# METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

## Volume 4

# **FEBRUARY 1937**

Part 2

# I.—PROPERTIES OF METALS

(Continued from pp. 1-3.)

Aluminium. M. Preiswerk (Bull. Assoc. Suisse Elect., 1936, 27, (25), 720-726).—An account of the sources, manufacture, and electrotechnical applications of aluminium, with special reference to the Chippis installation (Valais).—P. M. C. R.

\*Mechanical Calculations for Conductors with Evaluation of Permanent Deformations. N. Vinogradov and L. Torossian (*Rev. gén. Élect.*, 1936, 40, (3), 67–73).—The elongation of various types of aluminium, aluminium-steel, and copper conductors under increasing stress—the stress being maintained at each increment for 15-30 minutes—was studied. The elongation under constant load, applied for periods up to 11 days, was also investigated. The values observed for the modulus of elasticity of the stranded conductors on initial straining and also after loading ("stable value of the modulus") are tabulated and compared with the values for the individual wires. The use of these data in the design of aerial cables is described, and a method is given for determining the factor of safety for conductors in service.—J. C. C.

\*Revision of the Atomic Weight of Arsenic. II.—Synthesis and Analysis of Arsenic Tribromide. J. H. Krepelka and M. Kočnar (*Coll. trav. chim. Tchecoslov.*, 1936, 8, (11), 485-495).—[In English.] Analysis of arsenic tribromide prepared from resublimed arsenic (obtained by reduction of sublimed trioxide with sugar charcoal) and carefully purified bromine, gave a value of 74-923 for the atomic weight of arsenic. This is in close agreement with Aston's value of 74-925 derived from the mass spectrum.—A. R. P.

\*Young's Modulus in Bismuth Crystals. A. B. Focke, R. B. Lindsay, and C. R. Wilks (*Phys. Rev.*, 1936, [ii], 50, (9), 872).—Abstract of a paper read before the American Physical Society. Young's modulus of bismuth single crystals was measured in the two principal crystallographic directions, by determining the velocity of sound in a short, single crystal rod soldered between two longer steel rods. One end of this system was driven by the familiar type of moving coil used in loudspeakers; the other end was free. The sound velocity was computed from the observed distance between two nodes when all or part of the crystal was included between them. Considering one of the nodes to be at a distance  $l_1$  from the nearest steel-crystal junction, the length of the crystal to be  $l_2$ , and the distance of the crystal to the second node to be  $l_3$ , the expression  $k_2l_2 = n^{\pi} - (\eta_1k_1l_1 + \eta_2k_1l_3)$  has been derived, where n is integral.  $k_1 = 2\pi\nu/C_1$ ,  $k_2 = 2\pi\nu/C_2$ ,  $\rho_1C_1S_1/\rho_2C_2S_2$ .  $\tan k_1l_1 = \tan \eta_1k_1l_1$ ,  $(\rho_1C_1S_1/\rho_2C_2S_3)$   $\tan k_1l_3 = \tan \eta_3k_1l_3$ ,  $\nu$  is the frequency,  $C_1$  the velocity of sound in steel,  $C_2$  the velocity in the sample under test,  $\rho$  the density, and S the cross-section of the material (indicated by the subscript). Measurements were made on 4 crystals in which the principal axis was perpendicular to the length of the rod and 3 crystals in which the principal axis was parallel to the rod. The velocities obtained for these crystals were  $C_1 = 2026$  metres/ second, and  $C_{\mu} = 1541$  metres/second. These give for the Young's moduli  $Y_1 = 4.04 \times 10^{11} \text{ dynes/cm.}^2$ , and  $Y_{11} = 2.25 \times 10^{11} \text{ dynes/cm.}^2$ . G.

> \* Denotes a paper describing the results of original research. † Denotes a first-class critical review.

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\*Magnetism and Cold-Working in Metals. II.—Single Crystals of Bismuth, Zinc, and Tin. S. Ramachandra Rao (*Proc. Indian Acad. Sci.*, 1936, [A], 4, (2), 186–203).—Single crystals of bismuth, zinc, and tin were prepared by the method of slow cooling and the influence of cold-working on the principal susceptibilities was investigated. Bismuth crystals showed a decrease in susceptibility, this decrease being of the same order of magnitude as obtained in polycrystals. This is explained by assuming a superstructure of planes, after Goetz and Focke. Zinc crystals showed very small decrease in diamagnetic susceptibility on cold-working. The paramagnetic susceptibility of tin crystals was slightly decreased by tensional stress; this decrease was much smaller than that obtained in polycrystals. This is accounted for as being due to the greater influence of the boundaries of the small crystals (inside the polycrystal) than the interior. The theory of Honda and Shimizu adequately explains these observed changes of susceptibility.—S. G.

\*The Suboxides and Subhalides of Cadmium [Behaviour of Cadmium in Fused Cadmium Chloride]. R. E. Hedger and H. Terrey (*Trans. Faraday* Soc., 1936, 32, 1614–1616).—Molten cadmium dissolves 0.2 mol.-% of cadmium chloride whereby the melting point of the metal is reduced by 3° C. The solubility of cadmium in cadmium chloride increases from 13.6 mol.-% at 570° C. to a maximum of 20.6 mol.-% at 700° C.—A. R. P. \*Fatigue of Oxygen-Cæsium Photo-Cathodes. P. W. Timofejew and N. S.

\*Fatigue of Oxygen-Cæsium Photo-Cathodes. P. W. Timofejew and N. S. Kondorskaja (*Physikal. Z. Sowjetunion*, 1936, 9, (6), 683-691).---[In German.] The photoelectric current emitted by an oxygen-cæsium photoelectric cathode is known to decrease with time when the cathode is exposed to constant illumination. This fatigue phenomenon is attributed to the conversion of atoms of the metal into negative ions under the influence of the illumination, and the migration of these ions into the interior of the cathode under the influence of the field. The irreversible fatigue of oxygen-cæsium cathodes at room temperatures depends on reaction between free cæsium ions and silver oxide residues.--J. S. G. T.

\*Diffusion of Copper in Rock-Salt. S. A. Arzybyschew (*Physikal. Z. Sowjet-union*, 1936, 10, (1), 56–66).—[In German.] The coeff. of diffusion (*D*) of copper ions in rock-salt at temperatures ( $T^{\circ}$  C.) between 590° and 740° C. is found, experimentally, to be given by  $D = 1.07e^{-13,100/T}$  cm.<sup>2</sup>/second.—J. T.

\*A Preliminary Report of Tests Made to Determine the Physical Properties and Clinical Values of Gold and Platinum Foil. R. W. Rule (*J. Amer. Dental Assoc.*, 1936, 23, (1), 93-96).—For certain dental restorations gold foil may be advantageously replaced by a foil made by rolling or beating out a layer of platinum foil inside two layers of gold foil until the composite foil weighs 4 grains/in.<sup>2</sup>. Malleted fillings made from this foil are about 16 Brinell units harder than similar fillings made from pure gold foil. The apparent sp. gr. of the doublé fillings is 17.8 compared with 16.0 for gold foil fillings.—A. R. P.

\*Thermal Expansion Coefficients of Magnesium and Its Alloys. Kiyosi Takahashi and Rimpei Kikuti (*Kinzoku no Kenkyu (J. Study Metals*), 1936, 13, (10), 401-414).—[In Japanese.] The linear coeffs. of thermal expansion of pure magnesium, various binary alloys of magnesium with silver, aluminium, cadmium, copper, nickel, tin, and zinc, and a large variety of commercial alloys of magnesium were determined in the range  $0^{\circ}$ -500° C. by means of the apparatus devised by K. Honda. The effects of the addition of the elements on the coeff.-temperature curves are explained by reference to the equilibrium diagrams.—S. G.

\*The Effect of the Grain-Size on the Mechanical Properties of Extra Pure Magnesium. Jean Herenguel and Paul Lacombe (*Métaux*, 1936, 11, (133), 185-186).—The best conditions of recrystallization of magnesium containing no trace of silicon or iron were investigated. The best annealing temperature for specimens 1 mm. thick after 15% cold-work is 250° C. Above 300° C. the metal is overheated and the mechanical properties decrease rapidly. Between certain limits of grain-size (200-8000 grains/mm.<sup>2</sup>), the tensile strength and elongation varied linearly as the logarithm of the number of grains. For larger structures, the elongation is uniform at a low value.—J. H. W.

