the deposition of copper, nickel, lead, and zinc, in the determination of copper and zinc in brass and in chromium plating. The tabulated results show good agreement with those obtained with accumulators.—N. A.

ELECTRO-REFINING, &c.

Electrolytic Refining of Copper with Complex Salts of Cuprous Chloride. VII.—Behaviour of Antimony. Shoji Makishima and Naoto Kameyama (*Kōgyō Kwagaku Zasshi* (*J. Soc. Chem. Ind. Japan*), 1931, **34**, (9); *C. Abs.*, 1932, **26**, 380).—[In Japanese, with English summary in supplemental binding, pp. 324–325.] Cathodic deposits obtained by the electrolysis of cuprous chloride solutions contained up to 0·00024% antimony when 1 kg. of the electrolyte originally contained 100 mg. of antimony as $SbCl_3$. Addition of KH tartrate to the electrolyte tended to reduce the amount of antimony in the cathodic deposit.—S. G.

On the Formation of Anode Slime in Copper Baths. O. Esine (*Uralskiy Tehnik* (*Ural Technologist*), 1931, 7, (5–6), 31–35).—[In Russian.] Assuming that in the reversible electrolysis of equilibrium solutions, the cathodic discharge of the ions $Cu^{\cdot}$ and $Cu^{\cdot\cdot}$, as well as dissolution of copper at the anode take place proportionally to the concentration of these ions in solution, it is shown that the passage of current through the solutions destroys the equilibrium between the ions at the electrodes. To restore this equilibrium, reactions which tend to reduce the concentration of $Cu^{\cdot}$ ions at the cathode and to increase it at the anode must take place. The formation, therefore, of an anodic slime of copper powder can be explained without postulating anodic polarization.—N. A.

Selection of an Electrolytic Method of Obtaining Metallic Magnesium. I. G. Schterbakov (*Uralskiy Tehnik* (*Ural Technologist*), 1931, 7, (5–6), 12–16). —[In Russian.] The factors which influence the choice of any particular method of producing electrolytic magnesium are electric power, cost of plant, operating conditions, purity of raw materials, and resultant products.—N. A.

Electrolytic Deposition of Nickel by Means of Insoluble Anodes. W. I. Lainer, S. A. Pletenev, W. W. Kuznetzova, and B. I. Rozov (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, 6, (10), 1294–1370).—[In Russian.] The possibility of electrolytically depositing nickel by means of insoluble electrodes is examined in detail, with a view to applying it industrially in the production of nickel from the low-grade Chalilovo ores. In view of the lack of any data on this subject, the problem was approached from first principles, the influence of free acid content, current density, and presence of such impurities as iron and aluminium being determined, and the conditions governing a successful continuous production on a commercial scale investigated. The electrolyte used was nickel sulphate, the cathode being aluminium and the anode platinum. It is concluded that the optimum conditions are: an absence of free acid, temperature 80° C., nickel concentration 20 grm./litre, and current density 600 amp./m.^{2}. For continuous commercial production the anode and cathode spaces are separated by porous diaphragms of acid-resisting pottery, the circulation of the two electrolytes being carried out separately (that of the cathodic liquor by the cascade method). The anodic liquor contains sodium sulphate in solution (25–70 grm./litre and free sulphuric acid (6–18 grm./litre) and is used for lixiviating the nickel ore, whilst the composition of the cathodic liquor passing out of the cathode space is 1·0–1·5 grm./litre nickel and 0·8–1·3 grm./litre free sulphuric acid. As regards the influence of iron and aluminium, it is shown that if a rotating cathode is used, a ratio of nickel : iron = 10 : 1 may safely be employed, and that iron and nickel can be deposited simultaneously in the production of ferro-alloys. A concentration of 0·1 grm./litre aluminium has actually a beneficial influence on the nickel deposition, but higher concentrations are harmful.—M. Z.

Investigation of Anodes for Production of Electrolytic Zinc.—II. H. R. Hanley, C. Y. Clayton, and D. F. Walsh (*Trans. Amer. Inst. Min. Met. Eng.*, **1931,** General Volume, 142–146).—As little as 0·1% calcium in lead anodes used in the production of electrolytic zinc lowers the anode potential by 50%. Anodes containing 0·1% calcium, 4% thallium, and 95·9% lead show the greatest stability and produce zinc cathodes with the lowest lead content; the lowering of the anode potential in this case is 40%. Silver slightly and tin almost completely neutralizes the effect of calcium on the lead potential. Photomicrographs of various lead anode alloys containing calcium, thallium, silver, and tin are shown.—A. R. P.

The Rapid Determination of Current Efficiency in the Electrolysis of a Zinc Sulphate Electrolyte. Research Staff, Consolidated Mining and Smelting Co., Traill (*Electrochem. Soc. Advance copy*, **1931**, Sept., 1–7).—Roasted blende is leached with spent acid sulphate liquor from the cell room. Before discharging the zinc-enriched solution back into the cells, it is advisable to test it as to cathode efficiency, which is a sensitive indicator of the quality of the solution. In the past such a test required several hours. The new apparatus and comparatively rapid test here described have been in satisfactory use for several months. The underlying principle is the fact that the hydrogen cathode efficiency is a measure of the purity of the solution and of the current efficiency of the zinc cells that can be expected during the electrolysis of the zinc solution at any given current density.—S. G.

Electrochemistry and Electrometallurgy. Annual Report of Committee on Electrochemistry and Electrometallurgy. —— (*Trans. Amer. Inst. Elect. Eng.*, 1931, **50**, 1513–1517).—See abstract from another source, this *J.*, 1931, **47**, 667.—W. P. R.

ELECTROCHEMISTRY—GENERAL

A Detailed Study of Sodium Amalgam Formation from Sodium Chloride Solutions. K. S. Tesh and H. E. Woodward (*Electrochem. Soc. Preprint*, **1932**, April, 143–151).—The rate of formation of sodium amalgams has been determined, using various types of platinum electrodes, and under various conditions of current density, voltage, temperature, and concentration of electrolyte. Preliminary work showed that an unplatinized platinum electrode gave the most satisfactory results. For a fixed value of current density, the amount of amalgam formed was found to be less than that required for a direct proportionality with the time. For a fixed period of time, the amount of amalgam formed is greater than would be required for a direct proportionality with the current density. Temperature changes below 50° C. have very little effect on the rate of amalgam formation. Above 50° C. the rate of decomposition of the amalgam increases greatly with the temperature. For a fixed period of time, the concentration of the amalgam is proportional to the concentration of the electrolyte for values up to $4N$-sodium chloride. Above this concentration of electrolyte, the amalgam concentration varies little with changes in electrolytic concentration. The rate of amalgam formation is sensitive to voltage changes within the cell. Further work on amalgam formation is in progress.—S. G.

Hydrogen and Oxygen Overvoltages on Nickel–Iron Alloys. M. de Kay Thompson and Albert L. Kaye (*Trans. Electrochem. Soc.*, 1931, **60**, 229–234).—See this *J.*, 1931, **47**, 552.—S. G.

The Effect of Addition Agents upon the Conductivity, Cathodic Polarization, and Grain-Size of Deposits Obtained from the Cell: $Cu|CuSO_4,H_2SO_4|Cu$. B. Clark and E. O. Jones (*J. Electroplaters' Depositors' Tech. Soc.*, 1929–30, **5**, 21–28; discussion, 44–48).—Read at a joint meeting with the Faraday Society. See this *J.*, 1930, **43**, 616–617.—S. G.

The Time Factor in the Anodic Passivation of Metals. William James Shutt and Vincent Jackson Stirrup (*J. Electroplaters' Depositors' Tech. Soc.*, 1930, **6**, 41).—Read at a joint meeting with the Faraday Society. See this *J.*, 1931, **47**, 165.—S. G.

X.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 179–185.)

On the Friction and Abrasion of the Bearing Metals. Shirô Kusunose (*J. Soc. Mech. Eng. Japan* (*Foreign Edn.*), 1930, 33, 80–85).—[In English.] Bearing metals such as high-lead bronze, hard bronze, phosphor–bronze, "aluminium–bronze," and manganese bronze, together with cast iron and mild steel, were tested in contact with mild steel and a lubricating oil in a special friction and abrasion testing machine run at 350 r.p.m. Coeff. of friction ranging from 0·035 for high-lead bronze to 0·048 for cast iron were obtained, and also abrasion numbers from 1·9 for cast iron to 5·9 for phosphor–bronze. It is stated that in order to obtain the best results the surface condition of the bearing must be considered, a heterogenous structure being preferred to a homogenous one as lubrication is assisted by the former condition.—J. W. D.

Cleaning Bearing Shells Preparatory to Relining. W. E. W. (*Machinery* (*Lond.*), 1930, 36, 238).—Bronze, brass, steel, or cast-iron shells may be thoroughly cleaned by scouring with a paste of pumice powder and turpentine. Difficulty sometimes experienced in making the white metal adhere to the shell may be overcome by sponging the bearing surface with a solution of 4 oz. per gall. of copper sulphate, drying, and wiping with a soft cloth. This treatment may be applied also before tinning a surface.—H. F. G.

Cleaning Bearing Shells Preparatory to Relining. A. E. (*Machinery* (*Lond.*), 1930, 36, 482).—The copper sulphate solution method (cf. preceding abstract) is beneficial only in the case of cast-iron shells, and even then electrodeposition of copper is preferable. For bronze and brass shells proper cleaning and tinning are desirable.—H. F. G.

Anti-Friction Metals. J. Dautrebande (*Chaleur et Ind.*, 1928, 9, 413–414). —The various types of bearing metal in general use, and their special advantages, are noted. The need of ensuring correct pouring temperature, good mixing, sufficient preheating of the shells, and slow uninterrupted cooling is emphasized. Since the chemical composition of the alloys is of the utmost importance, accurate methods of analysis are necessary. Details are given of the determination of lead, copper, tin, and antimony.—H. F. G.

Insulation and Embedding of Aluminium Fermentation Vats. W. Schmauder (*Woch. Brau.*, 1931, 48, 407–409; *J. Inst. Brewing*, 1931, 37, 582).—In the mounting of aluminium vats in brickwork or cement it is most important that the insulating materials used should not only be of suitable quality, but also be used in very generous quantity. The bitumen, as well as the asphalt-varnish with which the outside of the vat is first coated, should be pure petroleum products, quite free from chlorides, phenols, and alkalis. S. gives very full chemical specifications for these materials. On no account should coal-tar pitch be used, as the phenolic substances in it cause corrosion in presence of moisture. The exterior of the vat is coated first with asphalt-varnish. When this has dried a thick layer of bitumen is applied, then 2 or 3 layers of jute fabric or preferably bitumen felt, and again a thick even layer of bitumen. The fixing of the vat in position and the method of bricking it up are described. Particularly important is the junction of the edges of the vat with the top of the casing. Illustrations are given showing different methods of effecting a satisfactory junction between the edges of two adjacent vats or of the edge of a vat with an adjacent wall, so as to provide a draining channel.—S. G.

Aluminium Brewery Plant in Germany. Anon. (*Aluminium Applications*, 1930, 2, (4)).—The capacity of aluminium brewery vessels supplied by the German aluminium brewery plant industry up to January 1930, amounts to between 4·7 and 5·0 million hectolitres.—J. C. C.

The Use of Aluminium in Apparatus for Making Varnish. A. Dumas (*Peintures, pigments, vernis*, 1931, 8, 1599–1601; *C. Abs.*, 1932, 26, 859).—A general discussion.—S. G.

Progress in the Construction of Tank Cars. H. Staffehl (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1931, 3, 399–401).—Discusses the use of aluminium in the construction of tanks for the conveyance of liquid fuel.—M. H.

Aluminium for Large Industrial Vessels, &c. Anon. (*Aluminium Broadcast*, 1930, 2, (12)).—Abstract of a booklet issued by Birmal Chemical Engineers, Smethwick.—J. C. C.

Light Metal in the Construction of Automobile Rotary Ladders. —— Castner (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1931, 3, 402–404). —M. H.

The First Light Metal Ladder. —— Castner (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1931, 3, 404–406).—A description of a collapsible ladder (20 m. long) made of Lautal.—M. H.

The Longest Fire-Escape of Light Metal in the World. —— Castner (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1931, 3, 406–410).—The ladder which is 48 m. long is made of Lautal.—M. H.

Aluminium Foil for Packing. Anon. (*Aluminium Applications*, 1930, 2, (4)).—Abstracted from *Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1929, 1, 219–220. See this *J.*, 1930, 43, 622.—J. C. C.

Aluminium as a Foil—Against the Hazards of Modern Distribution. Anon. (*Aluminium Broadcast*, 1930, 2, (11)).—Abstracted from *Packing Gazette*, 1930, March. Describes the advantages of aluminium foil as a wrapping material.—J. C. C.

Duralumin Construction of Aircraft Components; Spars and Floats. Anon. (*Machinery* (*Lond.*), 1930, 36, 161–164).—An account of the system of construction developed by Short Brothers (Rochester and Bedford), Ltd. Spars are built up of corrugated web plates and semicircular flanges, of 14–20 gauge metal. Details and illustrations are given of the pressing and rolling operations necessary; on account of the rapid age-hardening properties of the annealed metal successive operations have to be carried out with the least possible delay. Portable pneumatic tools are used extensively for drilling and rivet closing.—H. F. G.

Constructing Fuselages for Airplanes. Anon. (*Machinery* (*Lond.*), 1930, 36, 321–325).—Tubular construction of aeroplane fuselages is impracticable when Duralumin is used, owing to the difficulty of welding this alloy. Duralumin angles and channels, riveted to gusset plates or flanges, have been employed, but on account of the heavy sections necessary it is considered that this metal cannot compete satisfactorily with steel for the purpose.—H. F. G.

Bending Tests of Metal Monocoque Fuselage Construction. Ralph W. Mossman and Russell G. Robinson (*U.S. Nat. Advisory Cttee. Aeronautics, Tech. Notes* No. 357, 1930, 1–38).—This is a study of the bending stress in smooth skin, aluminium alloy, true monocoque fuselage sections of varying ratio of diameter to thickness. The test specimens were in the shape of circular thin-walled cylinders, and were loaded to give a large bending stress in proportion to the shearing stress, in order to represent the critical section of a fuselage. The test results indicate that 90% of a theoretically derived value will be obtained in practice. Considerable theoretical discussion of the problem is introduced. It is suggested that the rules for bulkhead design are ultra-conservative and are worthy of investigation and revision. It is also shown that with the same sheet thickness and diameter of section a corrugated covering, having of necessity a slightly increased weight, would show a greater efficiency than the smooth skin, where the ratio between diameter and thickness is large.—W. A. C. N.

A Ten-Ton Crane Constructed from Aluminium Alloy. Anon. (*Machinery* (*Lond.*), 1930, **36**, 308).—A 10-ton crane, having a span of over 72 ft., is briefly described. The double web girders, walkway, and operator's cage are of aluminium alloy; the weight reduction, as compared with steel, is 12 tons. See also this *J.*, 1931, **47**, 556–557.—H. F. G.

Commercial Uses of Duralumin. Anon. (*Aluminium Broadcast*, 1930, **2**, (12)).—Synopsis of a pamphlet issued by the Duramin Engineering Co., Ltd., London.—J. C. C.

Glucinum [Beryllium] and Aeronautical Construction. L. Guillet and M. Ballay (*Rev. Mét.*, 1931, **28**, 525–528).—A brief survey of possible and existing developments under the headings (1) ultra-light alloys, (2) light alloys, (3) heavy alloys. In the pure state, beryllium is rendered suitable for certain applications by its transparency to X-rays. It is also a good deoxidant for copper. Beryllium does not appear to be of interest as an addition to the light and ultra-light alloys used in aircraft construction. Heavy alloys of low-beryllium content will find more easy applications. They have already provided outstanding contributions to the theory of quenching. Copper–beryllium and nickel–beryllium alloys have already been proposed for use in the form of springs. Addition of beryllium to corrosion-resisting steels appears to be full of promise.—H. S.

A.S.T.M. Tentative Specifications for Copper Base Alloys in Ingot Form for Sand Castings. —— (*Trans. Amer. Found. Assoc.*, 1932, **3**, (1), 19–23).—See this *J.*, 1930, **44**, 644–645.—S. G.

Tentative Recommended Practice for Copper 85, Tin 5, Lead 5, Zinc 5, Alloy and for Manganese Bronze Alloy. Anon. (*Foundry*, 1931, **59**, (14), 64; (15), 60; (16), 52).—Abstracted from a report of the Non-ferrous Committee on Recommended Practices of the American Foundrymen's Association —F. J.

Monel Metal; Some Notes on Its Production and Industrial Applications. Norman C. Marples (*J. Junior Inst. Eng.*, 1931, **41**, 273–303).—A general account of the physical and chemical properties, resistance to corrosion and uses of Monel metal.—W. A. C. N.

Surface Treatment of Zinc for Use as Printing Plates. Eugen Werner (*Oberflächentechnik*, 1931, **8**, 215–217).—Methods of preparing, etching and retouching zinc printing plates are briefly described.—A. R. P.

Metal Blades for Modern Steam Turbines. A. Bedmer (*Chaleur et Ind.*, 1928, **9**, 163–181, 239–244).—Simple brasses, containing, for example, 72% of copper and a small quantity of lead, are of little use for modern high-pressure turbines, and the possibility of using nickel bronzes has therefore been investigated. An alloy containing copper 50, zinc 40, and nickel 10% has a high elastic limit, and although it weakens rapidly at high temperatures it has found considerable application. An alloy of copper 80, nickel 20% is suitable for moderate peripheral speeds and for temperatures up to 350° C. Alloys containing 65% of nickel and 28% of copper may be used at temperatures up to 300° C., but they become fragile at 500° C. and have but little resistance to erosion. For use in modern turbines Monel metal is little better than brass as regards erosion, and although suitable for a small degree of superheating, it corrodes rapidly at temperatures above 400° C. The paper continues with an account of the applicability of various alloy steels.—H. F. G.

The Time Lag of Spark Gaps.—VI–VII. Y. Toriyama and U. Shinohara (*Denki Gakkwai Zasshi* (*J. Inst. Elect. Eng.* (*Japan*)), 1931, **51**, 49–50, 56–57; *C. Abs.*, 1932, **26**, 923).—[In English.] (VI.)—Curves are given for the relation between time lag and gap length for electrodes of annealed and quenched steels, wrought iron, brass, nickel, lead, copper, silver, gold, zinc, aluminium, and tin. The tensile strength of the electrode material is of greater importance than the melting point in determining time lag. (VII.)—The effects on time lag and critical gap length of spark gaps of gas films of hydrogen, oxygen, carbon dioxide, and ozone on electrode surfaces of nickel, iron, copper, aluminium, brass, silver, lead, and zinc are described. Time lag increases with the amount of gas adsorbed. Ozone is especially effective. Moisture decreases time lag.—S. G.

Metal-Truss Wing Spars. Andrew E. Swickard (*U.S. Nat. Advisory Cttee. Aeronautics, Tech. Notes* No. 383, 1931, 1–31).—Suggestions are made for improvements in the calculation of the loads in the members of metal-truss wing spars which are subjected to combined bending and compression. Various discrepancies which arise when ordinary formulæ are employed are discussed and reference is made to the design rules of the U.S. Department of Commerce. The paper is divided into three main sections: (1) derivations of the theoretical concepts; (2) practical applications of the theoretical principles; (3) an appendix in which a calculation of the effective moment of inertia of an actual metal-truss wing spar is made. The latter was tested for deflection under combined bending compression, and, from a comparison with the calculated effective moment of inertia, conclusions are reached as to their relative accuracy. In general there is good agreement, and the differences are discussed.—W. A. C. N.

Production of Aircraft Parts from the Point of View of Safety. M. J. Androuin (*Rev. Mét.*, 1931, 28, 575–580).—Deals with mechanical aspects of the subject, including fit, mode of assembly, interchangeability, standardization, &c.—H. S.

XI.—HEAT-TREATMENT

(Continued from p. 185.)

On the Tempering and Annealing of Eutectoid Alloys. M. G. Oknov (*Zhurnal Tehnicheskoy Fiziki* (*Journal of Technical Physics*), 1931, [B], **1**, (6), 546–569).—[In Russian.] The tempering and annealing of eutectoid alloys were studied in the case of the systems copper–aluminium, copper–beryllium, copper–tin, and silver–cadmium, the density and Brinell, Shore, and Rockwell hardnesses being determined. All the alloys take on a temper which causes profound modifications of their properties. On tempering, part of the solid solution is permanently fixed, whilst part suffers a partial disintegration with a greater or less degree of deformation, the quantitative relation between these two parts determining the properties of the tempered alloys. During annealing, the relation between these two parts alters owing to their different velocities of disintegration. This may take place both continuously and by jumps, the properties being correspondingly altered. The structures resemble those of the iron–carbon alloys and show similar gradations.—N. A.

XII.—JOINING

(Continued from pp. 186–188.)

British Standard Specification for Soft Solders (Grades A, B, C, D, E, F, G, H, J, and K). (Revised February 1932.) —— (*Brit. Stand. Inst.* No. 219, 1932, 1–6).—This specification was first published in 1925, and the present revised issue has been prepared to incorporate a further grade of solder, grade K, suitable for certain classes of machine soldering. This grade is required to consist of tin 59–61%, antimony maximum 0·50%, and lead the remainder, with maximum impurities of iron 0·02%, arsenic 0·05%, aluminium or zinc nil, and total 0·25%. The compositions of grades A to J remain unaltered, although slight modifications have been made in some instances to the references relating to the uses for which the solders are primarily intended. A complete table of compositions is given.—R. G.

British Standard Specification for Cored Solder, Rosin Filled. —— (*Brit. Stand. Inst.* No. 441, 1932, 1–6).—The solder is required to consist of a tube of solder, of the grade "F" B.S. Soft Solder, unless otherwise specified, of circular cross-section, completely and uniformly filled with rosin to form a continuous core. Pure amber rosin, free from salammoniac, stearic acid, calcium chloride, or foreign matter, is specified, and must comprise 3–5% of the total weight. Six nominal sizes, with limits, are fixed, and appropriate metrical equivalents are given. Tests may be made on up to 1% of the coils supplied. Other clauses deal with rejection and delivery, and an appendix gives the composition of grade "F" soft solder, reproduced from B.S. Specification No. 219 (preceding abstract).—R. G.

Soldering of Aluminium. L. Rostosky and E. Lüder (*Aluminium Applications*, 1930, 2, (4)).—Abstracted from *Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1930, 1, 272–278. See this *J.*, 1931, 47, 295.—J. C. C.

Investigation of the Soldering of Aluminium with "Alulot" Solders. A. P. Goriatchev, R. R. Syromiatnikov, and E. W. Zechovitzer (*Sobshenia Vsesouznogo Instituta Metallov.* (*Communications of the Pan-Union Institute of Metals*), 1931, (5–6), 57–65).—[In Russian.] Four solders marketed by the firm of Schentel & Company, under the name of "Alulot," were investigated. "Alulot" solders Nos. 2 and 3 may be considered identical in composition and fusion temperature. The best mechanical properties and resistance to corrosion are shown by "Alulot" No. 4. If a preliminary coating of the lead–tin alloy "Alulot" No. 1 is given before soldering with "Alulot" No. 4, the mechanical properties and corrosion resistance of the seam are greatly reduced. The seam is not susceptible to bending.—N. A.

Autogenous Welding of Aluminium and its More Important Alloys. H. Buchholz (*Z. Metallkunde*, 1932, 24, 19–22).—Some suggestions for the autogenous welding of aluminium and its casting alloys are given. Age-hardened aluminium rolling alloys should never be welded, as the mechanical properties and corrosion resistance are thereby considerably impaired.—M. H.

The Welding of Aluminium. Anon. (*Aluminium Broadcast*, 1930, 2, (12)). —Annotated extracts indicating the sources of an Alcoa pamphlet on autogenous welding.—J. C. C.

The Practice of Copper Welding. E. Weese (*Z. Metallkunde*, 1932, 24, 11–15).—The principles of autogenous copper welding and the methods of making joints are discussed; figures are given showing the influence of various welding wires on the tensile, ductile, and bending properties of welded joints. The welding of copper locomotive fireboxes (repair as well as manufacture of all-welded fireboxes) is described, copper welding in the construction of chemical apparatus is discussed, and experiences with arc-welding of copper are detailed. —M. H.

Nickel-Welding. C. Canzler (*Z. Metallkunde*, 1932, 24, 15–18).—The technique of oxy-gas welding, atomic hydrogen-welding, arcogen-welding (combination arc and autogenous welding, and hammer-welding of nickel and Monel metal is discussed. Practical hints are given and various applications described. The paper contains macro- and micro-photographs of welded joints.—M. H.

The Autogenous Welding of Monel Metal in the Construction of Chemical Apparatus. Rudolf Müller (*Apparatebau*, 1932, 44, 29–32; *Z.V.d. Kupferschmied.*, 1932, 44, 29–31).—Some practical hints.—M. H.

Increasing the Resistance to Repeated Impact of Test-Pieces Assembled by Welding. D. Rosenthal (*Génie civil*, 1932, 100, 98).—The low resistance of welds to repeated impact can be overcome by building up a thickened zone in the neighbourhood of the weld. The endurance limit under alternating torsional stresses can be increased by subjecting the weld to a static overstrain.—W. P. R.

Welding Facts and Figures.—LIII. D. Richardson (*Welding J.*, 1931, **28**, 230–232).—The following methods of welding are discussed: Oxy-benzol, the "Blau" system (mixture of gaseous hydrocarbons and readily-volatile compounds), the Oxy-Pintsch system, Schelgas, Urgas, Gasol, and the use of oil gases.—J. H. W.

Phases of Gas Welding. Glenn O. Carter (*Internat. Acetylene Assoc. Preprint*, **1931**, 1c–4c).—Gas welding processses are subdivided into their many distinct applications, and it is suggested that further subdivision of these will help to show the need of and the way for development.—H. W. G. H.

Adapting Gas Welding in the Chemical Industry. R. C. Hosterman (*Welding Eng.*, 1930, **15**, (5), 35–39; and *Indust. Gases*, 1930, **11**, 152–157). —A general discussion of the application of the oxy-acetylene process in the fabrication of chemical engineering plant—process piping, gas and water supply lines, chemical tanks and pressure vessels.—H. W. G. H.

Welding and Oxy-Cutting Side by Side in the Foundry. Ph. T. (*Rev. gén. Sci.*, 1931, **42**, 454–456).—Deals with the advances made in the U.S.A. in oxy-acetylene welding and cutting by means of an oxygen jet. Large gear wheels, up to several metres in diameter, are now constructed out of sheet metal by oxy-cutting and welding, and the finished article is stronger and lighter than a similar wheel which is cast by the usual foundry methods. —W. P. R.

The Arcatom Welding Process. Protective Arc Welding in Dissociated Hydrogen by the Langmuir Process. S. Sandelowsky (*Z.V.d.I.*, 1931, **75**, 1361–1364).—Apparatus for the atomic hydrogen process of arc-welding is described and the material and current consumption are given together with cost data. The process can be applied to most steels, to aluminium and its alloys, and to nickel, copper, and brass sheets less than 1 mm. thick and yields dense, well-formed welds without appreciably affecting the crystal structure of the material.—v. G.

Atomic Hydrogen Arc Welding. J. T. Catlett (*Metals and Alloys*, 1931, **2**, 272–276).—The welding torch consists of two tungsten rods inclined to one another at 60°, each rod being surrounded by a tube through which hydrogen is passed. When an arc is struck between the two electrodes a fan-shaped zone of dissociated hydrogen spreads outwards from the arc and a temperature of about 4000° C. is obtained by recombination of the hydrogen atoms. The fringe of the flame is used in welding, so that the joint is made in a bath of hydrogen which effectively reduces the oxide film on the metal and allows a perfectly clean and sound weld to be made which is as strong and malleable as the remainder of the metal. The process has been successfully applied to steel, iron, zinc, platinum, aluminium, brass, and Monel metal. For ordinary welds an alternating current of 50 amp. at 100 v. is used; direct current produces uneven wear on the electrodes but otherwise gives satisfactory welds.—A. R. P

Resistance Welding Data. Walter Anderson and Malcolm Clark (*Welding Eng.*, 1931, **16**, (8), 39–40; and *Welding News*, 1931, **2**, 28–29).—Gives typical examples of transformer capacity necessary for butt, spot, and projection welding various materials. Upset pressures for the first are also given. —H. W. G. H.

Jet Cutting and Electric Welding. Anon. (*Machinery* (*Lond.*), 1930, **36**, 329–377).—An illustrated description of developments in methods and equipment.—H. F. G.

Potassium Flux in Electric Welding. P. N. Esmont (*Autogennoe Delo*, **1931**, (9), 16–17; *C. Abs.*, 1932, **26**, 413).—[In Russian.] Compounds containing potassium should be used for fluxes in welding with a.c. of 55–65 v. Sodium salts should be avoided because they are occluded by the metal, causing brittleness and flows. The flux should have a coeff. of expansion different from that of the metal. This eliminates tedious cleaning operations, because the flux comes off easily when the metal is cold.—S. G.

Basic Principles of Education and Training in Industry as they may be Applied to Welding Instruction in Trade and Vocational Schools. W. H. Magee (*Internat. Acetylene Assoc. Preprint*, **1931**, 1M–7M).—Describes the system of education for welders developed at the General Motors Institute of Technology.—H. W. G. H.

To-day's Opportunities for Welding-Trained Men in the Metal Working Trades and Industries. S. Lewis Land (*Internat. Acetylene Assoc. Preprint*, **1931**, 1N–10N. **Training Gas Welders for the Job.** T. M. Jones (*ibid.*, 1D–5D). **The Growing Importance of Tests—What they Mean to the Welder and to the Welding Industry.** H. L. Whittemore (*ibid.*, 1R–4R). [Description of the Tests demonstrated by John J. Crowe and A. B. Kinzel and W. B. Miller] (*ibid.*, 1 O–9 O).—Papers read at the night session of the 32nd annual Convention, 1931, discussing the training of welders, and qualification tests of their work.—H. W. G. H.

XIII.—WORKING

(Continued from pp. 189–192.)

Force Relations in Drawing Copper Wire. R. L. Doan and J. L. Betsill (*Phys. Rev.*, 1931, [ii], **38**, 1922).—Abstract of a paper read before the American Physical Society. An empirical relationship has been derived between the drawing force and percentage reduction in drawing copper wire through successive chilled iron dies, which takes into consideration the progressive hardening of the metal with cold-work. This is: $\log F/\Delta = A - B \log X$, where F is the drawing force, Δ the reduction in cross-section, and X the percentage reduction at any particular die. A and B are factors which depend on the total reduction from the soft rod. The effect of varying the die angle has been investigated for 5°, 10°, 20°, 30°, and 40° single-angle dies. The drawing force was found to be a minimum and the tensile strength of the product a maximum for the 10° angle, although more detailed experiments will be required to locate the optimum angle. The fall in tensile strength of the wire when drawn through large angle dies is associated with the development of internal ruptures which widen out and give rise to typical cup and cone fractures.—S. G.

Developments in Non-Ferrous Metal Rolling Mills. L. Weiss (*Metallurgia*, 1932, **5**, 173–176).—Translation of a paper from *Z. Metallkunde*, 1931, **23**, 73–76. See this *J.*, 1931, **47**, 401.—J. W. D.

An Investigation of Chilled Roll. Tario Kikuta (*J. Soc. Mech. Eng. Japan* (*Foreign Edn.*), 1930, **33**, 60–61).—[In English.] Translated and abridged from the Japanese "Home Edition." See this *J.*, 1931, **47**, 402.—J. W. D.

Rolling Grooves in Aluminium Pistons for Airplane Engines. H. T. L. (*Machinery* (*Lond.*), 1930, **36**, 469).—Difficulty has been experienced, when machining piston grooves, in maintaining the required size limits. In the improved method described the grooves are cut by a set of accurately spaced knife-blade cutters and are then finish-rolled. The variation of width of the grooves does not exceed 0·0005 in.—H. F. G.

Cold-Heading Materials. P. Mabb (*Machinery* (*Lond.*), 1930, **36**, 461–463).—A general account of the process, with a note of suitable types of brass and copper. Half-hard brass containing copper 62–64, impurities not more than 0·3%, and the remainder zinc, and having Brinell hardness 110–130, Rockwell hardness B 62–B 72, tensile strength 22–30 tons/in.^{2}, is recommended; tin should be absent. Copper should contain about 0·25% of arsenic, and have a Brinell hardness of about 65; on heading this may rise to 120.—H. F. G.

Hot-Pressings of Brass. J. D. Speakman (*Met. Ind.* (*Lond.*), 1932, 40, 97–100).—The operations involved in hot-pressing (or stamping) of brass and other non-ferrous alloys and the presses employed are described and the applications and advantages of the process are discussed.—J. H. W.

Adjustable Toggle-Joint Sub-Press for Stamping Small Parts. R. J. (*Machinery* (*Lond.*), 1930, 36, 83).—Illustrated description of a device, operated by the ram of the press, in which the stroke may be readily adjusted within very fine limits.—H. F. G.

Small Quantity Production Methods in Press Work. W. Richards (*Machinery* (*Lond.*), 1930, 36, 73–75).—A description of methods applicable to the production of sheet-metal components required in numbers which do not appear to justify the making of special tools.—H. F. G.

Further Considerations of Blank Formulæ. J. Langton (*Machinery* (*Lond.*), 1930, 35, 809–811).—Cf. this *J.*, 1931, 47, 601. An account of the determination, by the area and volume methods, of the blanks required for cylindrical shells and domed stampings of which a finished sample is not available.
—H. F. G.

Machinability of Free Cutting Brass Rod. Alan Morris (*Amer. Inst. Min. Met. Eng. Tech. Publ.* 454, 1932, 1–10).—The effects of such variables as lead content, microstructure, and cold-work on the machinability of brass rod are discussed. It is felt that an understanding of the effect of basic mill operations on power consumption, finish, and tool life is necessary for economic efficiency. The special arrangement of a single-tooth milling cutter in which a heavy pendulum has been substituted for the pulley on the arbor is described. The machinability of Muntz metal improves rapidly at first with the addition of lead, but diminishes as the lead content is increased. It is also improved by cold-drawing after annealing. Tensile properties do not indicate machining quality.—W. A. C. N.

Turning Tools for Elektron Alloys. F. W. S. (*Machinery* (*Lond.*), 1930, 36, 149).—Since the angle at which the cutting edge is presented to the work is the only matter of importance, a flat-topped tool applied above centre is perfectly satisfactory for turning Elektron.—H. F. G.

Turning Tools for Elektron Alloys. J. L. de P. (*Machinery* (*Lond.*), 1930, 36, 344–345).—A note on the inadvisability of setting a turning tool above or below centre.—H. F. G.

Turning Tools for Elektron Alloys. W. P. (*Machinery* (*Lond.*), 1930, 36, 345).—Cf. preceding abstract. An explanation of the objection to setting the tool above the centre line.—H. F. G.

Small Diameter Drills for Light Alloys and Other Materials. H. J. Stoewer (*Aluminium Applications,* 1930, 2, (4)).—Abstracted from *Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1930, 1, 295–300. See this *J.*, 1931, 47, 403.—J. C. C.

Machining Spherical Surfaces in a Screw Machine. B. J. S. (*Machinery* (*Lond.*), 1930, 35, 700–701).—A detailed account of the tooling equipment employed for rapidly machining two spherical surfaces and two faces on a brass component of a water-measuring device.—H. F. G.

Machine Tapping Speeds. A. L. Valentine (*Machinery* (*Lond.*), 1930, 36, 6–7).—Charts are given showing the speed at which taps should be run when cutting threads of a range of sizes in brass, copper, bronze, and iron and steel. The question of tap lubrication is discussed; for general use a good grade of lard oil is recommended, but in certain cases (unspecified) sperm oil is preferable.—H. F. G.