\*Action of Carbon Dioxide and Carbon Monoxide on Compact Magnesium at High Temperatures. Robert Delavault (Bull. Soc. chim. France, 1936, [v], 3, (12), 2403-2407).—Molten magnesium oxidizes slowly and uniformly in pure dry carbon dioxide or carbon monoxide. If a trace of water vapour is admitted oxide protuberances from over the surface of the metal but no acceleration in the rate of oxidation takes place.—A. R. P.

\*Some Thermodynamical Values of the Transformations of Iron and Manganese. Kökiti Sano (*Kinzoku no Kenkyu* (J. Study Metals), 1936, 13, (10), 432-436).—[In Japanese.] Some thermodynamical values for the transformations of iron and manganese are calculated from experimental values of heat content obtained by Oberhoffer and Umino.—S. G.

\*Effect of Molecular Nitrogen on Molybdenum at High Temperatures. Paul Túry and Stephen Krausz (*Nature*, 1936, 138, (3486), 331).—It is shown that heating 0.2 mm. molybdenum wircs in nitrogen has a marked effect on their tensile properties, as compared with wires heated in hydrogen, argon, or vacuum. The "nitriding" takes place gradually, its rate being influenced by previous treatment. The total amount of nitrogen sorbed is not more than about 0.007%.—B. C.

\*Distortion of Iron and Molybdenum. E. W. Fell (*Nature*, 1936, 138, (3496), 760).—The cause of the distortion associated with yield in iron and soft steel is discussed, and it is concluded that the effect depends on the mode of distortion of the iron single crystal, and on the small crystal size, which is regarded as facilitating transmission of the distortion through the aggregate. Attempts to confirm this view by similar experiments on  $\beta$ -brass and molybdenum are described.—B. C.

\*Distortion and Yield-Point of Molybdenum. Paul Túry and Stephen Krausz (*Nature*, 1937, 139, (3505), 30–31).—Replying to Fell (preceding abstract) T. and K. state that the cause of yield in certain specimens of molybdenum previously described (abstract above) is due to sorption of nitrogen during heating in nitrogen. Further experiments are described in which the effect of nitrogen is exhibited.—B. C.

\*Thermomagnetic Properties of Nickel Wire.—III. William Band (Proc. Phys. Soc., 1937, 49, (1), 14–16).—A brief report of results of a complete and careful analysis of observations already published on the e.m.f.'s found in nickel wires (Met. Abs., 1935, 2, 456; 1936, 3, 72) is given. The analysis shows that: (1) there is a constant potential gradient susceptibility remaining in the nickel at temperatures well above the Curie point; (2) there is a Villari reversal phenomenon of the potential-gradient susceptibility under different tensional strains, (3) the magnetic change of the Thomson specific heat vanishes, under all tensions, at a definite Curie point corresponding with the temperature at which the potential-gradient susceptibility becomes independent of temperature. Conclusions (1) and (2) indicate that the magnetic change in potential-gradient is not entirely ferromagnetic in origin. These conclusions can be interpreted in terms of Bridgman's theory of thermoelectricity.—J. S. G. T.

\*The Resistance of Palladium and Palladium-Gold Alloys. J. G. G. Conybeare (*Proc. Phys. Soc.*, 1937, 49, (1), 29–37).—The electrical resistances of palladium and palladium-gold alloys containing, respectively, 25, 40, 55, and 65 atoms-% of gold were determined at 90° and 1273° abs. The variation of resistance of the alloys with temperature resembles that of Constantan for alloys containing up to about 60 atoms-% gold, where a change over to the normal type of resistance curve occurs. This result and the results for pure palladium (99.98% purity) agree with deductions from Mott's application of the quantummechanical theory of conductivity to the transition metals.—J. S. G. T.

\*Permeability of Palladium to Hydrogen. VI.—Change in Diffusive Power by Increase in Temperature. Regeneration of Poisoned Palladium. V. Lombard, Charles Eichner, and Maxime Albert (*Bull. Soc. chim. France*, 1936, [v], 3, (12), 2203-2220).—Cf. *Met. Abs.*, 1936, 3, 290. A septum of pure palladium loses the greater part of its permeability to hydrogen by prolonged heating in that gas at temperatures above  $500^{\circ}$ - $520^{\circ}$  C. If the metal is heated at this temperature for some time, then cooled below  $450^{\circ}$ - $500^{\circ}$  C. further reduction of its permeability is arrested so that metal of almost any desired degree of permeability may be prepared by heating foil for various periods at above  $520^{\circ}$  C. and then cooling in hydrogen. Metal which has lost some or all of its diffusive power can be regenerated by heating in air until a good oxide film has formed and then in hydrogen at below  $140^{\circ}$  C. until this film is reduced. —A. R. P.

\*On the Rate Determining Step in the Diffusion of Hydrogen Through Palladium. Adalbert Farkas (Trans. Faraday Soc., 1936, 32, (12), 1667-1679) .--Comparison of the rate of diffusion of hydrogen through a palladium disc and tube with the rate of the conversion of para-hydrogen at  $20^{\circ}-300^{\circ}$  C. under 20 mm. pressure allows conclusions to be reached as to whether and to what extent the reactions occurring at the metal-gas boundary determine the rate of diffusion. Two characteristic cases were found: (a) the para-hydrogen conversion is 3-4 times quicker than the diffusion and its dependence on temperature is the same as that of diffusion; (b) the conversion is very much faster and has a smaller temperature coeff. than the diffusion. In (a) the boundary reaction (dissociation of the hydrogen molecule) and in (b) the actual transfer of the hydrogen atoms in the bulk of the metal determines the rate of diffusion. The two sides of the tube or disc may have entirely different catalytic activities though the rate of diffusion does not depend on the direction of diffusion; energies of activation of a palladium disc showing this behaviour have been determined. These results are used to explain why hydrogen diffuses so rapidly through metals in electrolysis; the hydrogen is liberated in atomic form and hence no hindrance to diffusion is presented by the energy of activation for dissociation.-A. R. P.

\*The Thermionic Emission of Platinum. L. V. Whitney (*Phys. Rev.*, 1936, [ii], **50**, (12), 1154–1157).—The thermionic emission from round filaments and flat strips of platinum was studied, and gave a work-function of  $5\cdot32$  v., and  $32 \text{ amp./cm.}^2/\text{deg.}^2$  for the constant A. Reliable results are obtained only under the highest possible vacuum conditions, and with heat-treatment at nearly 2000° K. Lack of these precautions probably accounts for the abnormally high values of A previously found. Special theoretical explanations for platinum are no longer necessary.—W. H.-R.

\*Photoelectric Sensitization of Potassium by Hydrogen. James J. Brady and Joseph H. Rochel (*Phys. Rev.*, 1936, [ii], 50, (9), 870).—A note. The effect of admitting traces of hydrogen to very thin films of potassium (of the order 1 molecular layer) was studied with reference to the selective photoelectric effect. The results indicate that the selective photoelectric effect is caused by isolated layers of potassium held away from the underlying metal surface by a layer of potassium hydride. The sensitization of a potassium photoelectric cell by means of a hydrogen discharge is effective only for thick layers of potassium; with very thin layers, the admission of hydrogen destroys the photoelectric effect completely.—W. H.-R.

**†Silver : Its Properties and Industrial Uses.** B. A. Rogers, Irl C. Schoonover, and Louis Jordan (U.S. Dept. Commerce, Nat. Bur. Stand. Circ. No. 412, 1936, 72 pp.).—Data are given in tables and graphs and in the text for the mechanical, thermal, electrical, thermoelectrical, magnetic, optical, and chemical properties of silver, together with up-to-date information on the working, annealing and structure, equilibrium diagrams, and properties of binary alloys of silver with aluminium, cadmium, copper, lead, tin, and zine, and industrial uses of silver in chemical and electrical equipment and for bactericidal purposes. *Bibliographies* are attached to the various sections.

-A. R. P.