External Broaching Developments. Anon. (*Machinery* (*Lond.*), 1930, 36, 400).—A brief note of the increase of broaching methods, during recent years, for finishing external surfaces, as an alternative to straddle or form milling or turning. A very high finish is obtainable, extremely accurate sizing is possible, and the broaches can be used for long runs without being reground or adjusted. The applicability of the method for grooving aluminium pistons and for finishing flat surfaces is noted.—H. F. G.

Milling, Die-Casting, and Assembly Operations in Gas Meter Production. Anon. (*Machinery* (*Lond.*), 1930, **36**, 327–329).—Details are given of the machining of the brass coin-wheels used in pre-payment meters, and of the die-casting of the valves which are soldered to the top face of the valve plate; a special tin–antimony alloy is used for the valves, and gas-tight faces are produced by hand-grinding against a slate slab.—H. F. G.

Scientific Purchase of Small Tools. H. T. U. R. (*Machinery* (*Lond.*), 1930, **36**, 399).—The chief points to be considered are: (1) the reputation of the maker; (2) the constancy of size tolerance; (3) the number of cuts which may be made with a cutting tool before re-grinding is necessary; (4) resistance to shock and overload; and (5) price, in relation to these factors.—H. F. G.

Machine Tools. J. Pickin (*Trans. Soc. Eng.*, 1930, **21**, 25–38; discussion, 38–43).—An account of the developments in lathe design and construction during the last 50 years.—H. F. G.

Machine Tools from the User's Point of View. H. C. Armitage (*Machinery* (*Lond.*), 1930, **35**, 782–785, 817–820, 849–851).—See this *J.*, 1931, **47**, 176.
—H. F. G.

The Application of Hydraulic Power to Machine Tools. Anon. (*Machinery* (*Lond.*), 1930, **35**, 633–637, 665–668, 697–699).—A general account.—H. F. G.

Recent Developments in Electric Drives of Machine Tools. Anon. (*Machinery* (*Lond.*), 1930, **35**, 801–806).—A detailed account of push-button control systems, auxiliary motor self-starters, automatic controls for shearing machines, the mounting of motors and control gear on machine tools, and cutting speed indication.—H. F. G.

The Use of Cutting Fluids in Machine Shop Practice. Anon. (*Machinery* (*Lond.*), 1930, **35**, 811).—A brief note of the report on current practice in the use of cutting fluids compiled by S. A. McKee in connection with the joint endeavour of the U.S. Bureau of Standards and the Special Research Committee on Cutting of Metals of the American Society of Mechanical Engineers to co-ordinate information on the subject.—H. F. G.

Metal-Cutting and Hard Cutting Materials. Anon. (*Metallurgia*, 1932, **5**, 86).—Some recent investigations with the object of discovering the most effective use of machine tools and cutting materials are discussed. The results of a recent series of tests in milling a variety of ferrous and non-ferrous metals are considered. Reference is also made to the report of the Sub-Committee of Metal-cutting Materials, 1930, of the American Society of Mechanical Engineers dealing with tungsten-carbide and other hard cutting materials such as Stellite, tantalum carbide, cobalt high-speed steel, and the diamond.
—J. W. D.

[Ramet] Cemented Tantalum Carbide—a New Tool Material. Anon. (*Metal Progress*, 1931, **19**, (3), 53–55).—Describes the manufacture and properties of Ramet, a tool material consisting of tantalum carbide cemented with about 8% nickel. The carbide melts at about 4400° C., as against 2700° C. in the case of tungsten carbide. Its heat conductivity is abnormally low, being about a third of that of tungsten carbide. Cutting tests give satisfactory results in point of coolness and speed. There is very little thermal expansion, and the life of tools is stated to be at least equal to that of tungsten carbide tools.—P. M. C. R.

Widia Cutting Tools. Anon. (*Machinery* (*Lond.*), 1930, **35**, 841–845).—An account of the development, manufacture, and capabilities of Widia (tungsten carbide). A table of the cutting speeds on various metals and non-metallic materials is given. Widia tools have given results equal to those obtained with diamonds, at the same cutting speeds and feeds, on non-ferrous metals; *e.g.*, bronze and gun-metal castings can be machined " in thousands " without the tool loosing its edge, since the sandy and scaly surface has no effect on the tool. The principles and details of the design of Widia tools are given, and the method of fixing the tips is described. 95% of the complaints made by users of Widia are due to the use of incorrect grinding wheels. The clearance angles must not be rounded in the manner obtained by grinding on the periphery of a large wheel. A very keen edge free from raggedness is essential.—H. F. G.

What the Works Foreman Should Know about Widia. O. Rieckhoff (*Oberflächentechnik*, 1931, **8**, 37–41).—Widia metal tips are best soldered on to steel shanks by means of pure copper using borax as a flux. The tips can be cut and polished only by means of carborundum wheels. Tables of cutting speeds and methods of making tools for various purposes are given, together with a description of the method of making Widia metal and a brief account of its properties.—A. R. P.

The Extending Field for Tungsten Carbide Cutting Tools. Anon. (*Machinery* (*Lond.*), 1930, **36**, 464).—Mention is made of the cutting through of 3 in. diam. brass stock in 3 seconds by a 16 in. diam. saw running at 2,400 r.p.m. and containing 60 inserted tungsten carbide teeth.—H. F. G.

A Tool-Bar for Use with Tungsten Carbide–Cobalt Tools. J. T. T. (*Machinery* (*Lond.*), 1930, **36**, 315).—The overhang from the tool rest, and the overhang of the cutter beyond the bar, are reduced to a minimum.—H. F. G.

Grinding a Vee Tool. R. Tindall (*J. Sci. Instruments*, 1932, **9**, 29).—A note. Describes the grinding of a vee tool to a desired angle by a method simpler than that of Munday (*J. Sci. Instruments*, 1931, **8**, 302; cf. *J.*, this volume, p. 121).—W. H.-R.

XIV.—FINISHING

(Continued from pp. 192–193.)

Colouring [Nickel-Plating] of Aluminium. Eugen Werner (*Oberflächentechnik*, 1931, **8**, 175–176).—Pure aluminium can be plated directly with nickel in a bath made by dissolving 5 kg. of nickel sulphate crystals, 5 kg. of magnesium sulphate crystals, 20 grm. of citric acid, 35 grm. of sodium carbonate, and 120 grm. of glycerin in 10 l. of water. The bath is operated at 60° C. with 5 v.; at higher temperatures the deposit peels. Better results are obtained by first treating the aluminium as a cathode in an alkaline stannate-zincate bath using lead anodes, then plating it with a thin film of copper from a cyanide bath, and finally applying the nickel coat as described above.
—A. R. P.

" Alumilite " Process for Colouring Aluminium. Anon. (*Aluminium Broadcast*, 1930, **2**, (12)).—Samples of aluminium treated by the " Alumilite " process, which is stated to be electrolytic and to produce a hard, corrosion-resisting surface in any colour, were examined and found to have a good finish, resembling lacquer, and resistant to scratching.—J. C. C.

Black Pickling of Brass. K. Schuch (*Oberflächentechnik*, 1931, **8**, 163).—The brass is immersed in a cold solution made by dissolving 150 grm. of copper carbonate in 750 grm. of ammonia (*d* 0·9) and 150 grm. of water. The resulting film may be further darkened by treatment with a solution of an alkali chromate.—A. R. P.

Brown Colouring of Brass and Copper. K. Schuch (*Oberflächentechnik*, 1931, **8**, 166–167).—Various shades of brown are obtained by pickling the metals in baths containing various proportions of alkaline sulphides, sodium thioantimoniate, and ammonium chloride. A dark brown "oxidized bronze" effect is produced in a bath containing 75 grm./l. of copper sulphate crystals 25 grm./l. of nickel sulphate crystals, 25 grm./l. of potassium chlorate, and 7 grm./l. of potassium permanganate. A dark green effect is produced in a bath containing 5% each of copper and nickel sulphates and 2% of potassium permanganate.—A. R. P.

Clean Metal Surfaces. Anon. (*Oberflächentechnik*, 1931, **8**, 2–5).—Methods of cleaning and polishing ferrous and non-ferrous metal castings are described in some detail.—A. R. P.

[Polishing Discs.] H. S. (*Machinery* (*Lond.*), 1930, **36**, 399).—When emery cloth is glued to a disc the glue is liable to crack and form a rough surface, with the result that the cloth tends to tear; in addition, the glue cannot easily be removed from the disc. It is more satisfactory to coat the disc with softened beeswax and press the cloth on to the wax.—H. F. G.

Lacquers for Polished Aluminium. Anon. (*Aluminium Applications*, 1930, **2**, (4).).—The use of "Silver Lacquer" manufactured by Bakelite Ltd. is recommended for protecting polished aluminium at temperatures of about 275° F. (135° C.).—J. C. C.

XV.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 194–196.)

A Method for Determining the Volume Changes Occurring in Metals during Casting. C. M. Saeger, Jr., and E. J. Ash (*U.S. Bur. Stand. J. Research*, 1932, **8**, 37–60; *Research Paper* No. **399**).—Reviews methods which have been proposed and used for determining the various types of shrinkage undergone by a cooling metal. The three types of shrinkage to be considered may be defined as: (*a*) shrinkage in the liquid metal; (*b*) shrinkage during solidification, and (*c*) shrinkage in the solid state. The authors also consider briefly the sand-cast cone method for determining total shrinkage during casting and the more fundamental procedure of constructing a specific volume–temperature curve for each metal or alloy from some temperature well above the melting point or melting range to room temperature. The specific volume–temperature curve in the range of liquid metal is constructed from data secured by application of the crucible-immersion method; that is, by filling a crucible of known volume with liquid metal at known temperature. Since the mass of the sample of liquid metal is the same as that of the sample at room temperature, the specific volume of the liquid can readily be calculated. Data on the contraction of the solid metal were obtained by direct observations of the change in length with change in temperature of a sand-cast bar of metal. The difference between the specific volume of the solid metal and of the liquid metal at the melting point is the shrinkage during solidification. In the case of an alloy, shrinkage during solidification occurs over a range of temperature. —S. G

Fluxes in Melting and Remelting Aluminium. Edmund Richard Thews (*Metallbörse*, 1931, **21**, 147–148, 195–196).—The function of fluxes in melting aluminium is discussed with reference to recent articles on the subject, and the composition and efficiencies of various mixed fluxes are detailed. —A. R. P.

Melting Practice with Aluminium Turnings. W. I. Findikaki (*Liteinoe delo* (*Foundry Practice*), **1931**, 15–16).—[In Russian.] In remelting dirty, oily turnings which were fed into the crucible after pressing into bundles, a loss of 30–40% was experienced with a casting temperature of 720°–730° C. By adding the turnings in small quantities to aluminium previously melted and heated at 730°–740° C., with the furnace current cut off, the losses were reduced to 11–14%. If the oil is previously removed by heating at 400° C.

the loss is further reduced to 7·2%. Experiments on briquetting reduced the losses to 4·2–6·2%.—N. A.

Melting Aluminium Scrap and Waste Metal. Edmund R. Thews (*Z. ges. Giesserei-Praxis: Das Metall*, 1932, 53, 25–26).—The possibility of using scrap and chippings in aluminium melting depends on the proper preparation of the material. All oil and dirt must be removed from the scrap by washing in a suitable solvent and warming at a temperature of not more than 325° C. Pieces of iron can be removed by hand or with a magnet. The scrap is necessarily oxidized to some extent, and loss in melting on that account will occur. Details of the preparation, melting, slagging, and casting of the material are given. The metal is heated to 850° C. for 20 minutes, then soaked between 775° and 800° C., the slag skimmed, the metal " washed " with zinc chloride, and poured.—J. H. W.

Melting and Pouring Some Newer Alloys. Anon. (*Met. Ind.* (*Lond.*), 1932, **40**, 169).—The more generalized use of aluminium in brasses makes the use of brass scrap a dangerous procedure, since for some alloys even a very small quantity of aluminium is detrimental. For such alloys, therefore, high-grade virgin metals must be used. Where aluminium is a constituent of finely adjusted alloys, the metal must not have been stored in damp places, and some such flux as resin is to be preferred to the more usual zinc chloride. The pouring temperature may be lower than ordinary and pouring must be steady and continuous. Cadmium is often used in place of zinc in bronzes, as little as 1% having a considerable hardening effect on copper. Various precautions to be taken in casting " aluminium-bronzes " are discussed.
—J. H. W.

Satisfactory Melting of Copper. Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1932, 53, 12–13).—The manufacture of thick castings of copper presents many difficulties. The very best grade copper containing not more than 0·05% oxygen must be used. Preheating must not be resorted to, owing to the danger of absorption of sulphur dioxide by the metal. The crucible should be materially larger than the volume of metal to be melted, and deoxidation is done with 10% phosphor-copper. The casting temperature for pure copper is 1150°–1200° C. Various precautions to be observed in casting the metal are described.—J. H. W.

Melting from Copper Scrap in the Foundry. Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1932, 53, 48–49).—Melting copper scrap requires considerable care, and the precautions to be taken in the case of heavy copper cuttings, copper wire scrap, scrap from electrical apparatus, telephone wire, trolley wire, heavy armature wire, and copper chippings are given with regard to the preparation of the scrap and its subsequent melting.—J. H. W.

Melting of Bronze in a Cupola Furnace. P. E. Liamin (*Liteinoe delo* (*Foundry Practice*), **1931**, (6), 21–22).—[In Russian.] A description of the design and operation of a cupola furnace using oil-coke at the works of the Imperial Brass Corporation of Chicago.—N. A.

Investigation of the Casting of [Bronze] Cylinders at the " Krasnye Fakel " Works. K. B. Dering, A. P. Smiriagin, and I. B. Kumanin (*Liteinoe delo* (*Foundry Practice*), **1931**, (6), 23–28).—[In Russian.] The chief reason for the cracking and failure under hydraulic test of bronze fire-engine cylinders is the presence of stannic oxide in the castings. Directions for improving the casting conditions at the works are given.—N. A.

Investigation of Bell-Metal. A. P. Smiriagin (*Liteinoe delo* (*Foundry Practice*), **1931**, (3), 3–6).—[In Russian.] To obtain the usual standard types of bronze from bell-metal the tin content must be reduced by addition of copper. If lead is used as diluent, the hardness of bell-metal is reduced, but the mechanical properties of the resultant alloys are still unsatisfactory. The removal of tin by oxidation with sodium nitrate is irrational. The best results are obtained by oxidizing with an air-blast and removal of the oxides by slagging. Slags containing sulphates should not be employed, as they cause contamination of the metal by sulphur dioxide.—N. A.

Making Large Bells for a Carillon. Anon. (*Iron Age*, 1932, **129**, 230–231, 250).—Details of mould-making and preparation and casting of a group of bells weighing 26 tons mounted, made at the Croydon Bell Foundry, England, are described.—J. H. W.

Melting Secondary Brass in the Reverberatory Furnace. Edmund R. Thews (*Met. Ind.* (*Lond.*), 1932, **40**, 145–147).—The choice of melting methods and furnaces is chiefly influenced by the need of preventing undue oxidation of the zinc content of brasses. Such methods as are adopted for this purpose are usually effective against the absorption of gases, a secondary but important consideration. The factors influencing oxidation and the essentials of a melting furnace are described, and the main advantages of reverberatory furnaces are set out. The mechanism of the oxidation of zinc, the absorption of gases other than oxygen, and in particular the influence of sulphur dioxide are described. The absorption of gases increases with the temperature up to a point when it is offset by the evolution of zinc fumes. Above this critical temperature, the amount of gases held in solution will decrease with increase of temperature. It is therefore very necessary to control the temperature carefully, and also the condition of the charge, *i.e.* the size, weight, and preliminary cleaning of secondary material must receive careful attention.
—J. H. W.

Deep Etching of Brass Applied to Gating Problems. R. W. Parsons (*Trans. Amer. Found. Assoc.*, 1931, **39**, 843–852, discussion, 852–856; and *Met. Ind.* (*N.Y.*), 1931, **29**, 477–480).—The value of the deep etching test on sections of brass castings in enabling the operator to form an opinion as to the correctness of the gating is illustrated with reference to several examples of right and wrong methods of gating.—A. R. P.

Cutting Production Costs in the Brass Foundry. James Breakey (*Canad. Found.*, 1931, **27**, (12), 7–9, and 20).—The arrangement of work in the preparation of core boxes, details of casting, and the general organization adopted in a large brass foundry with a view to reduce costs of production are described.
—J. H. W.

Melting and Casting Nickel–Silver Alloys. Edmund R. Thews (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 21–22).—Practical suggestions are given for avoiding unsatisfactory castings in nickel–brasses, which can be successfully cast only within a narrow range of temperature. The alloys require a high temperature to be sufficiently fluid, while overheating introduces other difficulties. The so-called " German Process " is considered unsuitable, and the method of alloying nickel or nickel–copper alloy with brass scrap is recommended. Salt is used as a flux, and the best casting temperature is about 150° C. above the melting point of the alloy. A little aluminium (¼ oz. per 100 lb.) is added to deoxidize the melt just before pouring, but excess of aluminium leads to brittleness of the castings. A number of moulds should not be filled successively from the same crucible. Recommendations are made regarding the construction of moulds and cores.—R. G.

Production of Lead–Tin Alloys from Tin Slags. Edmund Richard Thews (*Metallbörse*, 1931, **21**, 3–4).—In working up slags containing tin it is usual to smelt the slags with lead ashes or roasted lead ores to obtain a lead–tin alloy. Lead ashes used should contain less than 3–6% of tin and be preferably free from arsenic and antimony, the presence of which results in the formation of speiss. The resulting lead–tin alloy should contain not more than 25% and preferably about 10–15% of tin. By blowing air through the molten alloy tin ashes containing 30% or more of tin may be obtained, which can then be reduced to a rich tin–lead alloy.—A. R. P.