\*The Heat Capacities of Silver, Nickel, Zinc, Cadmium, and Lead from - 80° to 120° C. H. L. Bronson and A. J. C. Wilson (Canad. J. Research, 1936, [A], 14, (10), 181-193) .- Cf. following abstract. The mean heat capacities over 10° intervals from - 80° to 120° C. were determined. The average deviation of the points from a smooth curve was in each case less than 0.1%and it is believed that the absolute values are not in error by more than this The method used was the adiabatic electric heating of 1 kg. or more amount. of the metal in an all-copper jacket. The following equations have been found to fit the curves with maximum deviations of about 0.1%; silver  $C_{\rho} = D(220/T) + 1.233 \times 10^{-5}T^{1.16}$ ; nickel  $C_{\rho} = D(372/T) + 3.64 \times 10^{-0}T^{5/3}$ ; zinc  $C_{\rho} = D(235/T) + 3.75 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmium cadmiu cadmium  $C_{\rho} = D(160/T) + 9.63 \times 10^{-6}T^{3/2}$ ; cadmiu  $10^{-7}T^{5/3}$ ; lead  $C_{\rho} = D(88/T) + 3.06 \times 10^{-5}T^{1.383}$ , where D(0/T) is the Debye function and the units are joules/grm./° C. A discussion of the theoretical basis for the equations is given together with some calculations of heat capacities using data (coeffs. of expansion, compressibility, &c) involving no measurement of heat. As a matter of interest and for purposes of comparison, tables of heat capacities at 10° interval are given for each metal. Quadratic or linear equations are also given which fit the experimental curves within 0.25%. -S. G.

\*The Heat Capacity of Silver and Nickel between 100° and 500° C. H. L. Bronson, E. W. Hewson, and A. J. C. Wilson (*Canad. J. Research*, 1936, [A], 14, (10), 194–199).—Cf. preceding abstract. The mean heat capacities between 0° C. and various temperatures from 100° to 500° C. were determined by the method of mixtures, an all-copper adiabatic calorimeter being used. A brief discussion deals with the difficulty of obtainining accurate results of the values of the true heat capacity,  $C_{\rho}$ , from the mean heat capacity,  $\bar{C}_{\rho}$ , measurements. A brief summary of the results is given below :

 $\begin{array}{c} 100^{\circ}. \ 150^{\circ}. \ 200^{\circ}. \ 250^{\circ}. \ 300^{\circ}. \ 350^{\circ}. \ 400^{\circ}. \ 450^{\circ}. \ 500^{\circ} \text{C}.\\ \hline \text{Silver}\\ \hline \overline{C}_{\rho} & . \ 0.2364 \ 0.2376 \ 0.2389 \ 0.2401 \ 0.2415 \ 0.2427 \ 0.2420 \ 0.2542 \ 0.2452 \ 0.2465 \\ \hline C_{\rho} & . \ 0.2389 \ 0.2413 \ 0.2439 \ 0.2463 \ 0.2490 \ 0.2514 \ 0.2540 \ 0.256 \ 0.259 \\ \hline \text{Nickel} \end{array}$ 

 $\overline{C}_{\rho}$  . 0.4536 0.4636 0.4741 0.4856 0.4972 0.5117 0.5162 0.5177 0.5188  $\overline{C}_{\rho}$  . 0.474 0.495 0.517 0.543 0.575 0.627 0.531 0.529 0.527

The uncertainty in  $\overline{C_{\rho}}$  of both silver and nickel is about 0.2% in  $C_{\rho}$  of silver from about 0.2% at 100° C. to nearly 1% at 500° C., in  $C_{\rho}$  of nickel from about 0.5% at 100° C. to 2% at 350° C. and above.—S. G.

\*Reflectivity of Evaporated Silver [and Aluminium] Films. Hiram W. Edwards and Robert P. Petersen (*Phys. Rev.*, 1936, [ii], **59**, (9), 871).—A note. Pure silver films have been deposited on glass by evaporation in a vacuum, and show higher reflection coeffs. than those from silver deposited by other methods. Reflection coeffs. for different coloured lights for these films and for films of aluminium prepared similarly are tabulated; the coeffs. for silver are always the greater.—W. H.-R.

\*The Spectral Properties of the Anomalous Optical Constants of Thin Silver Sheets. H. Murmann (Z. Physik, 1936, 101, (9/10), 643-648).—The refractive indices, transmission ratios, and reflecting powers of thin sheets of silver for various wave-lengths from 1050 to 265 m $\mu$  are given. The sheets varied from 29.4 to 5.22 m $\mu$  in thickness. The cause of the variations of these properties, and their departure from those of silver in bulk, is discussed.—B. C.

The Optical Constants of Thin Silver Sheets. F. Goos (Z. Physik, 1936, 101, (9/10), 702).—G. points out that differences between the results of Murmann (preceding abstract) and G.'s carlier results were due to differences in the thicknesses of the sheets used.—B. C.

Absorption of Thermal Neutrons in Silver at Low Temperatures. V. Fomin, F. G. Houtermans, I. W. Kurtschatow, A. Leipunsky, L. W. Schubnikow, and G. Shchepkin (*Physikal. Z. Sowjetunion*, 1936, **10**, (1), 103–105).—[In German.] Data relating to the absorption of the *C*-group of neutrons by silver at temperatures between 20.4° and 290° abs. are presented and discussed.—J. S. G. T.

\*Critical Values of the [Magnetic] Field and Current Characterizing the Superconductivity of Tin. L. W. Schubnikow and W. I. Chotkewitsch (*Physikal. Z. Sowjetunion*, 1936, **10**, (2), 231-241).—[In German.] A current is found to destroy the superconductivity of a ring of tin when the value of the currentfield at the surface attains a critical value,  $H_{\kappa}$ . In external fields, the superconductivity is destroyed when the tangential component of the field attains the critical value,  $H_{\kappa}$ . In external magnetic fields the superconductivity of a ring in which a current flows, is destroyed when the sum of the tangential component of the external field and the current field at any one point of the surface of the ring attains the critical value  $H_{\kappa}$ . J. S. G. T.

\*Positive and Negative Thermionic Emission from Tungsten. H. B. Wahlin and L. V. Whitney (*Phys. Rev.*, 1936, [ii], 50, (8), 735–738).—The positive and negative thermionic emission, and the rate of evaporation of neutral atoms were studied for well out-gassed tungsten. The heat of evaporation of neutral atoms is 8.44 e.v. The filament after heat-treatment for 1200 hrs. up to 2300° K., gave a reproducible electron work-function (determined from a Richardson plot) of 4.55 e.v., with the constant A = 75 amp./cm.<sup>2</sup>/deg.<sup>2</sup>. After flashing the filament at 3100° K., the work-function increased to 4.63 e.v., with A = 212. The average positive ion work-function was 11.93 e.v. These values agree with the relation deduced by L. P. Smith (*J. Inst. Metals*, 1930, 44, 462),  $H + I = \psi_{0-} + \psi_{0+}$ , where *H* is the heat of evaporation of neutral atoms, *I* the ionization potential, and  $\psi_{0-}$  and  $\psi_{0+}$  the electron and positive work-functions, respectively. In order to fix a temperature scale, the spectral emissivity for  $\lambda = 0.669 \mu$  was determined for a cylinder heated in a vacuum, and was constant and equal to 0.46 from 1200° to 2200° K.—H.-R.

Colloid Chemical Phenomena in Metals.-III. J. A. Kliachko (Kolloid-Beihefte, 1936, 44, (8/12), 387-426; Sci. Abs., 1936, [A], 39, 1248).-The fundamental problems of present-day metallurgy are briefly discussed, particular attention being devoted to the properties and structure of fluid metals, deformation of solid metals, recrystallization, and ageing. The inadequacy of the classical concepts in interpreting many of these problems is demon-strated. The hypotheses of Smekal and Zwicky concerning the real structure of crystals are criticized, and a micellar hypothesis is developed to account for the structure of fluid and solid metals and alloys which has none of the objections of the former theories. It is assumed that the building up of a metal crystal takes place by two distinct types of binding (primary and van der Waals' type) and that there are two types of inner surface: (a) an intermicellar and (b) an intra-micellar surface. This hypothesis is useful for solving other important problems, and a number of examples are given. The colloid phenomena in metals are finally subdivided into 3 systems : (a) metal-metal; (b) metal-non-metal; and (c) miscellanous, examples of which have been given (see Met. Abs., 1936, 3, 237).-S. G.

†Cohesive Forces in Metals. N. F. Mott (Sci. Progress, 1937, 31, (123), 414-424).—M. explains briefly, and without the introduction of abstruse mathe-

matics, how quantum mechanics has been employed to calculate the energy of a metal and thence to deduce expressions for the specific volume, lattice energy, and compressibility of metals. Theoretical values of the compressibility of the alkali metals agree satisfactorily with experimental value; in the cases of copper, silver, and gold the theoretical values are much too large. It is suggested that the ions in these latter metals are relatively larger than the ions in the alkalis. The Hume-Rothery rule of alloy structures, as deduced by Jones, is briefly explained. Values of the electron/atom ratios at which the  $\alpha$  and  $\beta$  structures become unstable are deduced.—J. S. G. T.