The Comparison of Different Fluxes for Magnesium Alloys. Kishio Endô (*Kinzoku no Kenkyu*, 1932, **9**, (1), 24–30).—[In Japanese.] Magnesium and its alloys were melted with the use of various fluxes, and the effect of the latter was compared by measuring the electrical resistance and tensile strength and studying the microstructure and melting loss of the specimens obtained.—S. G.

Examination of Electrolytic Nickel. A. N. Kuznetzov and S. A. Baranov (*Sobshenia Vsesouznogo Instituta Metallov.* (*Communications of the Pan-Union Institute of Metals*), **1931**, (7), 93–104).—[In Russian.] Electrolytic nickel is a metal of variable quality owing to the occurrence of undesirable phenomena during the process of electrolysis. In estimating the value of this grade of nickel chemical analysis alone is insufficient, and data on the microstructure and resistance to heat are necessary. In order to improve the quality of the metal, experiments on remelting were carried out. Prolongation of the remelting time, in general, has an injurious effect on the quality of the metal, as the nickel monoxide content is considerably increased thereby. Salts which are always present in electrolytic metal should be removed by washing with warm water prior to remelting. After heating just below the melting point for 2 hrs., then just above this point for 10 minutes, the metal contains 2·45–2·64%, and after a further 50 minutes in the molten state 5·85–6·1% of oxide. Carbon is considered to be the proper deoxidizer for nickel, but care must be taken to avoid excess, as otherwise graphite is formed between the grain boundaries and the metal becomes brittle. Deoxidation with manganese is dangerous, since manganese oxide has an adverse effect on the properties of nickel. Manganese is, however, useful to complete the deoxidation of the bath, to remove dissolved gases, and to convert the sulphur into manganese sulphide (although magnesium must be regarded as the best desulphurizer). The following procedure is recommended: to the charge of nickel is added about 0·5% of wood charcoal, and when the carbon content has fallen below 0·1%, up to 0·3% of manganese (0·2 if the nickel is to be forged) is added to complete the deoxidation, followed by 0·1–0·14% of magnesium, preferably in the form of a nickel–magnesium alloy.—N. A.

Monel Metal and Nickel Castings. B. K. Dering (*Liteinoe delo* (*Foundry Practice*), **1931**, (9), 17–18).—[In Russian.] The properties of nickel and Monel metal, and methods of casting these metals are reviewed.—N. A.

Fluxes for Precious Metal Production. E. T. Ellis (*Met. Ind.* (*Lond.*), 1932, **40**, 170–176).—Drosses for precious-metal melting are often well worth treating. The fluxes used for this purpose are fluorspar, potassium bisulphite, potassium nitrate, common salt, salt cake, and soda ash. The manner in which these may be mixed to give the best results is described, but there are some errors in the text.—J. H. W.

Practical Silver Casting. Wilhelm Friedrich (*Z. ges. Giesserei-Praxis*: *Das Metall*, 1932, **53**, 37–38).—For single castings, wax, stone, wood, gypsum, or metal moulds can be used; for multiple castings, metal only is available. The preparation of sand, wax, and other moulds is described. Dry casting saves 10% of the cost and more than 10% of the otherwise wasted material. The casting of pure silver and of silver–copper alloys is described. Alloys containing up to 50% copper are white, between 50 and 70% reddish, and more than 70% red. Zinc 0·5–1% is usually added as a deoxidizer and the casting is left to cool in the mould.—J. H. W.

What is the Best Pouring Temperature for a Genuine Babbitt? James Brinn (*Metals and Alloys*, 1931, **2**, 180).—A letter to the editor discussing the relation between the grain-size and the wearing properties of a bearing metal. Theoretically a bearing with a fine-grained structure should wear best, but in practice a medium coarse-grained structure gives the best results, probably owing to the presence of small pores or fissures which hold the lubricating oil. This type of structure is obtained by using a high pouring temperature and warm shells and mandrels. In America the shells and mandrels are heated to 150° C. and the metal is cast at 460°–490° C. by one large firm and at 650°–700° C. by another; in Germany the practice is to pour the metal at 650° C. into shells heated to 500° C. No information seems to be available as to the life of bearings prepared in these different ways.—A. R. P.

Babbitting Large Bearings. J. S. (*Machinery* (*Lond.*), 1930, **36**, 367).—Direct pouring is likely to produce gas pockets and blow-holes if the bearing diameter exceeds 12 in. Filling the holes with Babbitt metal, with the aid of a soldering iron, is very wasteful of time. The difficulty may be overcome by bottom pouring, with a clay wall built round the top of the bearing to contain the additional metal required to compensate for shrinkage.—H. F. G.

The Electrothermic Manufacture of Silicon Alloys. J. E. Alexeevsky (*Trudi Instituta Metallow* (*Transactions of the Institute of Metals*), 1931, **1**, (15), 9–14).—[In Russian.] Experiments on the production of the following alloys are described: silicon–calcium (20–25% calcium, 55–60% silicon, 10–15% iron; energy required, 18 kw.-hr./kg.); silicon–calcium–aluminium (50–55% silicon, 20% calcium, 8–10% aluminium, 18–15% iron; energy required, 25–28 kw.-hr./kg.); ferro–silicon–aluminium (Type I, 50–55% silicon, 8–10% aluminium, rest iron; energy required, 12–15 kw.-hr./kg. Type II, 50–55% silicon, 18–20% aluminium, rest iron; energy required, 18–20 kw.-hr./kg.); silico–aluminium (70–75% silicon, 20–25% aluminium, and the inevitable 1–3% iron; energy required, 15 kw.-hr./kg.); cupro–silicon (70% silicon, 25–30% copper, 0·8–1% iron; energy required, 12–14 kw.-hr./kg.); cupro–silicon–aluminium (55–60% silicon, 15–18% aluminium, 25–30% copper, 1–1·5% iron; energy required, 15 kw.-hr./kg.).—N. A.

The Centrifugal Casting Process as Applied to Non-Ferrous Metals and Alloys. J. E. Hurst (*Met. Ind.* (*Lond.*), 1932, **40**, 88–92).—A full description of the centrifugal casting process applied to the production of brass, bronze, "aluminium–bronze," and nickel–alloy castings and an indication of its further developments with other alloys are given. The macro-structure and micro-structure of bronze and "aluminium–bronze" sand-, chill-, and centrifugally-cast are described and illustrated.—J. H. W.

Zinc in Die-Casting. Robert M. Curts (*J. Amer. Zinc Inst.*, 1930, **13**, 52–63).—Read before the American Zinc Institute. See this *J.*, 1930, **44**, 699.—J. H. W.

Design of Automatic Die-Casting Dies. Anon. (*Machinery* (*Lond.*), 1930, **36**, 477–480).—A detailed description of the dies used for producing a carburettor body.—H. F. G.

Permanent Mould and Die-Casting. J. Holmes (*Met. Ind.* (*Lond.*), 1932, **40**, 126).—Abstract of a paper read before the Junior Section, Lancashire Branch of the Institute of British Foundrymen. Briefly describes the making of dies, type of die-casting, and the advantages of permanent moulds.—J. H. W.

Alloys for Pressure-Casting. K. W. Peredelsky (*Liteinoe delo* (*Foundry Practice*), **1931**, (7), 15–18).—[In Russian.] P. gives the composition, mechanical properties, and methods of manufacture of tin, lead, zinc, manganese, aluminium, and copper alloys for pressure-castings.—N. A.

Test on the Operation of a Machine for Pressure-Casting. K. W. Peredelsky (*Liteinoe delo* (*Foundry Practice*), **1931**, (6), 17–20).—[In Russian.] The pressure-casting machine of the Spark Plug Company, and its method of operation are described. The disadvantages of the machine are: (1) air exerts pressure on the whole of the metal and oxidizes it; (2) absence of a regulating device on the high-pressure system which would regulate the air automatically in the event of an incomplete closing of the mould.—N. A.

Steel for Moulds in Pressure-Casting. K. W. Peredelsky (*Liteinoe delo* (*Foundry Practice*), **1931**, (7), 19).—[In Russian.] Ordinary mild steel moulds may be used for casting lead and tin alloys, as they withstand 30,000–50,000 castings. For zinc alloys, nickel–chromium or chromium–tungsten steel moulds may be employed.—N. A.

Preparation of Moulds for Pressure-Casting. K. W. Peredelsky (*Liteinoe delo* (*Foundry Practice*), 1931, (9), 19–20).—[In Russian.] In designing moulds for castings the following factors must be taken into consideration: (1) number of castings and their distribution; (2) position of the castings with respect to the joints in the moulds; (3) designed runners, and arrangements for feeding the metal and removal of air from the moulds; and (4) design and arrangement of cores. An analysis of all the above is given, together with a review of the method of manufacture of the moulds.—N. A.

Calculations in the Foundry. Harry W. Dietert (*Met. Ind.* (*N.Y.*), 1931, **29**, 380–382).—A series of formulæ is deduced for determining the area of the choke, the pouring time, the static pressure, the thickness of the gate, and the size of the sprue.—A. R. P.

Practical Points on Dowelling Methods. J. H. S. (*Machinery* (*Lond.*), 1930, **36**, 182).—Practical notes on the accurate positioning and sizing of dowel holes.—H. F. G.

Some Observations on Preparation and Use of Synthetic Sand. L. B. Knight (*Trans. Amer. Found. Assoc.*, 1931, **39**, 718–727; discussion, 727–728).—The use of synthetic sand, which has increased extensively in the past few years, has emphasized the need for information as to how this material can best be prepared. Mechanical mixing to coat the sand grains with the bonding material is a necessity. Many foundries have found it advantageous to start their rebonding programme with facing sands, later extending the work to the entire quantity of sand used. To use this material, definite standards of permeability, bond strength, and moisture must be established and maintained. An illustration of the practice in one plant is cited. The development in continuous systems is discussed, showing the different methods used.—S. G.

Relation between Shape and Grain and Strength of Sand. H. Ries and H. V. Lee (*Trans. Amer. Found. Assoc.*, 1931, **39**, 857–860).—Gives the results of an investigation to determine the affect of grain shape on the strength of foundry sands. Clean sands with varying shapes were bonded with a strong ball clay, and were then tested in green and dry conditions and with varying degrees of hardness of ramming. The data obtained indicate that the mixtures with rounded sand grains showed lower permeability and higher compression, in both the green and baked conditions, than those with angular grains. The authors recommend further work along these lines.—S. G.

Investigation of Materials for Moulds in Bronze Casting. I.—Raw Materials. P. E. Liamin and A. A. Ginzburg (*Liteinoe delo* (*Foundry Practice*), 1930, (3), 9–12).—[In Russian.] Cf. this *J.*, 1931, **47**, 706. Moulding sands from the Moscow region have been studied, the chemical composition, shape of grains, and influence of moisture on the mechanical properties being determined. Medium resistance to compression (0·382 kg./cm.^{2}) was obtained with semi-fat sands containing 4% moisture and maximum breaking stress with a somewhat greater humidity of 5%. With a fat sand, the maximum compression resistance (0·489 kg./cm.^{2}) was obtained with 6% humidity. The finer the texture of the sand, the more moisture is required. Most of the sands tested contained large quantities of injurious impurities such as lime, magnesite, and alkali. As regards sand for cores, the following factors were determined: (1) proportions of the mixture; (2) influence of binders; (3) influence of drying temperature. Strength and gas-permeability tests were used in the investigation. The best results were obtained with a mixture of 3 parts lean sand and 1 part semi-fat sand. The optimum amounts of binders to be added and the drying temperature (400°–600°C.) were also determined. The best results with mixtures of old and new sand were obtained with 30–40% of new sand.—N. A.

The Co-Ordination of the Methods of Testing Moulding Materials. B. P. Selivanov and P. P. Berg (*Liteinoe delo* (*Foundry Practice*), **1931**, (1), 7–10).—[In Russian.] Co-ordination of the methods of testing moulding materials is a necessity. In conformity with the system of the American Foundrymen's Association, specimens 50 mm. in diam., weighing 170 grm., are recommended for strength and permeability tests. In testing for permeability according to the formula $\frac{QH}{T.p.F.}$ care must be taken that the resistance of the air tube between the specimen and the manometer is reduced to a minimum. The construction of a percussion mechanism, which corresponds in weight of dropping parts, height of drop, and number of blows, with American practice does not give a guarantee that specimens with a uniform degree of compression will be obtained.—N. A.

Practical Tests for Foundry Sands. P. Aulich (*Fonderie mod.*, 1931, **25**, 434–435).—Abstract of a paper read before the 6^{e} Congrès Internationale de Fonderie at Milan. A summary of the principal tests for sands used in foundry work.—J. H. W.

An Indirect Method of Determining Humidity by Means of Electrical Conductivity. P. P. Berg (*Liteinoe delo* (*Foundry Practice*), **1931**, (8), 7–8). —[In Russian.] The determination of the absolute humidity of moulding sand by measurement of the electrical conductivity is possible only in mixtures of identical composition; the results even then are inaccurate when the humidity exceeds 8%.—N. A.

Magnetically Operated Moulding Machines. Anon. (*Engineering*, 1932, **133**, 169.—Illustrated article.—W. P. R.

XVI.—FURNACES AND FUELS

(Continued from pp. 197–198.)

FURNACES

On the Standardization of Pulverized Fuel Installations for Non-Ferrous Metallurgical Plants. A. G. Tchlenov (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (8), 1003–1013).—[In Russian.] The selection of the most suitable type of pulverized fuel installation for reverberatory furnaces for copper smelting (and, to a lesser extent, for copper and lead refining) is examined in the light of experience in the treatment of different varieties of Russian coals in various standard types of pulverizers. The effects of the hardness and moisture content of the coals on the efficiency of operation of the pulverizers is discussed and comparative data on the economics of various types of direct and bin-and-feeder systems under Russian conditions are given. As the result of tests carried out at the Kashira electrical generating station, on a "Resolutor" pulverizer treating Tkvibul coal, it is concluded that such an installation can be used satisfactorily in copper plants, if the coal has a low pyrites content and the hygroscopic moisture is 9–11%. This conclusion is of importance in connection with the equipping of the Karsak-Paisk, Karabash, Zangezur, and, especially, Kazmedstroy non-ferrous combines. The design of the "Resolutor" pulverizer is described and various types of the lay-out for the burners and the pipes feeding them are discussed. Finally, the claims of the bin-and-feeder system are mentioned as worthy of further examination.—M. Z.

Continuous Liquid Heating Solvent Heat-Treat[ment] Production Problem for Large Automobile Wheel Manufacturer. W. Gordon Park (*Amer. Gas J.*, 1932, **136**, (1), 35–36).—A combination of furnace employing surface combustion of gas and lead hardening pot for treating 90 truck hubs per hr. is described.—J. S. G. T.

Industrial Furnaces for Gas (continued). L. E. Biemiller (*Amer. Gas J.*, 1932, 136, (1), 32–34).—Cf. *J.*, this volume, p. 130. Thermostatic devices, pyrometers, and thermostatic pilot lights employed with gas-fired furnaces are briefly described.—J. S. G. T.

New Gas-Fired Furnace Fuses High Melting-Point Metals. Palo-Myers, Inc. (*Gas-Age Record*, 1931, 68, 699; *Ceram. Abs.*, 1932, 11, 47).—A new high-temperature furnace for firing highly refractory products made from zirconium oxide, magnesium oxide, and aluminium oxide, and for melting and alloying platinum and other metals with a high melting point employs a style of "double flame conduction" which insures a more complete utilization of the heat contained in the combustion gases. Two cylindrical casings built concentrically one inside the other and made of a highly refractory material (magnesium oxide or zirconia) make up the inner portion of the furnace.—S. G.

Electric Furnaces and their Industrial Applications. L. P. (*Rev. Gén.*, 1931, 42, 417–419).—Contains no new matter.—W. P. R.

Tungsten-Wire Furnaces for Very High Temperatures. W. Fehse (*Tech.-Wiss. Abhandl. Osram. Konzern*, 1930, 1, 326–329).—From *Z. tech. Physik*, 1927, 8, 119–122. See this *J.*, 1927, 38, 652.—v. G.

Ironless Induction Furnaces. (Sir) Robert Hadfield and R. J. Sarjant (*Fuel Economy Review*, 1931, 10, 71–77).—The development of the high-frequency ironless induction furnace is traced from Faraday's discovery of electromagnetic induction down to the present day, reference being made to the work of Schneider, Jacoviello, Northrup, Ribaud, Burch and Davis, Campbell, and Brace, and to work done at the Kaiser-Wilhelm Institute. Costs, power consumption, refractories, and economic factors are briefly discussed, and references to 69 papers on the subject are given.—J. S. G. T.

An Induction Furnace with Ferro-Magnetic Muffle and Automatic Temperature Regulator. R. Perrin and V. Sorrel (*Rev. Mét.*, 1931, 28, 448–452).—The furnace is supplied for a.c. of industrial voltage and frequency, maintains temperatures up to 1100° C., and shows high thermal efficiency. The hollow core of ferro-magnetic material is placed in the magnetic field of a solenoid supplied with a.c. The ferro-magnetic core is surrounded by an envelope of conducting material which is not magnetic at the working temperatures. The magnetic circuit is closed externally by iron laminations. Currents are induced in the conducting envelope and the heat generated passes to the ferro-magnetic hollow core, which is further heated by the Foucault currents and hysteresis cycles. At the Curie point of the hollow core or muffle the induction diminishes sharply, and the heat generated behaves similarly. The sharp variation in heat liberated at the point where the transformation temperature of the muffle is reached is utilized in securing automatic regulation of temperature. The ferro-magnetic core is made in a material giving, by reason of the position of its magnetic transformation, the desired temperature of automatic regulation, and the non-magnetic envelope is made in material selected from a group of non-magnetic materials according to the temperature desired.—H. S.