Mechanics of Solid Bodies.—I. T. Poschl (*Die Physik*, 1936, 4, (4), 131– 144; *Sci. Abs.*, 1936, [A], **39**, 1257).—A summary of literature on the mechanical properties and behaviour of solids is given under the headings: (I) The elastic region—(a) clastic constants, (b) elasticity of crystals, (c) measurement of strain, (d) fundamental equations of the theory of elasticity, (e) pressure and tension on bodies of different shape, (f) bending of rods and plates, (g) bending of discs, tubes, and sheets, (h) torsion, and (i) elastic stability and fracture. (II) Beyond the elastic region—(a) elastic limits, (b) yield-points, (c) flow, (d) viscosity, (e) plasticity and resistance of crystals, (f) improvement by coldworking, (g) fracture, (h) endurance characteristics, (i) fatigue resistance, (j) elastic secondary effects, (k) corrosion, (l) rolling and drawing, and (m) welded seams.—S. G.

\*The Plastic Deformation of Metals and the True Ultimate Strength. Yasumasa Tani (*Rikwagaku-Kenkya-jo Ihō* (*Bull. Inst. Phys. Chem. Res.*), 1936, 15, (9), 937–950).—[In Japanese.] In the introduction, T. explains the hardening accompanied by plastic deformation of pure metals as follows : in the course of plastic deformation atoms in the crystals slightly change their relative positions by slipping so as to minimize the probability of slipping, and this new configuration is maintained as a quasi-stationary state even after the external load is removed, and this state corresponds to the so-called "internal stress." On this assumption, T. explains the Bauschinger effect and deduces the quantitative relation between the temperature of recrystallization and the degree of hardening, which agrees well with experimental results. Further, T. deduced the following approximate relation between the plastic elongation and tensile stress, which is verified by the short-time tensile tests :

# $\log (l/l_0) = p^2/p'^2 \quad . \quad . \quad . \quad . \quad (1)$

where  $l_0$  is the initial strength, l is the length after elongation, corresponding to the stress p, and p' is a constant which depends on the kind of metal and the testing temperature and is proportional to the true ultimate tensile strength of the metal. It is also found theoretically that this true ultimate tensile strength is expressed as a function of the melting temperature, the lattice constant, and the characteristic temperature of the metal. It is confirmed experimentally that regular deviations, with common tendency, from the formula (1) which appear in all the experimental results are due to the changes of the direction of minute crystals in the metal which take place in the course of plastic deformation. A relation is also deduced between the stress and the amount of plastic deformation by compression or torsion. These relations are given by formula of the same type as (1).—S. G.

\*The Effect of Specimen Form on the Resistance of Metals to Combined Alternating Stresses. H. J. Gough and H. V. Pollard (*Proc. Inst. Mech. Eng.*, 1936, 132, (549-573).—The resistance to combined fatigue stresses of a normalized mild steel, and a hardened and tempered alloy steel was examined using both solid and hollow (ratio of diameters D/d = 1.25) specimens. Owing mainly to stress redistribution effects, the fatigue limits of the hollow specimens are lower than for solid specimens. The difference is small (0-4%) for cycles of reversed plane bending stresses, and greater (71-10%) for cycles of reversed shear stresses. The fatigue limits of the hollow specimens under all combinations of stress are still represented by the simple relationship (an ellipse quadrant)  $f^2/f_1^2 + q^2/q_1^2 = 1$  previously found (Gough and Pollard, *Met. Abs.*, 1936, 3, 371) for solid specimens; f and q refer, respectively, to the applied bending and torsional stresses at the fatigue limit of the combination, whilst  $f_1$  and  $q_1$  denote the fatigue limits under simple bending and pure shear. The ellipse quadrant may, therefore, be used in the design of hollow crankshafts, &c.

-W. H.-R.

\*Note on Fracture. Harold Jeffries (Proc. Roy. Soc. Edinburgh, 1936, 56, (2), 158-163).—The conditions determining the fracture of a solid are discussed with special reference to the work of Anderson (Proc. Roy. Soc. Edinburgh, 1936, 56, 128) on geological phenomena, and of Taylor (Proc. Roy. Soc., 1934, 145, 1). There is no inconsistency between the Mieses-Taylor theory and that of Anderson since they refer to different stages in fracture. The form of the fracture surfaces is determined by changes of stress arising during fracture, and not by the original distribution of stress.—W. H.-R.

On the Elastic Constants of an Anisotropic Solid. Milton S. Plesset and Richard F. Baker (*Phys. Rev.*, 1936, [ii], **50**, (4), 399).—Brief abstract of a paper read before the American Physical Society.—S. G.

On the Maximum Mechanical Thermal and Electrical Stresses of Bimetals. Enrico Erni (Bull. Assoc. Suisse Elect., 1936, 27, (25), 732).—A theoretical analysis of the stresses within a bimetal plate furnishes data regarding the nature and magnitude of the stresses under given conditions, and hence provides guidance in the choice of materials.—P. M. C. R.

\*The Transformations Produced in Certain Metals by Heating in Vacuo or in Air. Jean-J. Trillat and Shiguéo Oketani (Compt. rend., 1936, 203, (21), 1064-1066).-The modifications undergone by different metals when heated in vacuo, in inert gases or in air were studied by electron diffraction (cf. Trillat, ibid., 1935, 200, 1466). The alterations in structure occurring on heating a very thin film of silver in nitrogen, argon, or in vacuo at about 500° C., closely resemble those of gold whose lattice constant is very similar ( $a_{Ag} = 4.077$  Å.,  $a_{Av} = 4.070$  A.), and this resemblance does not occur with any other of the metals studied. For certain metals, a superficial dimorphism exists which only appears on heating within well-defined temperature limits. Heated in air, very pure gold behaves as above, but if it contains, says, 1% of copper, a complex diagram appears at 400° C., becoming more pronounced towards 500°-550° C. It disappears progressively on heating in vacuo, and also disappears spontaneously after several years at ordinary temperature. This phenomenon is due to the formation of an unstable oxide, facilitated by the presence of traces of the oxidizable element (copper), and also by the particular porosity of very thin films. Other metals (aluminium, copper, iron) give stable oxides not reversible by heating in vacuo. Platinum shows no modification .- J. H. W.

\*On the Determination of the Rate of Melting [of Metals and Alloys]. G. Tammann and H. Hartman (Z. anorg. Chem., 1936, 230, (1/2), 53-64).—An apparatus is described by means of which the rate of melting of a metal can be determined. It consists essentially of a copper rod which can be uniformly heated at a controlled rate and on which the metal specimen is mounted so that the heat required to melt it passes only from the copper into one end of the specimen. The results obtained for bismuth at 271° C. are somewhat lower than the theoretical deduced from the heat conductivity and latent heat. When two metals forming a eutectic are heated in contact with one another the drops formed are of eutectic composition only when the heat conductivities of the metals are approximately the same; otherwise they are richer in the more conductive metal. For example, with cadmium and zinc the drops contain 14 and the eutectic 16% zinc; for lead and tin the values

are 77 and 67% tin, respectively, and for silver and copper the drops are exactly of eutectic composition.—A. R. P.

\*The Solubility of Gases in Molten Metals. H. v. Wartenberg (Z. Elektrochem., 1936, 42, (12), 841-845) .- The equivalent solubility of di-atomic gases in metals depends on the formation of chemical compounds which are in equilibrium with the gas atom-concentration. The stability of these however feebly exothermic or endothermic compounds at room temperature is considerably increased in equilibrium with atomic gases as opposed to molecular gases. The solubility of oxygen in silver as Ag<sub>2</sub>O was quantitatively determined by chemical reaction of the Ag<sub>2</sub>O, the calculation of the molecular weight of the dissolved Ag<sub>2</sub>O from the depression of the freezing point and by thermodynamic tests of the reaction equilibrium of silver with atomic oxygen. A series of systems, such as silver-phosphorus, iron-nitrogen, iron-hydrogen, and chiefly of metals with metallic hydrides, were investigated qualitatively. A value for the heat evolution of the suspected formation of AlH was calculated by observations on the system aluminium-hydrogen. The solution of molecular gases in metal castings is very different, these solutions having no state of equilibrium but being supersaturated solutions. These gases are present owing to chemical reaction with the metals and are independent of the circumambient gas atmosphere. They are dissolved in a supersaturated state, and can be removed by purely mechanical means, examples being carbon monoxide dissolved in iron and hydrogen in aluminium .- J. H. W.

Determination of Ferromagnetic Anisotropy in Single Crystals and in Polycrystalline Sheets. R. M. Bozorth (*Phys. Rev.*, 1936, [ii], 50, (11), 1076– 1081).—Theoretical. In a cubic crystal the energy of magnetization, E, per unit volume in a uniform field H may be expressed as a function of the direction cosines  $S_1$ ,  $S_2$ ,  $S_3$  of the magnetization I, referred to the crystal axes. In ascending powers of the direction cosines, the first three terms of the expression are  $E = K_0 + K_1(S_1^*S_2^* + S_2^*S_3^* + S_3^2S_1^2) + K_2(S_1^2S_2^2S_3^2)$  (see Akulov, Met. Abs. (J. Inst. Metals), 1931, 47, 265; Gans, Met. Abs. (J. Inst. Metals), 1933, 53, 119). If  $K_1$  is small compared with  $K_2$ , and of opposite sign, the direction of easiest magnetization may be [110] rather than the usual [100] (as in iron) or [111] (as in nickel). B. shows how to determine the constant  $K_1$  from the torque curves of hard-rolled polycrystalline sheet material. Magnetization curves for single crystals of iron, nickel, and 50 Permalloy are calculated and compared with experimental data.—W. H.-R.

\*Magnetic Properties of Superconducting Metals and Alloys [Lead, Tin, Mercury, Lead-Thallium, Lead-Bismuth, Lead-Indium, Mercury-Cadmium]. L. W. Shubnikow, W. I. Chotkewitsch, J. D. Schepelew, and J. N. Rjabinin (*Physikal. Z. Sowjetunion*, 1936, 10, (2), 165–192).—[In German.] The magnetic properties of poly- and mono-crystalline lead, mono-crystalline tin, polycrystalline mercury, mono-crystalline lead-thallium alloys, more especially the alloy of composition PbTl<sub>2</sub>, the lead-bismuth alloy containing 35% bismuth, lead-indium alloys containing, respectively, 2 and 3% indium, and mercury-cadmium alloys at temperatures attainable with liquid helium are investigated experimentally. A marked difference is observed in the relation of the magnetic induction to the strength of the applied magnetic field in the cases of the pure metals and the alloys, respectively. The alloys show the following characteristics: Up to a definite critical value of the magnetic field,  $H_{KI}$ , which depends on the temperature, the induction, *B*, is practically constant and equal to zero. Within this region of field strengths, alloys and pure metals behave similarly. In magnetic fields of strength *H* up to a second critical value,  $H_{H}$  *B* increases slowly with increase of field strength, and approximates to the value for non-superconducting metals. Within this interval of field strengths, moreover, the induction does not vary with

acts Vol. 4

approaches the value  $H_{K1}$ , is observed. An increase of the percentage proportion of one of the alloying metals leads to an increase in the value of  $H_{K2} - H_{K1}$ , brought about by a decrease of  $H_{K1}$  and a marked increase of  $H_{K2}$ . The value of the critical magnetic current,  $H_{K1}$ , at const. temperature, which destroys the superconducting property in wires made of superconducting alloys is proportional to the diameter of the wires, and is approximately equal to 0.65  $H_{K1}$ .-J. S. G. T.

The Phenomenon of Anode-Sputtering and the Deposition of Metallic Film on the Cathode of a Hadding's X-Ray Tube. S. Sharan (Indian J. Physics, 1936, 10, (5), 325-340).—Brilliant, coloured rings are produced on the surface of the concave cathode of a Hadding's X-ray tube during its operation. All the rings do not obey the ordinary formula for Newton's rings formed in a medium bounded by two spherical surfaces. Data relating to the sputtering of copper and platinum anodes and the deposition of the corresponding films on the cathode are analyzed, and a mathematical theory of the occurrence of the rings is proposed. Various theories of anode sputtering—vaporization, mechanical, and explosive—are very briefly discussed.—J. S. G. T.

\*A Special Type of Superficial Photo[-Electric] Effect. J. M. Kuschnir (*Physikal, Z. Sowjetunion*, 1936, 9, (6), 588-602).---[In German.] The existence of a badly-conducting layer in the photoelectric cell having the construction  $Ag-Ag_2O-Cs_2O-Cs$  is established. The effect of a magnetic field upon the photoelectric effect at the easium surface is investigated, and it is shown that a suitably directed magnetic field increases the effect by about 50%. The increased photoelectric current falls in a few minutes to zero value. The effect is attributed to electrons, which, emitted from the cathode, are caused by the magnetic field to be diverted so as to strike the cathode again without penetrating deeply into the body of the metal.--J. S. G. T.

\*The Cooling of a Surface by Photoelectric Emission. Hughes M. Zenor (*Phys. Rev.*, 1936, [ii], 50, (11), 1050-1053).—A thin layer of cæsium was deposited on platinum, and the cooling effect when photoelectrons flowed from the surface was measured. The photoelectric emission produced a cooling effect of nearly the amount expected theoretically if the photoelectrons lose very little energy to the metal during their journey to the surface.—W. H.-R.

Theory of Photoelectromagnetic Effects in Semi-Conductors. E. Lifshitz (*Physikal. Z. Sowjetunion*, 1936, 9, (6), 641-654).—[In English.] A mathematical theory is developed of the e.m.f. developed in a circuit containing an illuminated semi-conductor placed in a magnetic field.—J. S. G. T.

### **II**—**PROPERTIES OF ALLOYS**

#### (Continued from pp. 3-5.)

\*Age-Hardening of Aluminium Alloys. II.—Aluminium-Magnesium Alloy. William L. Fink and Dana W. Smith (Metals Technology, 1936, 3, (8); A.I.M.M.E. Tech. Publ. No. 760, 6 pp.).—The age-hardening of an aluminium alloy containing magnesium 10·30, silicon 0·013, iron 0·008, and copper 0·005% was studied. The specimens were made homogeneous by annealing at  $450^{\circ}$  C., quenched in cold water, and subsequently aged at 100°, 200°, and  $300^{\circ}$  C., respectively. Precipitation in the grain boundaries can be observed microscopically before any measurable change in the yield-strength or clongation occurs, but these mechanical properties change as soon as precipitation appears within the grains. The lattice parameter, as measured by the X-ray back-reflection method, is unaltered in age-hardening until substantial precipitation within the grains is visible microscopically; this is in contrast to precipitation under equilibrium conditions. The phase precipitated at  $300^{\circ}$  C. is the equilibrium phase  $\beta$  (Mg<sub>2</sub>Al<sub>3</sub>), but at the lower ageing temperatures the lattice arrangement is different and is termed  $\beta'$ . F. and S. suggest that in aluminium-base age-hardenable alloys the precipitate formed at the usual ageing temperatures may frequently or even generally have a structure different from that of the equilibrium phase.—W. H.-R.

\*The Ternary System Aluminium-Magnesium-Zinc. III.—Region Magnesium-Al<sub>3</sub>Mg<sub>1</sub>-Al<sub>2</sub>Mg<sub>3</sub>Zn<sub>3</sub>-MgZn<sub>2</sub>-Magnesium. Werner Köster and Walter Dullenkopf (Z. Metallkunde, 1936, 28, (12), 363-367).—Cf. Met. Abs., 1936, 3, 505. In this section there are 5 phases which separate from the liquid :  $\varepsilon$ -solid solution,  $\delta$ , T,  $\zeta$ , and  $\eta$ , and three 4-phase reactions, namely: (1) liquid  $+\delta \rightleftharpoons \varepsilon + T$  at 363° C., the compositions of the reactants being aluminium 13, 39, 3·5, 20, magnesium 49, 49, 91, 27, zine 38, 12, 5·5, 53%, respectively; (2) liquid  $+T \rightleftharpoons \varepsilon + \zeta$  at 342° C., the composition of T being aluminium 18·5, magnesium 26·5, and zine 55% and the liquid and  $\zeta$ -phases being practically free from aluminium; (3) liquid  $+\eta \rightleftharpoons \zeta + T$  at 354° C. A space model and ternary diagrams are given showing the equilibria in the complete ternary diagram at various temperatures, and equilibrium diagrams are also included for constant magnesium contents of 65, 55, and 4%, for the section Al<sub>3</sub>Mg<sub>4</sub>-MgZn<sub>2</sub> and for a section through the magnesium corner with an aluminium-zine ratio of 1: 1.—A. R. P.