Large Electric Furnace Installations. I.—Annealing. A. Glynne Lobley (*Metallurgia*, 1932, 5, 123–126).—A description of large mechanically electric furnaces of the resistance type which have been installed principally in the United States to handle products of widely different types. Various types of such furnaces are considered and special reference is made to those for continuous normalizing and to counterflow furnaces. For the annealing of non-ferrous metals between passes in rolling mills, batch-type furnaces are usually installed, and the continuous type of recuperative furnace in view of the increased economy obtained is also being introduced. Continuous recuperative furnaces of the return-flow type are being installed for the finished annealing of brass, and for large-scale aluminium heat-treatment a furnace is constructed 93 ft. long, 24 ft. wide which permits of the handling of shapes up to 90 ft. in length. For the annealing of nickel rods and tubes up to 25 ft. long a 200-kw. double-ended car-type furnace equipped with electric rods and pinion car puller is in use.—J. W. D.

Continuous Electric Annealing Furnace for Metal Bands. Anon. (*Metallwirtschaft*, 1931, **10**, 774).—A furnace for the continuous annealing of metal bands consists of a channel 500 mm. wide curved in the shape of a chain and adapted to compensate for the sagging of the band. In the normal annealing of brass strips at 650°–700° C. the energy consumption is 80 kw.-hr./ton and 6 tons of strip can be annealed in 24 hrs.—v. G.

An Electric Continuous Annealing Furnace. Anon. (*Met. Ind.* (*Lond.*), 1931, **39**, 558).—A description is given of an electric continuous furnace for brass strip, installed at Messrs. Emery Brothers, Ltd., Aston, Birmingham. The furnace is of the vertical type, the strip entering the top, where the furnace is hottest, and passing downwards through a water trough at the bottom. Sagging is thus prevented without the use of complicated friction clutches or undue tension being applied to the strip. The heating units are carborundum glow bars. About 8 cwt. strip per hr. at 5°–650° C. can be annealed. Oxidation is prevented by 2 inclined flaps at the top which act as an air-valve, and by a water-seal at the bottom.—J. H. W.

Electrical Annealing Furnaces of the Metal Industry. Alfred Schau (*Apparatebau*, 1931, **43**, 185–188, 196–198).—Reprint from *Siemens-Z.*, 1931, **11**, 209–218; see this *J.*, 1931, **47**, 410.—M. H.

FUELS

The Fuel Problem. C. H. Lander (*Chem. and Ind.*, 1931, **50**, 546–548).—A review.—E. S. H.

Town's Gas as a Fuel. C. M. Walter (*Gas World* (*Indust. Gas Suppt.*), 1931, **3**, (11), 12–17).—Read at a joint meeting of the North-Western Section of the Institute of Fuel and Manchester District Association of Gas Engineers, Nov. 11, 1931. Economics to be derived from the use of town's gas as fuel in industrial operations are discussed. Amongst subjects discussed are: the ratio of fuel cost to production cost, wastage of material, and heat produced by combustion.—J. S. G. T.

Industrial Uses of Town's Gas. C. M. Walter (*Fuel Economy Rev.*, 1931, **10**, 32–34).—Developments in the application of town's gas to industrial purposes during 1931 are briefly reviewed.—J. S. G. T.

The Utilization of Gas as a Fuel. C. A. Masterman (*Chem. and Ind.*, 1931, **50**, 577–580).—A review.—E. S. H.

Calculating Gas Heating Value from Analysis. J. R. Branham (*Amer. Gas J.*, 1931, **135**, (2), 42–43).—An average difference of only 2 B.th.u./ft.^{3} was found in 16 determinations, experimental and calculated, of the calorific value of the town's gas supply in Washington. The calculated value is probably as accurate as the experimental value in all cases, provided the proper heating value be used for the illuminating constituents of the gas. In the present case this was determined by assigning to the illuminants a value calculated from the first analysis by reference to the experimental value of the calorific value in that case.—J. S. G. T.

Gaseous Combustion in Industry. R. V. Wheeler (*Chem. and Ind.*, 1931, **50**, 550–554).—A review.—E. S. H.

Heat of Combustion of Fuels. Anon. (*Power House*, 1929, **23**, (4), 26–27).—Gives the air requirement and total heat of combustion of a number of fuels.—H. F. G.

Pulverized Fuel: Its Application to Metallurgical Industries. R. Jackson (*Met. Ind.* (*Lond.*), 1931, **39**, 605–608).—Abstract of a paper read before the

Co-ordinated Societies, Birmingham (Birmingham Local Section of the Institute of Metals, Birmingham Metallurgical Society, and Staffordshire Iron and Steel Institute). The history of the use of pulverized fuel in metallurgical furnaces from 1831 is reviewed and Crampton's fundamentals of 1869 are shown still to hold good. These fundamentals are: (1) uniform size of coal particles, (2) intimate mixing of the coal and air, (3) avoidance of impingement on the refractories of burning streams of coal and air, (4) control of the proportions of the coal and air. Pulverized coal-firing is similar to oil-firing, but the fuel costs are considerably lower. Its advantages are complete combustion, perfect control, flexibility, mellow heat, and reduction in labour. It is thus particularly applicable to the smelting and melting of non-ferrous metals. A description of typical furnaces and their operation is given.
—J. H. W.

Discussion on the Industrial Application of Pulverized Fuel. Watson Smith. H. Morgan (*Trans. Manchester Assoc. Eng.*, **1930–31**, 173–192).—W. S., strongly advocating the use of pulverized fuel for metallurgical furnaces, described as the seven chief advantages from this point of view: the cheaper coal which could be used; the rapidity of heating up; that existing furnaces could be easily converted; the ease of manipulation; smokeless combustion; reduced oxidation of the metal in the furnace; and accurate regulation of the temperature. H. M. stated that the difficulties of obtaining a sufficiently fine fuel for metallurgical work had been overcome, and that it was now possible, with wind-swept ball mills, to obtain a material of which 98% would pass a 100-mesh sieve. For roasting metal at 1000° C. he had found that a combustion chamber was unnecessary, and that better results were obtained by firing directly into the furnace; if the fuel were not fine enough, however, trouble due to coking would arise. In the discussion on storage difficulties, W. S. agreed that pulverized fuel was liable to absorb moisture; but a principal cause of caking was the gradual loss, in the bunkers, of the air which was occluded by the material during pulverizing. The difficulty of moving fuel which had been packed tightly in this manner had been overcome by applying air at 90 lb./in.^{2} to the closed bunker, and then opening the ejector and blowing the fuel through the delivery pipe.—H. F. G.

Canadian Nickel Smelter Boasts World's Largest Pulverized-Coal Plant. C. F. Herington (*Eng. and Min. World*, 1931, **2**, 703–705).—Describes the pulverized-coal plant at the Copper Cliff Works of the International Nickel Company of Canada. The plant is designed to serve 5 reverberatory furnaces, each furnace having a capacity of about 1000 tons of concentrates per day. The capacity of the pulverizing plant is 54 tons per working hr.—R. Gr.

The Gyro System of Pulverized Fuel Firing. Anon. (*Fuel Economist*, 1931, **6**, 435).—Installations of the "Gyro" system of pulverized fuel firing to be erected at Randfontein and already erected at Ergobia, Spain, are briefly referred to. The coal used in the latter installation consists largely of dross and refuse from coal washeries.—J. S. G. T.

Calculation of the Calorific Value of Coal. De Cahier (*Gas World*, 1931, **95**, 596–599).—Formulæ proposed for the calculation of the calorific value of coals based on ultimate or proximate analyses are briefly and critically reviewed.—J. S. G. T.

Coal and Coke Breakage and Segregation. E. G. Blackwell (*Amer. Gas J.*, 1929, **130**, (3), 30–33).—Means for effecting economies by the prevention of coal and coke breakage and for counteracting segregation in hoppers and bins are discussed. The Adams system of bin discharge, comprising a vertical rectangular chute extending upwards from the bin grate to the top of the bin and having one side open, is briefly described.—J. S. G. T.

The Sampling of Small Coal. E. S. Grumell and A. C. Dunningham (*Fuel Economy Review*, 1931, **10**, 4–8).—The British Engineering Standards Association specification relating to the sampling of coal for export is briefly and critically reviewed. The methods employed for sampling large and small consignments of coal at the works of Imperial Chemical Industries are briefly outlined.—J. S. G. T.

On the Use of the Electric Furnace for the Determination of Coke and Volatile Matter in Coal. L. Iolson (*Trudi gossudarstvennojo Dalnevostotschnogo Universiteta*, **1929**, Series 13, No. 8, 7 pp.; *Chem. Zentr.*, 1931, **102**, II., 2404). —[In Russian.] A Heræus furnace with temperature regulator is recommended; the best results are obtained by heating at 950° for 7 minutes using 0·5 grm. of coal. The crucibles may be of platinum or of silica, and should be at least 35 mm. high, with an upper diameter of 30 mm.—A. R. P.

Tentative Revisions of A.S.T.M. Standards. Standard Definitions of Terms Relating to Coal and Coke (D 121–30). —— (*Amer. Soc. Test. Mat. Tentative Standards*, **1931**, 936; and *Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 1070).—See this *J.*, 1930, **44**, 720.—S. G.

Tentative Definition of the Term Coke (D 121–30 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, **1931**, 545).—See this *J.*, 1930, **44**, 720.—S. G.

XVII.—REFRACTORIES AND FURNACE MATERIALS

(Continued from pp. 198–201.)

Refractory Materials in Casting Practice. N. N. Rubtzov (*Liteinoe delo* (*Foundry Practice*), **1930**, (11–12), 5–12).—[In Russian.] Refractory materials for casting furnaces are classified as follows: (1) acid-Dinas bricks; (2) basic-shamotte, magnesia, bauxite; (3) semi-acid–quartz-shamotte; (4) neutral–chromite, zircon; (5) carbonaceous–carbon and carborundum. The following properties of refractories are analyzed: resistance to wear; heat capacity; conductivity; constancy of volume; resistance to sharp changes of temperature, resistance to slagging and to chemical corrosion.—N. A.

Trade Names in Refractories and Furnace Construction. Anon. (*Feuerfest*, 1931, **7**, 136–141).—A continuation of the index of trade marks applied to German and non-German refractory materials (see this *J.*, 1930, **43**, 700).—v. G.

Graphite Crucible Plant Meets Unusual Manufacturing Problems. Anon. (*Chem. and Met. Eng.*, 1931, **38**, 282–284).—The manufacture of graphite crucibles is described and illustrated. The Bartley Crucible and Refractories Co., Trenton, N.J., U.S.A., uses only the foliated variety of graphite (from Ceylon), combining it with mixtures of clays, both domestic and imported. Storing, blending, and forming operations are described, the moist clay-graphite mixture being plastered round the inner surface of plaster-of-Paris moulds, by means of a rotating jigger-blade. Smoothing, drying, and firing operations are also described.—F. J.

Insulating Firebrick. Anon. (*Chem. and Met. Eng.*, 1931, **38**, 480).—For lining furnaces (oil- and gas-fired and electric) the Babcock and Wilcox Co., New York, has developed an insulating firebrick of very low thermal conductivity, of refractory qualities comparing favourably with any high-grade firebrick, of low specific heat, and having a sp. gr. only ¼ that of fireclay brick. —F. J.

Refractory Coatings and Cements. L. Litinsky (*Rev. Mét.*, 1931, **28**, 477–502). —Mention is made of a considerable number of proprietary refractory cements and facings. In some cases analyses are given. Methods of application of the cements are described. A full bibliography is appended.—H. S.

Discussion of F. H. Riddle's Paper on "The Possibility of Sillimanite Minerals as Refractories." F. H. Riddle. C. G. Fink (*Trans. Electrochem. Soc.*, 1931, **59**, 50–51).—Cf. preceding abstract. The best "super-refractory" sillimanite bricks settle less than 0·2% at 1520° C. under a load of 50 lb./in.^{2}. The spark plug test is suggested for obtaining an idea of the quality of a material for use as a refractory.—A. R. P.

Shamotte Refractory Materials. B. P. Selivanov (*Liteinoe delo* (*Foundry Practice*), **1931**, (2), 5–8).—[In Russian.] A preliminary estimate of the qualities of shamotte refractories can be made from the colour, large grain-size (1–1½ mm.), resistance to scratching (must not crumble), absence of cracks, behaviour under load at high temperatures (with 1 kg./cm.^{2} the softening point must be at least 1300° C.), and determination of density (2·5 actual). To obtain a good shamotte the material is fired at 900° C., ground to 1·5 mm., made into a paste with a normal clay content of approximately 45%, moulded at maximum pressure, dried at 100° C., and fired at 1300° C.—N. A.

Properties of Clay-Bearing Sands.—I. A. Tchernyshev (*Liteinoe delo* (*Foundry Practice*), **1931**, (9), 7–14).—[In Russian.] The plastic properties of sand depend not only on the clay content but also, to some extent, on the structure of the sandy grains. The cleanliness of the surface of the casting is considerably influenced by the quality of the clay constituent, the nature, quantity, and particle size of special organic admixtures, and to a smaller extent by the size (up to a definite limit) of the sand grains. The clay content cannot be taken as a measure of the binding properties of moulding sands; the adhesion of the clay must also be determined. The deciding factor in tempering is the increased mobility of the colloids composing the mixture. The degrees of plasticity and hardness of the walls of the mould must be mutually adjusted in a definite manner. Addition of alkali or basic salts exerts an important influence in improving the moulding properties of sands. A table showing the various types of clay-bearing sands is given.—N. A.

Talc as a Refractory. Mamykin and Permiakov (*Uralskiy Tehnik* (*Ural Technologist*), 1931, 7, (1), 12–17).—[In Russian.] Talc obtained from different deposits in the Urals differs markedly in macrostructure and chemical composition. The limit of its refractory properties lies at 1640°–1660° C. in an oxidizing, and 1480°–1575° C., in a reducing atmosphere. Contraction in volume at a firing temperature of 1300° C. is 5%. Tests on the thermal stability, by intermittent heating at 850° C. and quenching in water, showed that the specimen could withstand 23 quenches. The hygroscopicity of burnt talc varies between 2·6% and 15%. The compression strength of raw talc is 186·7 kg./cm.^{2}, whilst that of burnt talc is much higher—certain varieties reaching 1080 kg./cm.^{2}. Attempts to use talc for bricks in working furnaces gave good results.—N. A.

On the Influence of Carbon on the Transformation of Silica in Dinas Bricks. V. M. Schvetzov (*Uralskiy Tehnik* (*Ural Technologist*), **1930**, (5–6), 36–39).—[In Russian.] Magnesia and alumina in Dinas bricks hinder the transformation of amorphous silica into well-defined crystalline tridymite. Lime apparently assists the formation of cristobalite. All modifications of carbon favour crystalline transformation of quartz into tridymite at the temperature of brick-kilns, and into cristobalite at the temperature of the Martin's furnace.—N. A.

Measurements of the Heat Conductivity of Refractory Materials. H. Golla and H. Laube (*Tonind.-Zeit.*, 1930, 54, 1411–1414, 1431–1432, 1458–1460).—Most refractories have a positive temperature coefficient of thermal conductivity, but special refractories made from mullite, magnesia, alumina, zirconia, and carborundum have negative coefficient.—A. R. P.

Researches on the Slagging of Refractories. VI.—Researches on the Corrosive Power and the Constitution of Metallurgical Slags. Hermann Salmang and Joseph Kaltenbach (*Feuerfest*, 1931, **7**, 161–169).—The corrosive action of fused metal oxides, mixtures of metal oxides, and silicate slags containing various metal oxides on a fireclay crucible has been determined at 1300°–1500° C. Of the free oxides, cuprous oxide is the most aggressive, followed in order by litharge, ferrous oxide, antimony pentoxide, and ferric oxide. In basic and neutral ferrous silicate slags equal weight percentages of other oxides attack fireclay to an extent which decreases in the order: lime, cuprous oxide, litharge, baryta, ferrous oxide, nickelous oxide, stannous oxide, alumina, ferric oxide, antimony pentoxide, silica, nickelic oxide, zinc oxide, stannic oxide, chromic oxide.—v. G.

The Permeability of Refractory Materials to Gases.—I.-II. F. H. Clews and A. T. Green (*Gas J.*, 1931, **196**, (Suppt. Oct. 28), 21–22).—22nd Report of the Refractory Materials Joint Committee of the British Refractories Research Association. (I.)—There appears to be no definite relationship between the percentage porosity and the permeability to gases in the case of fireclay, silica, and diatomaceous refractory materials. The porosity of a straight silica product is greater than that of an average fireclay product; also the permeability of the former is, on the whole, greater. A diatomite insulating brick of 70% porosity gave, with one exception, the lowest permeability to gases. The mechanism of permeability is briefly discussed. (II.)—The permeability to nitrogen of 5 fireclay, 5 silica, and 1 siliceous material has been measured at temperatures up to 500° C. With increase of temperature the permeability decreases, and this is almost wholly accounted for by the increase of viscosity of the gas with increase of temperature.—J. S. G. T.

The Action of Carbon Monoxide on Refractory Materials. I.-II. W. Hugill, H. Ellerton, and A. T. Green (*Gas J.*, 1931, **196**, (Suppt. Oct. 28) 23–24).—22nd Report of the Refractory Materials Joint Committee of the British Refractories Research Association. (I.)—There is apparently no relationship between the "iron" content of a brick and its tendency to disintegrate under the action of carbon monoxide, when heated. Possibly the iron compound or compounds, separable in bromoform, play an important part in the disintegration process, which may, in some way, be associated with the development of blue-black crystals in the cavities of the "iron-spots." (II).—Refractory materials have been subjected to the action of carbon monoxide for 200 hrs., and the results indicate that disintegration is largely controlled by: (1) the character of the ferruginous matter contained in the refractory; (2) the permeability of the refractory; (3) the strength and elasticity of the matrix of the brick; and (4) the "internal strength" of the grog in the mass. The ferruginous material, separable in bromoform, is shown to be responsible for carbon deposition, and hence for eventual disintegration of the refractory.—J. S. G. T.

A Comparison of the Rates of Flow of Water and of Air through Refractory Materials. F. H. Clews, E. O. Mills, and A. T. Green (*Gas J.*, 1931, **196**, (Suppt. Oct. 28), 22–23).—22nd Report of the Refractory Materials Joint Committee of the British Refractories Research Association. Results of water penetration and water permeability tests with refractory materials indicate that when the materials are placed in order of increasing penetrability, they are also in order of increasing permeability to water, and very nearly in the same order as that of increasing permeability to air.—J. S. G. T.