\*Equilibrium Relations in Aluminium-Magnesium-Zinc [and Magnesium-Aluminium] Alloys of High Purity. William L. Fink and L. A. Willey (Metals Technology, 1936, 3, (8); A.I.M.M.E. Tech. Publ. No. 761, 32 pp.).-(1) The solid solubility limits of the \$-phase of the magnesium-aluminium system were determined at  $350^\circ$ ,  $400^\circ$ , and  $440^\circ$  C. by the quenching and microscopic method. At  $350^\circ$  C. the phase is homogeneous between approx. 34.6 and 37.1 weight-% magnesium, and the range of solubility diminishes with increase of temperature. (2) The phase boundary of the aluminium-rich solid solution in ternary aluminium-magnesium-zine alloys was determined between 200° and 450° C. by electrical resistance measurements supplemented by the quenching and microscopic method. Isothermal sections of the ternary diagram at intervals of 50° are reproduced ; the solid solution limits diminish with decrease of temperature. The phase boundary is divided into three parts in which the aluminium-rich solid solution is in equilibrium with (a) the  $MgZn_2$ phase of the magnesium-zine system; (b) a ternary magnesium-aluminiumzinc phase of unspecified composition, and (c) the ß phase of magnesiumaluminium system, respectively. The phases were identified by Debye-Scherrer X-ray photographs, and some of the lines separating the different polyphase areas in the ternary diagram are determined. It is not stated whether in (a) and (c) above, the phases of the binary systems form ternary solid solutions.

-W. H.-R.

\*The Decomposition of Cadmium Ferrite. Hubert Forestier and Francis Redslob (Compt. rend., 1936, 203, (22), 1160-1162).—Thermomagnetic analysis of moist, precipitated  $Fc_2O_3$ -CdO shows that magnetism begins to appear about 70° C., increases more and more rapidly, reaches a maximum about 140° C., and then diminishes very rapidly, being very feeble at 200° C. If the temperature exceeds 300° C., the substance after cooling shows no trace of ferromagnetism. If it is allowed to remain in water at different temperatures for several hours, it appears that: (1) at 20° C., the precipitate does not become ferromagnetic within the time limit of the experiment; (2) at 40° C., the increase in susceptibility is perceptible after 40 hrs.; (3) at 700° C., magnetism is very evident after 30 minutes and reaches its limit after 15 hrs.; the material is then very ferromagnetic. If it is thoroughly dried, it is impossible to make it ferromagnetic subsequently by any thermal treatment. If, however, a strongly ferromagnetic specimen is treated with hot potassium cyanide until the CdO has completely disappeared, the magnetic properties do not alter. Thus, the presence of water is indispensible for the production of the ferromagnetic substance, but this property is not due to the ferrite, but only to the oxide,  $Fe_2O_3$ , in an unstable ferromagnetic form. The process can be explained by: (a) simultaneous precipitation:  $Fe_2O_3 + CdO = Fe_2O_3 \cdot CdO$ , and (b) hydrolysis:  $Fe_2O_3 \cdot CdO + H_2O = Fe_2O_3$  (cubic, unstable) +  $Cd(OH)_2$ , without the formation of the intermediate stable hydrate.—J. H. W.

\*Solid State Changes in Iron-Chromium Alloys. N. N. Kurnakov and N. I. Korenev (Izvestia Sektora Fiziko-Khimicheskogo Analiza (Ann. Sect. Anal. Phys.-Chim.), 1936, 9, 85-98).—[In Russian.] The formation of FeCr is shown, by hardness and electrical resistance tests and thermal analysis, to take place at 908° C.; it forms a limited range of solid solutions with both components, that with iron having a wider composition range and a higher electrical resistance than that with chromium. The decomposition of FeCr on heating is more rapid than its rate of formation on cooling.—N. A.

Iron-Cobalt-Copper Alloys. —— (Metallurgist (Suppt. to Engineer), 1936, 10, 180-182).—A summary and discussion of the recent work of Jellinghaus, of Andrew and Nicholson, and of Maddocks and Claussen, dealing with different aspects of the iron-cobalt-copper alloy system.—R. G.

\*The Equilibrium Diagram of the Copper-Antimony System. I.-Thermal Analysis and Microscopic Examination. Takejiro Murakami and Nisaku Shibata (Kinzoku no Kenkyu (J. Study Metals), 1936, 13, (11), 445-470) .---[In Japanese.] A re-investigation was made of the whole system by means of thermal analysis, microscopic examination, differential dilatation measurements, and X-ray analysis; and a new diagram is proposed. This paper contains the results of the investigations by thermal analysis and microscopic examination. The system consists of 5 branches of the liquidus with a maximum melting point at 683° C. and at the composition corresponding to Cu<sub>5</sub>Sb<sub>2</sub>. There are two eutectics on the copper and antimony sides at 69.0% copper, 645° C., and 23.5% copper, 526° C., respectively. Copper and antimony have mutual solubility, forming the solid solutions  $\alpha$  and  $\varepsilon$ ; the solubility of the latter in the former is about 7.5%, while that of the former in the latter is very small, 0.1% at room temperature. Four intermetallic compounds are found :  $Cu_{11}Sb_2$ ,  $Cu_5Sb_2$ ,  $Cu_5Sb_2$ , and  $Cu_2Sb$ , forming, respectively, the solid solutions  $\eta$ ,  $\delta$ ,  $\beta$ , and  $\gamma$ . The compound  $Cu_2Sb$ , formed at 586° C. by the peritectic reaction liquid +  $\beta \gtrsim Cu_2Sb(\gamma)$  was found by thermal analysis, and its formation as well as its solubility range were revealed by microscopic study. The solid solutions  $\eta$  and  $\delta$  were found : they are formed by the peritectoid reactions  $\alpha + \beta \ge \eta$  and  $\eta + \beta \ge \delta$ , respectively, at 488° and 462° C.; the former decomposes at about 400° C. into a and S. The range of solid solubility of the  $\eta$  phase is almost negligible, while that of the  $\delta$  phase is about 2%. The  $\beta$  solid solution is formed directly from the liquid and has a wide range of solubility, as hitherto recognized, but it decomposes at 436° C. into the y and  $\delta$  phases by the cutectoid reaction  $\beta \neq \gamma + \delta$ , a detailed account of which will be given in the second report which is due for early publication. The antimony used was distilled in a high vacuum. The effects of impurities in the antimony and of volatilization of the metal during the experiments are emphasized. Special care was taken that these effects should be avoided in the present investigation.-S. G.

\*Precipitation-Hardening and Double Ageing [of Copper-Cobalt-Beryllium and Copper-Chromium-Beryllium Alloys]. R. H. Harrington (Metals Technology, 1936, 3, (8); A.I.M.M.E. Tech. Publ. No. 759, 15 pp.).—Double ageing is defined as heating a precipitation-hardening alloy to the solution temperature, quenching, reheating to the suitable dispersion precipitation temperature, strain-hardening, and again reheating. The strain-hardening may be induced by cold-working between the two reheats, or by cooling from the first reheat at a rate sufficient to strain the lattice. Examples are given of the effect of double ageing on high-speed steels. The mechanical properties and electrical resistance after different ageing treatments are investigated for a coppercobalt-beryllium alloy containing 2.6% cobalt and 0.4% beryllium. This has high proportional limit, ductility, and hardness, and an unusually high electrical conductivity, approx. 50% of that of copper. No appreciable improvement is effected by cold-working between the quench and the anneal, and after complete precipitation-hardening the "cold-workability" is very limited. A similar study of a copper-chromium-beryllium alloy containing 0.4% chromium and 0.1% beryllium shows a marked improvement in tensile properties by cold-working between the quench and the precipitation anneal, and still further improvement by a double ageing treatment. A proportional limit of 35,000 lb./in.<sup>2</sup> with a conductivity 70% of that of copper can be obtained.—W. H.-R.

\*X-Ray Investigations on the Tin Bronzes.—II. Takesaburo Isawa (*Tetsu* to Hagane (J. Iron Steel Inst. Japan), 1936, 22, (12), 960–966).—[In Japanese.] X-ray investigations at temperatures above 600° C. show that the tin bronzes containing 22-32.5% tin consist entirely of the body-centred cubes of the  $\beta$ -phase, and that no other phase makes its appearance along the  $\beta + \gamma$  boundary described by Bauer and Vollenbruck. The transformation at 580° C. should be regarded as a superstructure change similar to that in  $\beta$ -brass rather than as a eutectoid transformation. Alloys containing less than 25% tin show an intermediate phase ( $\beta'$ ) when quenched in water from above 600° C, but similarly quenched alloys containing 25–27% tin consist of the  $\beta$ -phase. The disintegration process in the quenched alloys takes place in at least two stages, the transformation  $\beta \rightarrow \beta' \rightarrow \alpha + \delta$  being definitely established.—P. M. C. R.

Lead-Bronzes. —— (Giesserei-Praxis, 1937, 58, (1/2), 8-10).—Discusses the equilibrium diagram of the system copper-lead and of ternary alloys containing copper and lead, and describes the mechanical properties of typical lead bronzes. The principal lead-bronze bearing metals are: binary copper 95-60, lead 5-40%, with small additions of nickel and sulphur; ternary —tin < 5, lead 25%, rest copper, which has low mechanical resistance, but very high abrasion properties; tin 8-10, lead 12-15%, rest copper, which has good mechanical and bearing properties; tin 7-10, lead 15-25%, rest copper, which has good bearing properties at high temperatures. 7 references are given.—J. H. W.

\*X-Ray Investigation of Work-Hardening Produced in the Machining of Brass. N. A. Kravchenko, J. P. Selisski, and V. N. Tiuleneva (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (9), 1085-1094).-[In Russian.] The broadening of X-ray interference lines obtained in back reflection diagrams of brass (59:40 + 1% lead) was studied. The surface of the test-pieces was etched away in steps of 0.04-0.01 mm. using 50% nitric acid. The cutting speed was varied from 4 to 255 m./minute, the advance of the cutting tool from 0.1 to 0.9 mm./rev., and the cutting depth from 0.5 to 2 mm. Cutting was carried out with both sharp and blunt tools. Increase in advance and depth of cut increased the depth of work-hardening. A threefold increase in the advance from 0.25 to 0.72 mm./rev. increased the depth of work-hardening from 115 to 220  $\mu$ . A threefold increase in the cutting depth from 1 to 3 mm. increased the depth of work-hardening from 170 to 195  $\mu$ . Increase in the cutting speed decreased work-hardening which was also greater with a blunt than with a sharp tool. The curve giving the connection between depth of work-hardening and cutting speed is a straight line up to 200 m./minute, after which it becomes parallel to the speed axis. The decrease in the depth of work-hardening with increase in cutting speed is explained by the increase in temperature of the test-piece when machined at high speeds .-- D. N. S.

\*The Rate of Dissolution of Alloys of Gold, Silver, and Copper in Cyanide Solutions and Its Connection with the Equilibrium Diagrams of the Systems Gold-Copper, Silver-Copper, and Gold-Silver. I. N. Plaksin and S. V. Shibaev (Izvestia Sektora Fiziko-Khimicheskogo Analiza (Ann. Sect. Anal. Phys.-Chim.), 1936, 9, 159-182).-[In Russian.] The rate of dissolution of gold-copper alloys in evanide solutions reaches a well-defined maximum at a composition corresponding to AuCu and a less well-defined maximum at AuCua. In the coppersilver system the rate of dissolution of copper increases sharply from pure copper to a maximum at 1.7-12 atomic-% silver, then decreases rapidly to a minimum at the eutectic composition, and finally increases to a second maximum at 91.8 atomic-% silver; dissolution of silver from alloys containing primary copper does not commence until all primary copper is dissolved, increases to a maximum at the cutectic composition, decreases to a minimum at 84 atomic-% silver, and then increases to the value for pure silver. The curve for gold in the gold-silver system is convex to the axis of composition with a minimum at 40 atomic-% gold, a sharply rising portion between 40 and 60 atomic-% gold and a relatively flat portion at 68-100 atomic-% gold. These results suggest that the gold-silver system is complex at low temperatures .-- N. A.

\*Thermal Expansion of Lead-Antimony Alloys. Peter Hidnert (J. Research Nat. Bur. Stand., 1936, 17, (5), 697-708; and Research Paper No. 938) .- The results are given of an investigation of the linear thermal expansion of cast lead-antimony alloys containing 2.9-98.0% antimony. Observations were made at temperatures between  $-12^{\circ}$  and  $+200^{\circ}$  C. A majority of the curves obtained on cooling lie below the expansion curves obtained on heating. The deviations between these curves are particularly noticeable for the alloys containing up to 15% antimony which were cast in a preheated steel mould and cooled slowly. The deviations are less noticeable for the alloys of higher antimony content which were east either in a sand mould or chill mould. It is probable that the deviations indicate a lack of equilibrium in the samples on account of the effect of the casting conditions or of the chemical composition. The coeff. of expansion, the change in length after heating and cooling, and the densities of the alloys are given in tables. Equations are given for the linear relations between the coeff. of expansion and the atomic-% antimony of the alloys containing 4.8-97.0 atomic-% (2.9-85.0 wt.-%) antimony, and show that the coeffs, of expansion decrease linearly with increase in the atomic-% antimony. The densities of the lead-antimony alloys also decrease linearly with increase in atomic-% antimony. These linear relations are typical of relations for other properties of binary alloys having structures composed of solid solution + eutectic. The coeffs. of expansion of the lead-antimony alloys cover a wide range of values. It is possible to select alloys that have approx. the same coeffs. of expansion as iron, nickel, gold, copper, silver, aluminium, magnesium, and many of their alloys.-S. G.

\*Influence of Beryllium on Magnesium Alloys. K. V. Peredelski (Legkie Metalli (Light Metals), 1936, (5), 39-45).—[In Russian.] Magnesium cannot be alloyed with teryllium at 1330° C. under 100-120 atm. pressure. By the addition to Elektron of 0.1% beryllium as an alloy with aluminium, the metal can be melted with a minimum of flux and sand-cast without the use of sulphur, boric acid, or similar substances in the sand or as dusting materials. The protective action of beryllium against oxidation is effective only up to 700° C. The mechanical properties of the alloys remain practically unaffected, but the structure becomes coarser necessitating the use of a modifying agent such as titanium. The presence of zinc or cadmium in the alloy tends to nullify the beneficial effect of the beryllium. Alloys treated with beryllium are more resistant to sea-water than untreated alloys, but little difference is observed in tap-water.—D. N. S.

\*Thermal Expansion Coefficients of Magnesium and Its Alloys. (Takahashi and Kikuti.) See p. 26.

Amalgams: A Definite Mode of Manipulation. Claude C. Cannon (J. Amer. Dental Assoc., 1936, 23, (4), 629-641).—Methods of testing amalgams for wear, of carrying out the amalgamation process to obtain a satisfactory structure in the hardened amalgam, and of packing the amalgam in the tooth cavity are described. Microstructures of amalgams produced under various conditions are shown, but no information is given as to their composition.—A. R. P.

\*Potential Difference Between Various Kinds of Metals Applied in Oral Cavity and Their Physiological Effects. Eijiro Wakai (J. Amer. Dental Assoc., 1936, 23, (6), 1000-1006).—Experiments are described which show that when two contiguous teeth or corresponding upper and lower teeth contain different metals, e.g. gold in one and amalgam in the other, there is a tendency for the teeth to decay by electrochemical action, lime tending to dissolve away from the amalgam-filled tooth and phosphoric acid from the gold-filled tooth.

-A. R. P.

Constructing Amalgam Fillings by Reinforcement to Approximate Strength of Cast Gold. F. A. Bull (J. Amer. Dental Assoc., 1936, 23, (9), 1655–1665).— Reinforcing of amalgam fillings with small plates or bars of 90% silver alloy increases the transverse strength by 500%, reduces the flow by more than 50% and considerably increases the erushing strength and resistance to shear. At the same time the mercury content of a reinforced filling is only about half that of an ordinary amalgam filling, while the adhesion of the metal in the cavity is considerably improved and temperature changes are much less marked.—A. R. P.

Amalgam Restorations. F. J. Viner (J. Amer. Dental Assoc., 1936, 23, (9), 1682-1689).—The composition and properties of amalgams are described and exact details are given of modern methods of using them for filling tooth cavities.—A. R. P.

A Simple Method of Improving Amalgam Restorations. Francis A. Bull (J. Amer. Dental Assoc., 1936, 23, (10), 1880-1883).—A small plate of standard silver which just extends across the cavity is placed over the amalgam when the cavity is about two-thirds filled; after tamping the silver well in so that it is a tight fit the rest of the cavity is filled in with amalgam. The strength of such fillings is about equal to that of cast dental gold fillings.—A. R. P.

On the Preparation of "Raney's Nickel." R. Paul and G. Hilly (Bull. Soc. chim. France, 1936, [v], 3, (12), 2330-2332).—The compounds NiAl<sub>2</sub> and NiAl<sub>3</sub> may be readily prepared by dropping metal cubes into the appropriate amount of aluminium previously melted and heated to  $1200^{\circ}$  C., reaction occurring in the first case with incandescence and the second case quietly, but completely. When the compounds are powdered and digested at 105° C. with 25% sodium hydroxide solution powdered nickel is left in a highly reactive form suitable for use as a catalyst.—A. R. P.