XVIII.—MISCELLANEOUS

(Continued from pp. 202–204.)

Improvements in Non-Ferrous Metals and Alloys for Chemical-Engineering Purposes. Anon. (*Indust. Chemist*, 1931, **7**, 435–437).—A review of recent developments in the production of copper, "aluminium bronzes," copper-silicon alloys, nickel, silver, aluminium, lead, tantalum, alloys for high-temperature service, and electro-deposited coatings.—E. S. H.

Value of Research in Non-Ferrous Metals. H. W. Gillett (*J. Amer. Zinc Inst.*, 1930, **13**, 64–72).—See this *J.*, 1930, **44**, 731.—J. H. W.

Use of Cast-Iron in the Non-Ferrous Industry. A. L. Norbury (*Met. Ind.* (*Lond.*), 1931, **39**, 587–590).—Read before the Swansea Local Section of the

Institute of Metals. The use of cast-iron in the non-ferrous industry is considerable, examples being for structural work and piping, melting pots and furnace, ingot moulds, rolls, annealing boxes, and machinery generally. The nature of the metal used for these purposes and the effects of impurities on its strength and the requirements of the metal for various applications are discussed.—J. H. W.

The Unfavourable Position of the Manufactured Article Industry in Non-Ferrous Metals and its Cause. von Schönebeck (*Demizet*, 1931, **47**, 180–181). —S. replies to criticism of a paper with the above title reported in *Demizet*, 1930, **46**, 1358, and the critic comments on the reply.—J. H. W.

Durability. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1931, **7**, 162–163). —A discussion of the metallurgical bearings of considerations of quality and life in relation to obsolescence of engineering products. The demand for cheaper, more easily worked materials requires progress in the development of improved methods of manufacture, treatment, and testing.—R. G.

Preventing Anti-Friction Bearing Troubles. Elmer Zitzewitz (*Blast Fur. and Steel Plant*, 1931, **19**, 1471–1472).—The protection of anti-friction bearings against corrosion, grit, and dirt, while in stock, is advocated. The speeds above which oil should be used or below which grease should be used as a lubricant cannot be defined, but, in general, oil is preferable for high speeds, grease for low speeds. " When in doubt, use oil." The lubricant should be non-hygroscopic, so that it will not absorb moisture, which causes corrosion. A number of other points are given on the care and upkeep of bearings.—R. Gr.

The Technical Development of Aluminium in the Last Ten Years. P. Scherber (*Demizet*, 1931, **47**, 77, 79, 80).—An account is given of the rapid progress in the metallurgy of aluminium that has taken place since the Great War.—J. H. W.

The Aluminium Industry in Canada. R. E. Parks (*Engineering J.*, 1930, **13**, 486).—Recently developed uses for aluminium include: the manufacture of shingles, ridge roll doors, window-frames, stair treads, decorative hardware, I-beams, railway and street cars, and sleeping-cars. Other uses are side rods for locomotives, collapsible tubes for toilet preparations, foil for chewing gum and chocolate, acid tanks, turpentine stills, transmission cables, aeroplane parts, bronze powder, and furniture.—H. F. G.

Aluminium Research Program Extended. Anon. (*Automotive Ind.*, 1930, **63**, 13–14).—Describes a research programme initiated in the new research laboratories of the Aluminum Company of America. Light alloy structures and fittings are a notable feature. Problems now under investigation include paint research, by-product developments, and ageing tests on Alclad. The latter are conducted in special tanks in an atmosphere of steam and salt spray. Microtechnical and testing equipments are described, fatigue testing receiving special attention. The properties of alloys at high temperatures are being investigated, as are cutting and machining problems.—P. M. C. R.

Aluminium and Health. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1931, **7**, 74).—A review of an Intelligence Memorandum dealing with the " toxicity " of aluminium and including a bibliography, issued by the British Aluminium Co.—R. G.

Cobalt Discovery in Westphalia. (*Times Trade and Eng. Suppt.*, 1931, **28**, (687), 537).—Investigation at the " Philipps Hoffnung " cobalt mine in Westphalia which was worked some 200 years ago has led to the discovery of what promises to be an important deposit of cobalt ore. 1 ton of earth containing the ore yielded 3·6 grm. of gold, 9·3 grm. of silver, 2·33% of cobalt, 0·32% of copper, and 3·6% of arsenic.—S. V. W.

Debismuthizing Lead with Calcium. Ralph F. Cohn (*Trans. Electrochem. Soc.*, 1931, **59**, 107–112; and *Indust. Australian*, 1931, **85**, 309–310).—See this *J.*, 1931, **47**, 246 and 627, and following abstract.—S. G.

Discussion on R. F. Cohn's Paper on "Debismuthizing Lead with Calcium." W. Kroll. Louis S. Deitz, Jr. Ralph F. Cohn (*Trans. Electrochem. Soc.*, 1931, **59**, 112–113).—Cf. preceding abstract. The process reduces the bismuth content of lead to a minimum of 0·04%, and is therefore of little value in Europe, as the limiting bismuth content in lead is there less than 0·001%. About 0·2% calcium is required to reduce the bismuth in lead from 0·2% to 0·04%.—A. R. P.

The Influence of Sulphur Compounds on the Extraction of Nickel by the Carbonyl Process. C. M. W. Grieb and R. H. Jones (*J. Inst. Chem.*, 1931, (v), 291).—Abstract of a lecture to the South Wales Sections of the Institute of Chemistry and the Society of Chemical Industry. An active nickel sulphide is a very efficient promoter of the rate of extraction of nickel by means of carbon monoxide, and all substances which react to introduce such a nickel sulphide into the matte are suitable.—E. S. H.

Platinum in Canada. Anon. (*Indian Eng.*, 1931, **90**, 51).—The output of the precious metals refinery of the Mond Nickel Co. at Acton has been increased from 40,000 to 300,000 oz. per annum owing to the discovery of platinum and other rare metals in the Sudbury district, Ontario. The principal metals, other than platinum, are palladium, iridium, osmium, rhodium, and ruthenium. —P. M. C. R.

Attempt to Systematize a Method of Melting Fine Precipitated Tin Powders. W. A. Vaniukov, N. N. Muratch, and A. P. Genvarsy (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1931, **6**, (2), 204–210).—[In Russian.] In the process of recovering tin from tinplate scrap, the latter is treated with chlorine and the resulting stannic chloride distilled off, reduced to stannous chloride, and the tin precipitated as a grey powder by means of zinc. The powder has a tin content of about 79%, and consists of very fine granules which cannot be fused to give pure tin without a high loss of metal owing to oxidation. Attempts to carry out the fusion under a protective layer of fusible slags consisting of various inorganic salts (potassium cyanide, calcium chloride, sodium sulphate, and sodium chloride) did not give higher yields than 50–60%, although an excellent result was obtained with calcium chloride in the case of a coarse crystalline precipitate of electrolytic tin. With a high-melting organic protective layer, such as petroleum pitch or colophany, a 90% yield of pure tin globules was obtained. An alternative method is to carry out the fusion in a reducing atmosphere, *e.g.* a current of coal-gas. Under such treatment, the mass separates into bright globules of pure tin (99·55%) and a dark, fine powder, passing through a 250-mesh sieve, and containing tin (89·5%) is obtained. The former may be further fused (for casting) under a layer of calcium chloride and the fine powder under an acid borate slag. The yield of tin by this method is about 87%.—M. Z.

Zinc from Slag by New Process. Anon. (*Compressed Air Mag.*, 1931, **36**, 3465).—Molten slag from lead blast furnaces contains the mixed silicates and oxides of zinc, iron, and calcium : a process of treatment with powdered fuel causes separation of zinc, and the vaporized zinc oxide is separated. The output from one plant is as much as 70 tons a day.—P. M. C. R.

General Points of View for the Patentability of Alloys. F. Herzfeld (36. *Hauptversammlung Deut. Bunsen-Ges.*: "*Fortschritte der Metallkunde und ihre Anwendungen auf Leichtmetalle*," **1931**, 125–128).—The law as regards patenting of alloys in Germany is briefly discussed.—A. R. P.

The Adherence of Lubricating Films to Metallic Surfaces. Augustin Boutaric (*Ann. combustibles liquides*, 1931, **6**, 443–458; *Compt. rend.*, 1931, **193**, 593–594; *C. Abs.*, 1932, **26**, 586).—The weight (p) of oil adhering to a piece of metal after a certain time of centrifuging (t) depends on the initial weight (p_0) and the final weight (π) after a long time of centrifuging. The relation is as follows: $1/(p - \pi) = 1/(p_0 - \pi) + mt$. For oils of low acidity

$p_0\pi$ and the factor m are practically independent of the kind of oil or metal, but are dependent on the viscosity of the oil. The acidity of the oil has an influence when the metal is sensitive to the action of acid.—S. G.

Purification of Wastes from the Metal Working Industries. A. Reich (*Zentr. Gewerbehyg. Unfallverhüt.*, 1929, **16**, 276–280; *C. Abs.*, 1932, **26**, 545).—The wastes from copper, brass, wire, zinc, silver, and other plants are briefly considered from the point of view of purification and possible reclamation. Free acids are readily removed by treatment with CaO. Copper may be removed from the wastes by the Göpferts or Wolfsholz processes or by plating out on iron. Distillation must be resorted to fully to purify many of these trade wastes.—S. G.

Waste Metal—A Huge Industry. Anon. (*Chem. and Met. Eng.*, 1931, **38**, 540).—Secondary metals, *i.e.* those recovered from scrap metal, sweepings, skimmings, and drosses, have become increasingly important in recent years. More than 500,000 short tons of copper are recovered annually from brass and other scrap metal. Secondary lead production amounts to approximately 300,000 short tons, equal to 40% of the total refined primary lead produced. A table is given showing the quantities and values of various non-ferrous metals and alloys recovered in the years 1929 and 1930. There was a considerable decrease in 1930 compared with 1929.—F. J.

Fittings Control the Life of Metallic Tubing Subjected to Vibration. R. L. Templin (*Automotive Ind.*, 1931, **65**, (2), 50–51).—Resistance to vibrational fatigue should influence the choice of material for tubing. The design of supports and fittings is of great importance. Laboratory fatigue tests are reliable and mutually comparable only if made with standard fittings. Accelerated tests may give utterly misleading results, and comparative curves of endurance tests on copper and light alloy tubing are quoted in support of this statement.—P. M. C. R.

Standard Thicknesses, Weights, and Tolerances of Sheet Metal (Customary Practice). —— (*U.S. Bur. Stand. Circular* No. **391**, 1931, 1–32).—This circular is intended to furnish information as to the usual practice of American manufacturers with regard to stock thicknesses or weights of sheets and plates of common metals and alloys, but it does not promulgate these data as standards. The stock list of thicknesses or weights to which plates and sheets of a given metal are rolled, constitutes what is known as a gauge. There are various gauges for sheet metal in the U.S.A. The information and data included in this circular pertain to the specific applications of these gauges to various metals and alloys. There are also included gauges or stock lists for sheet metal widely used in Europe, particularly in England, France, and Germany, and in Japan. The circular also contains information regarding manufacturing tolerances adopted by American technical societies, manufacturers' associations, and standardizing bodies, or used by leading manufacturers.—S. G.

Screw-Nails for Fastening Sheet Metal to Wood. Anon. (*Railway Mech. Eng.*, 1929, **103**, 165).—The screw-nails described, which are made by the Parker–Kalon Corporation, N.Y., have hardened spiral threads and needle points, and can therefore be driven through relatively heavy sheet metal. Their holding power is 4 times that of ordinary nails.—H. F. G.

Determination of Cross-Sections from Diameter Measurements. I. Runge (*Wiss. Abhandl. Osram-Konzern*, 1930, **1**, 170–178).—The problem of calculating the cross-sectional area of a rod from a number of diameter measurements is strictly not soluble unless it is assumed that the cross-section is such that the two halves coincide when one is turned 180° about a vertical axis, *i.e.* if the centres of all diameters coincide. Area calculations from diameter measurements made in two directions at right angles to one another may for example be inaccurate by as much as 1–2% if the diameter measurements vary by about 4%.—v. G.

New Process for Bonding Metals. A. E. B. (*Sci. American*, 1931, **145**, 63–64).—W. P. R.

Waste Waters from Metal Goods Factories and their Purification. —— Mohle and —— Biesterfeld (*Tech. Gemeindebl.*, 1931, **34**, 165).—Largely devoted to treatment of wastes containing copper.—S. G.

Some of the Newer Uses for Silicon Carbide. Charles McMullen (*Trans. Electrochem. Soc.*, 1931, **59**, 81–86; and (abridged) *Indust. Australian*, 1931, **85**, 339–340).—Owing to its high heat conductivity and melting point, silicon carbide is used extensively for tubes for heat regenerator systems; the tubes are made of the powdered carbide with a suitable binder, and are glazed to render them impermeable to gases. The "Carboradiant" combustion chamber is simply a silicon carbide box into which is injected the proper mixture of air and fuel; the chamber is used in heat-treating and annealing furnaces where a uniform heat distribution is required throughout the furnace. Silicon carbide resistors are extensively used in electric furnaces operating up to 1500° C.—A. R. P.

Temperature Distribution in Solid Bodies during Heating or Cooling. J. B. Austin (*Physics*, 1931, **1**, (2), 75–83).—Most treatments of the problem of temperature distribution in a solid during heating or cooling assume that the change of surface temperature is either instantaneous or varies linearly with time. It is found that in many practical cases the change of surface temperature varies exponentially with time. Equations for the distribution of temperature within a body when the surface is heated in accordance with this exponential relation have been derived for: (1) a rectangular parallelopiped (brick); (1*a*) rectangular rod; (1*b*) slab; (2) cylinder; (2*a*) cylindrical rod; (3) sphere. The equations also represent the general case of diffusion under the given boundary conditions and apply to such problems as the diffusion of one metal into another.—J. S. G. T.

The First International Congress on Aerial Safety. J. Cournot (*Rev. Mét.*, 1931, **28**, 469–476).—The work of the Committee on Materials is discussed. Under the heading "Materials," forging, rolling, and casting alloys, magnesium-rich alloys, beryllium, and antifriction alloys are mentioned in this *résumé*. Reference is made to Vedal, described by M. Matter as Duralumin sheet protected on each face by a thin film of aluminium of extra-high purity. A *résumé* of contributions on methods of testing including determination of elastic limit, hardness tests, shock tests, cupping tests, wear tests, fatigue tests, mechanical tests on materials of low capacity for deformation, dilatometric analysis, and X-ray examination, is given. In the section dealing with corrosion, reference is made to standardization of tests, to the work of the Aeronautical Committee on Corrosion, to Parkerization, and Protalization. The latter is a process applied to aluminium-rich alloys, and consists of simple immersion in boiling aqueous solutions of salts of metals possessing 2 valencies. The higher salt gives an alkaline salt soluble in alkaline solution, and the lower an oxide insoluble in alkaline solution. Aluminium in contact with the boiling alkaline solution liberates hydrogen which reduces the soluble oxide to insoluble sub-oxide which forms the protective coating. Resolutions of the Committee are given.—H. S.

The Vibrations of Revolving Shafts. R. C. J. Howland (*Phil. Mag.*, 1931, [vii], **12**, 297–311).—The alleged occurrence of large vibrations in shafts run at a speed $\Omega_1/2$, where Ω_1 is the first whirling speed, is examined mathematically, and it is shown that, in accordance with experience, the phenomenon is sporadic. "Shaft-whipping" at speeds above Ω_1 is also investigated, and the results are shown not to support Kimball's theory. Alternative explanations are suggested, but no final conclusion is reached.—J. S. G. T.

Spectroscope Identification of Telephone Wire. Anon. (*Instrument World*, 1931, **4**, (44), 150).—The Government analyst of Ceylon reports the detection of stolen telephone wire by spectroscopic tests carried out with a quartz spectroscope.—J. S. G. T.

What is "Probable Error"? J. F. Tocher (*Inst. Chemistry* (Special Publication), 1931, 1–63).—A lecture on the application of statistical mathematics to physical and chemical determinations, especially analysis.—E. S. H.

Some Aspects of Research in Applied Physics. Herbert E. Ives (*J. Eng. Education*, 1931, **22**, 82–89).—I. considers that the satisfactory development of practical applications is too often belittled as against the conduct of pure research. A practical solution to an urgent problem is often available before the underlying theory can be completely investigated. Cases in point are quoted, and the equiparent training and mental attitude of the worker in applied physics are discussed.—P. M. C. R.

A Method for the Survey of Industry. W. Soderholm (*Army Ordnance*, 1930, **11**, 199–204).—An article may be described not merely by its name and function, but in terms of the machines and machine-hrs. required for its production. In illustration of this principle, a very full and detailed analysis is given of the operations necessary for the production of a specified model of gunner's quadrant.—H. F. G.

Economy in Production. W. B. Challen (*Indian and Eastern Eng.*, 1930, **67**, 205–206).—See this *J.*, 1930, **44**, 675.—P. M. C. R.

XIX.—BIBLIOGRAPHY

(Continued from pp. 205–208.)

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

American Oil Burner Association. *Handbook of Oil Burning.* Pp. 630. New York: American Oil Burner Association.

***Anglo-Oriental Mining Corporation, Ltd.** *Tin. World Statistics*, 1932. Fourth year. Fcap. 8vo. Pp. 137. 1932. London: The Anglo-Oriental Mining and Smelting Corporation, Ltd., 55–61 Moorgate, E.C.2.

***Auerbach, F., und Hort, W.** Herausgegeben von. *Handbuch der physikalischen und technischen Mechanik.* Bearbeitet von K. Andress; F. Auerbach, R. Baumann, K. Bennewitz, R. Berger, E. Berl, R. Beyer, W. Block, O. Blüh, E. Bollé, W. Braunbek, H. Croseck, W. Deutsch, G. Duffing, O. v. Eberhard, V. W. Ekman, E. v. Ende, E. Everling, F. Exner, G. Flügel, Ph. Frank, H. Freundlich, H. Fromm, R. Fuchs, R. Fürth, W. Gaede, J. W. Geckeler, C. Göcke, H. W. Gonell, L. Graetz, B. Gutenberg, W. Hahn, O. Hecker, A. Hertwig, W. R. Hess, F. Horn, W. Hort, F. Hülsenkamp, G. Joos, A. Korn, O. Kratky, H. Lorenz, O. Martienssen, O. Meisser, P. Neményi, Fr. Noether, H. Riessner, K. Safranez, J. Schmekel, E. Schmid, O. Schwarz, A. Seligmann, R. Skutsch, A. Smekal, P. Stephan, H. Steuding, K. Stöckl, K. v. Terzaghi, S. Timoshenko, K. Wagner, G. Wassermann, F. Weinig, K. Weissenberg, und M. Winkelmann. Sup. Roy. 8vo. Band I, Lief. 1–3. Pp. 787, with 523 illustrations in the text. (Br. R.M. 80; geb. R.M. 84). Band II, Lief. 1–2. Pp. 673, with 453 illustrations in the text. (Br. R.M. 75; geb. R.M. 79.) Leipzig: J. A. Barth.

***Billiter, Jean.** *Technische Elektrochemie.* Band III.—*Schmelzfluss-Elektrolyse (Alkalimetalle, Erdalkalimetalle, Magnesium, Aluminium, Beryllium, u.s.w.).* 2. umgearbeitete und vermehrte Auflage. Med. 8vo. Pp. vii + 196, with 72 illustrations. 1932. Halle (Saale): Wilhelm Knapp. (Br. R.M. 12.50; geb. R.M. 14.)

***British Aluminium Company, Ltd.** *Aluminium in the Rubber Industry.* 7 in. × 9 in. Pp. 17, illustrated. (No. 344.) 1932. London: British Aluminium Co., Ltd., Adelaide House, King William St., E.C.4. (Gratis.)

***Canadian Manufacturers' Association, Inc.** *Canadian Trade Index.* Annual Issue of 1932. Comprising five parts. Roy. 8vo. Pp. 868. 1932. Toronto: Canadian Manufacturers' Association, Inc., 14th Floor, 67 Yonge Street. ($6.00.)

Canning, W., and Co. *The Canning Practical Handbook on Electroplating.* Eleventh edition. Pp. 329. Birmingham: W. Canning and Co.

***Dammer, Otto.** Begründet und in erster Auflage herausgegeben von. *Chemische Technologie der Neuzeit.* In zweiter, erweiterter Auflage, bearbeitet und herausgegeben von **Franz Peters** und **Herm. Grossmann.** Unter Mitwirkung von -Alexander, -Arndt, -Baudrexel, -Baumhauer, -Beck, -Berdel, -Bergander, -Bertelsmann, -Börnstein, -Brecht, -Bresser, -Brieger, -Brisker, -Brode, -Bujard, -Classen, -Cohn, O. Dammer, -Davidsohn, -Durst, -Eger, -Endell, -Engelhardt, -Evers, -Eyer, -Faust, -Ferenczi, E. J. Fischer, (Reg. Rat. Dr.) -Fischer, -Friedrich (Biebrich), -Friedrich (Stassfurt), -Geibel, -Gerhardt, -Geuther, -Goehring, -Graefe, -Haegermann, v. Hagen, -Heiduschka, -Henkel, -Herzfeld-Hoffmann, -Herzfeld-Wuesthoff, R. Hoffmann, -Jaeckel, -Junkmann, -Kast, -Kausch, -Kissling, -Knigge, -Kolb, -Koschmieder, -Kreth, -Krifka, -Kühle, -Kuttenkeuler, -Leitner, -Lohmann, -Luhmann, -Meyer, Jakob Meyer, Alfred R. Meyer, -Muth, -Napthali, P. Neumann, -Perndanner, -Rammstedt, -Riemann, -Ristenpart, -Rocha-Schmidt, -Rübencamp, -Rüdiger, -Sander, -Savelsberg, -Schall, -Schauwecker, Erich Schmidt, Max Schmidt, -Schmitz-Dumont, -Schnegg, -Schrauth, v. Schwarz, -Sembach, -Serger, -Springer, -Stahl, -Stephan, -Stooff, -Valenta, -Willstaedt, -Wipfler, H. Wolff, -Wulff, und -Wüstenfeld. Fünf Bände. II Band, 1 Teil. 4 to. Pp. xvi + 876, with 607 illustrations. 1932. Stuttgart: Ferdinand Enke. (Geh. R.M. 75; geb. R.M. 79.)

***Enderlein, G.** *Sächsische Zinnbergwerke.* (Schriftenreihe "Deutsches Museum, Abhandlungen und Berichte." 3. Jahrg., Heft 4.) Demy 8vo. Pp. 127–158, illustrated. 1931. Berlin: VDI-Verlag G.m.b.H. (R.M. 1.)

***Endo, Yositosi.** *Atomic Heat at Constant Pressure of Crystalline Substances.* (Report of the Aeronautical Research Institute, Tôkyô Imperial University, No. 71.) Imp. 8vo. Pp. 71–82. 1931. Tôkyô: Koseikai Publishing Office, Yûrakutyô, Kôdimati-Ku. (Yen 0.12.)

***Engineering.** "*Engineering*" *Directory.* 79th edition. With Glossaries in German, French, Italian, and Spanish. Compiled and classified from the current advertisements in *Engineering.* Pp. 212. 1932. London: *Engineering*, 35 and 36 Bedford Street, W.C.2.

***Ferguson, R. F.** *Sieve Analysis for Refractory Materials.* (American Refractories Institute, Technical Bulletin No. 31.) Med. 8vo. Pp. 7. 1931. Pittsburgh, Pa.: American Refractories Institute.

Findlay, Alexander. *The Phase Rule and its Applications.* Seventh edition. Pp. 342. 1932. London: Longmans, Green and Co. (10*s.* 6*d.* net.)

Gáspár, Margit. Compiled by. *Bibliography of the Hungarian Scientific Works*, 1901–1925. Part X, 1.—*Chemistry* (in Hungarian, with titles in German also). Pp. 334. Budapesth: Royal Hungarian University Press. (25 pengö.)

***Goto, Masaharu; Fukuta, Sin-ichi; Horiguchi, Sadao, and Nagai, Tenji.** *Über die Herstellung und die mechanischen Eigenschaften der Al–Cu–Si Legierungen.* (Report of the Aeronautical Research Institute, Tôkyô Imperial University, No. 73.) [In Japanese, with German abstract.] Imp. 8vo. Pp. 141–217, with 41 illustrations. 1931. Tôkyô: Koseikai Publishing Office, Yûrakutyô, Kôdimati-ku. (Yen 0.56.)

***Gregory, Edwin.** *Metallurgy.* With an introduction by C. H. Desch. Demy. 8vo. Pp. xv + 284, with 188 illustrations. 1932. London and Glasgow: Blackie and Son, Ltd. (17*s.* 6*d.*)

Hobart Brothers Company. *Electric Arc Welding.* Pp. 80. Troy, Ohio: Hobart Brothers Co.

***Hodgen, Joseph Dupuy.** *Practical Dental Metallurgy. A Text and Reference Book for Students and Practitioners of Dentistry, Embodying the Principles of Metallurgy, and their Application to Dentistry, Including Experiments.* Revised by **Guy S. Millberry** and **John S. Shell.** Seventh edition. Demy 8vo. Pp. 470, with 86 illustrations. 1932. London: Henry Kimpton, 263 High Holborn, W.C. (18*s.* net.)

v. Hoyer, Egbert, und Kreuter, Franz. *Technologisches Wörterbuch Gewerbe, Industrie, Technik und ihre wissenchlaftl. Grundlagen. . . .* Sechste vollkommen neubearbeitete Auflage, herausgegeben von Alfred Schlomann. 3 Bände. Imp. 8vo. Band I.—*Deutsch, Englisch, Französisch.* Pp. xii + 795. 1932. Berlin: Julius Springer. (R.M. 78.)

***Judge, Arthur W.** *Engineering Materials.* Volume II.—*Non-Ferrous Metals and Organic Materials.* Being a thoroughly revised edition of "Aircraft and Automobile Materials (Non-Ferrous)." Med. 8vo. Pp. xi + 822, with 268 illustrations. 1932. London, Bath, Melbourne, Toronto, and New York: Sir Isaac Pitman and Sons, Ltd. (40*s.* net.)

Linde Air Products Company. *Purox Manual. Instructions for Welding and Cutting by the Oxy-Acetylene Process.* Second edition. Pp. 150. New York: The Linde Air Products Co.

***McLean, D. A., Peek, R. L., Jr., and Schumacher, E. E.** *Some Physical Properties of Wiping Solders.* (Bell Telephone System Technical Publications, Monograph B–641.) Med. 8vo. Pp. 25, with 8 illustrations. 1932. New York: Bell Telephone Laboratories. [Reprinted from *Bell System Technical Journal,* 1932, **11**, 101–125.]

***McClelland, E. H.** *Review of Iron and Steel Literature for 1931.* A Classified List of the More Important Books, Serials and Trade Publications during the Year; with a Few of Earlier Date, not Previously Announced. (Reprinted from *Blast-Furnace and Steel Plant,* January–February, 1932.) Cr. 8vo. Pp. 27. 1932. Pittsburgh: Carnegie Library.

***Maurer, Edward R.,** and **Kelso, L. E. A.** *Friction of Some Babbitt, Roller, and Ball Bearings.* (Bulletin of the University of Wisconsin, Engineering Experiment Station Series No. 72.) Med. 8vo. Pp. 48, with 60 illustrations in the text. 1931. Madison, Wis.: University of Wisconsin, Engineering Experiment Station. (50 cents.)

Merseau, Samuel Foster. *Materials of Industry, their Distribution and Production.* With an introduction by A. L. Colson. 8vo. Pp. xviii + 478, illustrated. 1931. New York: McGraw-Hill Book Co., Inc. ($2.00.); London: McGraw-Hill Publishing Co., Ltd. (12*s.*).

Metallgesellschaft A.G. *Statlische Zusammenstellungen über Aluminium, Blei, Kupfer, Nickel, Quecksilber, Silber, Zink, und Zinn.* 32 yr. Pp. 91. Frankfurt: Metallgesellschaft A.G.

***Meyer, Hermann.** *Lehrbuch der allgemeinen mechanischen Technologie der Metalle.* Sechste, neu bearbeitete Auflage. Demy 8vo. Pp. viii + 332, with 402 illustrations. 1931. Leipzig: Max Jänecke. (Kart. R.M. 6; ganzleinen, R.M. 7.20.)

***Murex Welding Processes, Ltd.** *Handbook for Electric Welders.* Demy. 8vo. Pp. 75, with 21 illustrations. [1932.] London: Murex Welding Processes, Ltd., Ferry Lane Works, Forrest Road, Walthamstow, E.17. (1*s.* net.)

Offinger, Heinrich. *Technologisches Taschenwörterbuch in 5 Sprachen.* Abt. 2.—*Deutsch–Französisch–Italienisch.* Band 2.—*Französisch–Deutsch–Italienisch.* 9 veränder. u. verb. Auflage von **Helmut Krenkel.** Pp. 216. 1932. Stuttgart: Poeschel. (Lw. M. 6.)

***Research.** *Research Service for Industry.* (Department of Engineering Research, University of Michigan, Engineering Research Circular No. 5.) Med. 8vo. Pp. 38, with 31 illustrations. 1931. Ann Arbor, Mich.: Director, Department of Engineering, University of Michigan.

Robertson, T. Brailsford. *Spirit of Research.* Pp. 210. Adelaide: Preece and Sons.

Rossman, Joseph. *The Law of Patents for Chemists.* Demy 8vo. Pp. ix + 304. 1932. Washington, D.C.: The Inventions Publishing Co. ($3.50.)

Royal Society of London. *Year-Book of the Royal Society of London,* 1932. Demy 8vo. Pp. vi + 208. 1932. London: Harrison and Sons, Ltd. (7*s.* 6*d.*)

***Saeger, C. M.,** and **Ash, E. J.** *A Method for Determining the Volume Changes Occurring in Metals during Casting.* (U.S. Department of Commerce, Bureau of Standards Research Paper No. 399. Reprint from *Bureau of Standards Journal of Research,* Vol. 8, January, 1932.) Med. 8vo. Pp. 37–60, with 14 illustrations. 1932. Washington, D.C.: Government Printing Office. (10 cents.)

Seely, Fred B. *Advanced Mechanics of Materials.* Med. 8vo. Pp. xi + 331. 1932. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. (31*s.* net.)

***Shorts, R. Perry.** *The Value of Research to Industry.* (Department of Engineering Research, University of Michigan, Circular Series No. 4.) Med. 8vo. Pp. 16. 1930. Ann Arbor, Mich.: Director, Department of Engineering, University of Michigan.

Swietoslawski, Wojciech. *Chemja fizyczna.* Tom IV.—*Elektrochemja.* Pp. 285. Warsaw: Trzaska, Evert i Michalski.

Thurow, Willy H. *Englisch–Deutsch und Deutsch–Englisch Wörterbuch der Chemie.* Teil 2.—*German–English.* Pp. x + 287. 1932. Berlin-Schöneberg: Tetzlaff. (Lw. M. 14.)

Treadwell, F. P., et W. D. *Manuel de chimie analytique.* Tome I.—*Analyse qualitative.* Cinquième édition française, traduit d'après la quatorzième édition allemande par **M. Boll.** Ex. Cr. 8vo. Pp. xx + 629, with 3 plates. 1932. Paris: Dunod. (68 francs.)

***Van Leuven, E. Perry.** *Cold Metal Working; an Introductory Course to the Metal Trades.* Med. 8vo. Pp. x + 275, with 159 illustrations. 1931. New York: McGraw-Hill Book Co., Inc. ($2.25); London: McGraw-Hill Publishing Co., Ltd. (13*s.* 6*d.* net).

Waché. *Contribution à l'étude de la dissolution de l'aluminium et de ses alliages dans les acides.* 1932. Paris: Gauthier-Villars et Cie. (Broché, 15 francs.)

***Weidlein, Edward R.,** and **Hamor, William A.** *Science in Action. A Sketch of the Value of Scientific Research in American Industries.* Med. 8vo. Pp. xlii + 310, with 32 illustrations. 1931. New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd. (18*s.* net.)

***Welding.** *Les Organismes de l'Acétyléne et de la Soudure autogène.* Med. 8vo. Pp. 48, illustrated. [1932.] Paris: Office central et Institut de l'Acétyléne et de Soudure autogène, 32 Boulevard de la Chapelle.

***Welding and Cutting.** *Notions pratiques de soudure autogène, oxy-acétylénique, et d'oxy-coupage. Suivies de* 150 *questions et problèmes de la pratique.* Demy 8vo. Pp. 112, with 100 illustrations in the text. [1932.] Paris: Office central de la Soudure autogène, 32 Boulvard de lea Chapelle. (6 francs.)

XX.—BOOK REVIEWS

(Continued from pp. 140–144.)

Plasticity. A Mechanics of the Plastic State of Matter. By A. Nádai, assisted by A. M. Wahl. (Engineering Societies Monographs). Revised and enlarged from the First German Edition. Med. 8vo. Pp. xxiii + 349, with 397 illustrations. 1931. New York: McGraw-Hill Book Co. Inc. ($5.00); London: McGraw-Hill Publishing Co., Ltd. (30*s*. net).

Considerations of the plastic state of matter are to-day of very considerable interest in many branches of science and engineering, and the physicist and metallurgist are particularly concerned with the laws of plastic flow. Up to the present, however, the literature of the subject has never been adequately reviewed and summarized in a single volume, and the present work is extremely opportune and welcome; it is particularly fitting that this book has emanated from one who has achieved a world-wide reputation for research into plasticity problems. The treatment is complete and detailed, the mathematical and experimental aspects being developed and discussed in close relation, and illustrated by a large number of diagrams and photographs.

After a preliminary discussion of the solid and plastic states of matter, the properties of materials and their controlling factors, stress and strain conditions for equilibrium, the criteria governing the plastic limit and failure are discussed with the various theories which have been advanced. Strain and flow figures are treated in detail, and it is shown what valuable information these afford of stress distribution, particularly in sections containing discontinuities. Plastic torsion then receives consideration and the combined use of the Prandtl soap-film and the sand-heap analogies for determining the stress distribution in bars, some parts of which are stressed beyond the elastic limit is discussed: the correlation obtained by Fry's etching methods is very remarkable, and this is a feature of the whole subject which will be of absorbing interest to metallurgists. The plastic bending of bars, and the behaviour of tubes under internal pressure, are treated, assuming an arbitrary law of deformation with, and without, considerations of work-hardening. This leads to a treatment of the rise and spread of plastic yielding in rotating discs and members subjected to combined stresses. From the sliplines in two-dimensional problems the case of a plastic mass pressed between two rough plates is reached: experimental results obtained from clay and plaster support the analytical conclusions. Hardness testing and the flow lines produced by indenting cylinders and balls are discussed. Stresses induced by surfaces in contact are investigated using analytical, photo-elastic, etching, and recrystallization methods. Residual stresses in cold-drawn and cold-rolled bars are treated from plastic considerations and compared with experimental results obtained from Heyn's method: this is another section of especial interest to metallurgists. The influence of temperature on elasticity and plasticity is discussed with special attention to "creep" phenomena.

Part II, consisting of five chapters, is devoted to the application of the mechanics of the plastic state to geology and geophysics. A close correspondence is revealed between the changes in structure in severely deformed metals and the slow processes occurring during the formation of certain rocks: the same principal factors are involved.

This book meets an urgent need and can be recommended with confidence to the attention of engineers and metallurgists.—H. J. GOUGH.

Mechanical Testing. A treatise in two volumes by R. G. Batson and J. H. Hyde. Volume I: **Testing of Materials of Construction.** Second and enlarged edition. Demy 8vo. Pp. xv + 465, with 259 illustrations. 1931. London: Chapman and Hall, Ltd. (21*s*. net.)

In the decade which has passed since this book was first published, many important changes have occurred, both in the methods employed in the testing of materials of construction, and in the development of new testing machines and instruments designed to imitate more closely the apparatus employed in practice than the more approximate methods adopted hitherto. The authors state that the object of the book is to present to technical engineers, manufacturers, and students the conditions governing modern testing, together with particulars of standard testing plant and its limitations, and such information as will enable the results obtained to be apprised at their true value. In doing so, they have produced a book which will be an invaluable aid to all whose work necessitates some form of commercial testing to determine if materials are produced to the standards of the specifications required. The progress which has brought about changes in methods of testing has been largely due to the developments taking place in engineering and in constructional practice, such as increase in temperatures and pressures, the increase of power in prime movers without increasing weight, and the reduction of weight in all types of structures. This progress has necessitated a more rigid examination and inspection in the selection and choice of materials, and specifications have been issued by the British Engineers Standards Association, in some of which recommendations made previously by the authors have been included, on Brinell hardness numbers, grey iron castings, notched-bar impact tests, methods of testing timber, concrete flags and kerbs, &c.

In the testing of cast iron particular reference is made to the adoption of the cylindrical test bar by Great Britain, America, and Germany, to the test methods which have been adopted to obtain uniformity with castings of various thicknesses, and to the fatigue testing of cast iron, all of which have been developed during the last 5 years. In fatigue testing rapid methods of determining the limiting ranges of stress of materials under reversals of shear stress or reversals of tensile stress are fully described, and the results of tests for certain non-ferrous material by such methods are given. The chapters on hardness and abrasion testing, and on impact and notched-bar testing have been enlarged considerably to include in the former a description of such new testing instruments as the Hardometer, the Rockwell hardness tester, the constant diameter hardness indicator, and the pendulum hardness tester, and in the latter machines for slow bending and repeated bending impact tests, and for rapid impact fatigue tests. In view of the developments of high temperatures in modern engineering, a very important and valuable chapter is that dealing with the effect of temperature on the mechanical properties of metals. Testing apparatus is described for the determination of the limit of proportionality and yield-point at high temperature as well as for the ultimate tensile strength, and results of tests on iron, steel, alloy steels, and various non-ferrous alloys are given. Apparatus for prolonged loading tests by various methods for the determination of creep in ferrous and non-ferrous alloys are fully dealt with, and also apparatus for the determination of hardness, impact, alternating stress, repeated stress, and short-time torsion tests, at varying temperatures. Considerable space is also devoted to the testing of timber, stone, brick, concrete, road materials, and limes and cements.

The book is excellently produced, well indexed, and in addition to being illustrated by 259 illustrations consisting of detail sketches and a large number of fine photographs, contains 92 tables giving the results of tests, many of which will be of considerable interest to those engaged in non-ferrous metallurgy. At the end of each chapter there is also an admirable series of references.—J. W. DONALDSON.

Die Dauerfestigkeit der Leichtmetall-Sandguss-Legierungen. (The Endurance of Light Casting Alloys.) Von Walther Saran. Roy. 8vo. Pp. 87, with 56 illustrations. 1931. Darmstadt: Pfeffer und Balzer. (M. 6.65.)

The alloys discussed are typical " German " and " American " alloys, a piston alloy with 14 per cent. copper, Silumin, Lautal " L.IV," K.S.-Seewasser, Alufont, and Elektron AZG. The last three were cast in green-sand and the others in dry-sand. The Alufont alone was heat-treated. The Silumin was not completely modified, but no indication is given of its actual structure. A comprehensive table is given at the end of the book showing the results of static mechanical tests, Brinell readings, a repeated impact test, three forms of " fatigue " test, and an impressive selection of " quality ratios." The book itself is a detailed description of the procedure adopted to obtain these figures, particularly of the endurance tests. These consist of a rotary bending test in which the bending moment is constant over the parallel length of the specimen; a repeated torsion test, from which hysteresis curves are given; and a tension-compression test at 30,000 cycles per minute. The last is carried out in an electromagnetic machine, the deformation of the specimen being measured through a telescope and the applied stress calculated from the modulus of elasticity found in the static test. Dr. Saran himself does not seem to have complete faith in the accuracy of this arrangement, and he states in a footnote that the machine was subsequently improved by fitting a dynamometer between test-piece and " counterweight." Stress-reversals curves are given for the rotating bend test, but these are not plotted logarithmically.

Accelerated tests by the Lehr rise of temperature method and the change in rate of deformation and power consumption, were carried out, but the results of these bear no relation whatever to the figures for endurance strength, and Dr. Saran considers that these methods cannot be applied to the light alloys used for castings. He points out that although the static and impact figures for his sample of Silumin are lower than figures quoted for the completely modified alloy, the endurance strength is the same. This conclusion is not, however, based on strictly comparable testing or casting conditions, and needs confirmation. The Elektron gives the best endurance figures and the heat-treated Alufont is only moderate, in spite of its much superior static figures.—H. W. G. HIGNETT.

Industrial Electrochemistry. By C. L. Mantell. (Chemical Engineering Series.) Med. 8vo. Pp. viii + 528, with 178 illustrations. 1931. New York: McGraw Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd. (30*s*. net.)

The literature of the subject of applied electrochemistry has in recent years received a number of important contributions. From the British press there has emanated a volume which is known to every student. We refer to Allmand and Ellingham's " Applied Electrochemistry," which comprehensive treatment will for a long time constitute a standard work. But the subject of the application of electrical energy to chemical and metallurgical processes is one which is undergoing expansion and transformation. While the general theory is stabilized, practice progresses. The development of industrial electrochemistry must necessarily witness the evolution of a number of processes of a limited duration of application, these soon being doomed to give place to others of a more advanced type or offering a greater degree of economy.

Some books on the subject have to some extent suffered by over-emphasis of these transient phases. A work was required which would present to us modern practice rather than the stages of evolution through which modern methods have become possible. In our view the volume under review meets this need. In it a serious attempt has been made to cover all the well-recognized departments of the subject, including electrodeposition, electrolytic refining, electrolytic and electrothermal methods of extracting metals, and of the production of a number of chemical compounds together with some aspects of the electrochemistry of gases.

In spite of the size of the volume, no process seems to be over-elaborated. The details of any process must naturally be sought in original papers. Yet the broad outlines presented, together with the limited bibliography, give a good indication of what counts in the industry to-day. For example, numerous methods and types of furnaces have been devised for the production of calcium carbide, but few are in commercial operation to-day. The accompaniment of works data and photographs will give the student some assurance that he is studying a process which is not—like so many described in the usual text-book—obsolete. Having acquired some knowledge of current practice, he can, at will and leisure, refer to the historical aspect.

It would be an altogether too lengthy task to individualize on the matter treated, but the broad sections include technical electrochemistry, electrolytics, and electrothermics. There is a first section covering general theory, essential to an appreciation of the processes described, while towards the end of the volume a chapter deals with the engineering problems associated with the industry together with a brief discussion on power generation and economics, a vital matter.

The volume thoroughly justifies the important place which it will inevitably take in the technical library.—S. FIELD.

Ausgewählte Methoden für Schiedsanalysen und kontradiktorisches Arbeiten bei der Untersuchung von Erzen, Metallen und sonstigen Hüttenprodukten.

II. Auflage. Mitteilungen des Chemikerfachauschusses der Gesellschaft Deutscher Metallhütten- und Bergleute. Med. 8vo. Pp. xx + 457, with 14 figures. 1931. Berlin: Gesellschaft Deutscher Metallhütten- und Bergleute e.V. (R.M. 20.)

In this new edition both parts of the first edition have been incorporated into one volume, and the whole work has been brought up to date by including all the important advances made in the analytical chemistry of the metals since the first edition was published in 1924. The book contains a collection of rapid and accurate methods for the analysis of metals, alloys, ores, and metallurgical products, contributed by all the foremost German metallurgical works chemists, and edited by a committee of the publishing Society. The metals dealt with are aluminium, antimony, arsenic, beryllium, lead, cerium, the precious metals, cadmium, cobalt, copper, magnesium, nickel, mercury, selenium and tellurium, bismuth, zinc, tin, and the steel-hardening metals.

Every effort has been made to select only well-tried, rapid, and accurate methods, and in many cases the methods recommended have formed the subjects of careful tests by members of the Committee which has selected the methods. The result is that the book is an invaluable addition to the library of the metallurgical works chemist and consultant. The methods are described in considerable detail, and the effects of possible interfering elements are pointed out where necessary. In the case of ores, methods are given for the determination not only of the principal metal, but also of impurities which may decrease the value of the ore or cause trouble in extracting the desired metal from it. The sections on mercury, selenium and tellurium, and beryllium are included for the first time; in the last-named are described methods for the analysis of nickel, copper, iron, and aluminium alloys containing beryllium, and for the determination of beryllium in beryl and in copper which has been deoxidized by the use of beryllium.

Little change has been made in the methods of analysis of alloys containing platinum, which are still poor, and the method given in the first edition for the determination of tin in tungsten ores is retained, although better methods have been available for more than 10 years. No reference is made to the analysis of resistance alloys of the nickel–chromium type, to the analysis of Widia metal, or to the determination of alkali metals in aluminium alloys. A few references to Part I still appear in the later pages of the book, although, as mentioned above, both of the original parts are included in this volume; otherwise very few, and generally unimportant, misprints have been noticed.—A. R. POWELL.

Probenahme von Erzen und anderen metallhaltigen Verhüttungsmaterialien sowie von Metallen und Legierungen, mit einem Anhang. Mitteilungen des Chemikerfachausschusses der Gesellschaft Deutscher Metallhütten- und Bergleute. Med. 8vo. Pp. 108. 1931. Berlin: Gesellschaft Deutscher Metallhütten- und Bergleute e.V. (R.M. 4.)

This little book is really a second edition of the section on sampling which appeared in the first edition of *Ausgewählte Methoden fur Schiedsanalysen und kontradiktorisches Arbeiten bei der Untersuchung von Erzen, Metallen und sonstigen Huttenprodukten*, and has been omitted from the second edition of this publication reviewed above. In expanding the work into a separate book, opportunity has been taken to incorporate all the latest devices for, and experience gained in, recent years in sampling metallurgical products of all kinds from ore to scrap metal. The appendix consists of three sections giving (A) the commercial tolerances for the impurities in metal residues and other smelter materials, and the limits within which buyers' and sellers' assays are divided, (B) conditions of business adopted by German firms in buying and selling ingot metal, scrap metal, and residues, and (C) American standards for scrap metals. The sampling section (70 pages) contains 20 pages dealing with the principles of ore sampling; the remainder is devoted to the description of the methods adopted in sampling metals and residues.

The text matter is arranged and classified in a style which is admirable for ready reference, and the book is well printed on good paper. All who are engaged in the buying and selling of metallurgical products, as well as samplers and assayers, will find the book an invaluable acquisition.—A. R. POWELL.

A History of the British Chemical Industry. By Stephen Miall. Written for the Society of Chemical Industry on the Occasion of the Fiftieth Anniversary of Its Foundation. With a Foreword by Sir Harry McGowan. Demy 8vo. Pp. xvi + 273, illustrated. 1931. London: Ernest Benn, Ltd. (10*s.* 6*d.*)

In this little volume Dr. Miall has written in his own inimitable style an absorbingly interesting account of the development of the chemical industry in Great Britain during the last 150 years. The book is designed to appeal to the non-technical reader as well as to the chemist, and deals with all branches of the industry, heavy chemicals, dyestuffs, fermentation products, drugs and fine chemicals, cellulose, metallurgy, gas, coke and tar, paints and varnishes, soap and miscellaneous industries, and is prefaced by a foreword from the pen of Sir Harry McGowan, Chairman of Imperial Chemical Industries, Ltd. A number of photographs of the principal pioneers in the industry and some of its present leaders add further to the value of the book as a permanent record of British chemical progress, as also do the chronological tables at the end of every chapter. The metallurgy section extends to only 17 pages, more than half of which are devoted to steel and iron; in the few pages dealing with non-ferrous metals copper, brass, and bronze are dismissed in 4 lines and aluminium in 16 lines! Surely the copper and aluminium industries of this country are worthy of a little more space than this. Again, the chronological table at the end of the Metallurgy chapter is not as complete as it should be, for surely one of the most outstanding advances in non-ferrous metallurgy was the discovery by Wilm of the possibility of increasing the hardness of aluminium alloys by heat-treatment; without this discovery it would have been impossible to produce the important light constructional alloys which have placed aluminium to the forefront in aeronautical construction and have been the reason for the astounding increase in production of the metal since the beginning of this century. Another important discovery was the possibility of modifying silicon-aluminium alloys to produce an exceedingly strong and useful casting material, yet neither of these discoveries is mentioned in the table, although the preparation of aluminium by Deville in 1855 and the development of Hall's process in 1886 are mentioned. The important plating industry receives but scant attention, brief mention only being made of nickel, chromium, and silver plating. Apart from the distinctly one-sided character of the section on metallurgy the book can be thoroughly recommended to all interested in the history of the foundation and development of the British chemical industry.—A. R. POWELL.

Chemical Engineering Catalog. 1931 (Sixteenth Annual) Edition. 4to. Pp. 1017. 1931. New York: The Chemical Catalog Co., Inc. ($10.00 except to special classes of technical men to whom it is loaned gratis or sold at $3.00 per copy.)

Despite the business difficulties created by the present industrial depression throughout the world, the sixteenth edition of this valuable catalogue of American chemical and metallurgical industries fully sustains the deservedly high reputation which has been built up gradually throughout the preceding editions. Every effort has been made to induce space users to supply as much technical matter relating to their products as possible, instead of using their space solely as an advertisement medium; in the present edition these efforts have met with a considerable measure of success, so that the book forms quite a useful work of reference in many directions, especially in the fields of metallurgy and engineering. The scope and style of the book are now so well known as not to require further description; suffice it to say that the very useful "Technical and Scientific Books Section" has been thoroughly brought up to the date of going to press, and, together with its excellent Index, is a most valuable guide to all requiring information as to the most important text-books available in any particular branch of chemistry or metallurgy.—A. R. POWELL.

Chemical German. An Introduction to the Study of German Chemical Literature Including Rules of Nomenclature, Exercises for Practice and a Collection of Extracts from the Writings of German Chemists and Other Scientists and a Vocabulary of German Chemical Terms and Others used in Technical Literature. By Francis C. Phillips. Revised and vocabulary enlarged by James H. De Long. Third Edition. Med. 8vo. Pp. viii + 238. 1930. Easton, Pa. ($3.50 post free.)

This book is designed to assist students of chemistry who have already had a good grounding in the German language to gain an insight into German chemical nomenclature, and to obtain some experience in reading German text-books and periodicals. The sub-title above explains fully the scope of the book; the first five pages deal with the spelling of German chemical terms, followed by a few notes on the nomenclature of the elements and a table of the elements in German. Then follow 11 exercises, interspersed with 5 pages giving the rules of nomenclature for binary compounds, acids, and salts. The student is then given 15 articles in relatively simple German dealing with common operations in chemistry and serving as an introduction to the succeeding 44 extracts from German scientific literature, some of which are written in old German. Finally, there are brief biographies of Agricola, Priestley, Davy, Berthollet, Scheele, Liebig, and Wöhler. All the above are given without any notes in the text, but there are 5 pages at the end of the book in which certain idiomatic expressions are explained and short biographies are given of the chemists mentioned in the text. The book finishes with a 43-page vocabulary chiefly of technical terms and 2 pages of abbreviations frequently found in German scientific literature. Quite a number of abbreviations found in the *Chemisches Zentralblatt* and in lexicons such as Gmelin–Krauts are, however, not included, and some of those given are not in general use in these publications. A few misprints have been found in the text, and a peculiar error is made in the preface, where it is stated that four short articles on famous German chemists have been added to the third edition, among whom is Joseph Priestley. The book should prove useful for college courses in chemical German, but is hardly suitable for students who have no teacher to guide them.—A. R. POWELL.

Verzeichnis der Dr.-Ing.-Dissertationen der Technischen Hochschulen und Bergakademien des Deutschen Reiches in sachlicher Anordnung nebst Namen- und Schlagwort-Verzeichnis 1923 bis 1927. Bearbeitet von Willy B. Niemann und Martin W. Neufeld. Demy 8vo. Pp. vi + 212. 1931. Berlin-Charlottenburg: Robert Kiepert. (R.M. 12.50.)

This book contains a classified index of all the dissertations which have been accepted by the German universities and technical colleges during the years 1923–1927 inclusive, in fulfilment of the requirements for the Dr.-Ing. degree. The entries, which are numbered consecutively to follow on from the previous index for the years 1913–1922, comprise the full name of the author, the title of the paper, number of pages, name of publisher (if printed), and the name of the university conferring the degree with the year. The book contains well over three thousand entries, a complete author index, and a subject index based on the important word in the title. As many of these dissertations, exist only as mimeographed or typed copies in the libraries of the universities or in the various German State libraries, the book should prove of value in directing the attention of research workers to little-known previous work. The authors have taken every care to include every paper for which a degree has definitely been conferred, and the result is a useful reference book which is almost indispensable to all directors of research.

—A. R. POWELL.

The Directory of Shipowners, Shipbuilders, and Marine Engineers. 1932. Thirtieth edition. 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. (20*s*. net.)

The 30th edition of "The Directory of Shipowners, Shipbuilders, and Marine Engineers, 1932," which has been completely revised and enlarged, forms a handy desk companion, and furnishes particulars of all the leading steamship companies, shipbuilders, ship-repairers, and marine engineering works throughout the world. It also gives the names of the directors and principal officials of the companies and, in the case of shipping concerns, details of the fleets. A supplementary section includes a list of societies, institutions, trade and labour federations, and a directory of consulting marine engineers and naval architects. At the end of the volume are exhaustive indexes covering some 25,000 entries.