New Magnetic Alloy [Alnico]. — (J. Sci. Instruments, 1936, 13, (10), 336-337).— A note. Diagrams are given showing the magnetic properties of a new powerful magnetic alloy called Alnico. The coercive force is higher, and the residual induction lower than for other magnetic alloys. Alnico magnets are less subject to demagnetization by high temperatures, vibration, or stray fields than magnets of other alloys, but Alnico is relatively weak and brittle, and has a relatively high coeff. of thermal expansion.—W. H.-R.

Properties of Monel at Low Temperatures. D. E. Ackerman (Metal Progress, 1936, 30, (5), 56-60).—A summary of the properties of cast, forged, cold-drawn, and commercially welded Monel metal of statcd analyses contains tables of the tensile properties of the material at room temperature and at 70°, 32°, 10°,  $-20^{\circ}$ , and  $-310^{\circ}$  F. (21°, 0°,  $-12^{\circ}$  and  $-190^{\circ}$  C.), with similar data obtained by other workers. The elastic modulus of annealed and cold-drawn Monel in tension and in torsion is given at 75° and  $-50^{\circ}$  F. (24° and  $-45^{\circ}$  C.), as are the Charpy impact strengths at room and lower

Vol. 4

temperatures; the thermal expansion over various temperature ranges, and the influence of temperature on different mechanical properties, are shown graphically.—P. M. C. R.

\*X-Ray Investigation of Pure Iron-Nickel Alloys. I.-Thermal Expansion of Alloys Rich in Nickel. E. A. Owen and E. L. Yates (Proc. Phys. Soc., 1937, 49. (1), 17-28) .- The thermal expansions of annealed pure iron-nickel alloys containing, respectively, 96.6, 93.7, 90.7, 82.2, and 73.0 atomic-% of nickel were determined by the X-ray method at various temperatures up to 600° C. Data relating to nickel of purity 99.98% (atomic) are also included. Details are given of the annealing of the alloys. Close agreement was found between the expansion of the crystal lattices and that of composite masses of crystals, such as were used by previous workers who employed ordinary dilatometric methods. The addition of iron to the nickel lattice is found to produce two effects: (1) the nickel lattice expands approximately in proportion to the amount of iron added, and (2) the temperature of discontinuity in the thermal expansion curve is increased by the addition of iron but not in proportion to the amount added. No change of structure occurs at the temperature of magnetic transformation of the alloys; the face-centred structure persists from room temperature through the transformation temperature up to 600° C. No ageing effect was observed with an alloy containing 94 atomic-% of nickel, the lattice parameter showing no consistent change over a period of 15 months. -J. S. G. T.

\*Ferromagnetic Anisotropy of Nickel-Iron Crystals at Various Temperatures. J. D. Kleis (*Phys. Rev.*, 1936, [ii], **50**, (12), 1178-1181).—Small oblate spheroids were cut from annealed (face-centred cubic) single crystals of nickeliron alloys containing from 10 to 50% iron, and magnetization curves were taken by the pendulum magnetometer method at temperatures up to 500° C. With less than about 24% iron the order of increasing difficulty for magnetization to saturation is, as in nickel, at room temperature,  $\langle 111 \rangle$ ,  $\langle 110 \rangle$ ,  $\langle 100 \rangle$ , but with higher percentages of iron the order is  $\langle 100 \rangle$ ,  $\langle 111 \rangle$ ,  $\langle 110 \rangle$ . —W. H.-R.

\*Electrical Conductivity and Equilibrium Diagrams of Binary Alloys. XXI.-The Palladium-Chromium System. G. Grube and R. Knabe (Z. Elektrochem., 1936, 42, (11), 793-804) .- See Met. Abs., 1936, 3, 201. The equilibrium diagram of the palladium-chromium alloys was constructed by means of thermal, microscopic, X-ray, and electrical conductivity investigations. The intermediate phase, Pd<sub>2</sub>Cr<sub>3</sub>, is shown at 1398° C. by a marked maximum in the heating curve. It has a cubic, face-centred lattice and with palladium forms a continuous series of solid solutions with a minimum freezing point at 45 atomic-% palladium; with excess of chromium it forms no solid solution. On the other hand, the cubic body-centred lattice of the chromium is able to absorb the compound in solid solution up to 5 atomic-% of palladium at 1320° C. A cutectic horizontal stretches between 5-40 atomic-% palladium at 1320° C., with the cutectic point at 25 atomic-% palladium. Between 0-25 atomic-% palladium, primary chromium-rich solid solution crystallizes, between 25-40 atomic-%, the compound Pd2Cr3. The Brinell hardness of palladium increases with increasing chromium content up to 60 atomic-% (Pd2Cr3), and then decreases to pure chromium. The specific resistance-temperature curve of pure chromium from room temperature to 1800° C. is continuous, and shows no indication of any polymorphous transformation of chromium. Chromic oxide is soluble in molten chromium; the melting point of pure chromium is  $1890^{\circ} \pm 10^{\circ}$  C., while the oxide-containing metal begins to frecze between 1770° and 1790° C .-- J. H. W.

\*The Resistance of Palladium and Palladium-Gold Alloys. (Conybeare.) See p. 27. \*Electrical Conductivity and Equilibrium Diagrams of Binary Alloys. XXII. —The Palladium-Manganese System. G. Grube, K. Bayer, and H. Bumm (Z. Elektrochem., 1936, 42, (11), 805–815).—Cf. preceding abstract. The alloys showed marked hysteresis in heating and cooling curves. Palladium melts at 1552° C. The melting point decreases on the addition of manganese to 1350° C. at 34.5 atomic-% manganese, and then increases to a sharp maximum of 1515° C. at 50 atomic-% (PdMn); it then decreases to 1147° C. at the cutectic composition of 72.5 atomic-%, and finally increases to 1243° C. at pure manganese. The boundaries of the  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ ,  $\eta$ , and  $\zeta$  phases were, though in some cases only approximately, determined by thermal and electrical conductivity measurements. The lattice constant, determined by X-ray measurements, varies from 3.907 A. for 50 atomic-% manganese to 3.748 A. for 95 atomic-%. The Brinell hardness increases from 38 for pure palladium to 700 for the unannealed and 650 for the annealed 95 atomic-% manganese alloy. Alloys quenched from 1100° C. show a maximum hardness of 178 at 70 atomic-% manganese. Alloys with up to 25 atomic-% manganese have good working and cold-rolling properties; above 40 atomic-% they are brittle. —J. H. W.

\*Magnetic Susceptibility and Equilibrium Diagrams of Binary Alloys. XXIII. -The Palladium-Manganese System. G. Grube and O. Winkler (Z. Elektrochem., 1936, 42, (11), 815-830) .- Cf. abstracts above. The palladiummanganese system was investigated by thermal conductivity, microscopic, and temperature-resistance investigations. Since the electrical resistance of the alloys with more than 33 atomic-% manganese in the higher temperature ranges has a negative temperature coeff., it was not possible to apply conductivity measurements in the usual manner to explain the transformations, so that susceptibility-temperature curves of para- and dia-magnetic alloys up to 1400° C. in vacuo or in a protective gas were determined. The palladiummanganese alloys from 0 to 63 atomic-% manganese crystallize as a facecentred z-solid solution with a minimum freezing point of 1350° C. at 34.5 atomic-% manganese, and a sharp maximum of 1515° C. at 50 atomic-%. Between 63-79.5 atomic-% the alloys solidify to a heterogeneous mixture of  $\epsilon$ -solid solution with 63 atomic-% manganese and the cubic face-centred  $\gamma$ -solid solution containing 79.5 atomic-%. The eutectic horizontal lies at 1147° C., the eutectic point being at 72.5 atomic-% manganese. Between 79.5-85 atomic-%, the alloys solidify as homogeneous y-solid solution, between 85-95 atomic-% as primary 8-solid solution, and between 95-100 atomic-% manganese as unsaturated  $\delta$ -solid solution. The temperature of the  $\gamma \rightleftharpoons \delta$ transformation of manganese is raised by the addition of palladium, that of the  $\beta \rightleftharpoons \gamma$  transformation lowered. The face-centred cubic lattice of the ε-phase (40 atomic-% manganese) changes at 1175° C. to the face-centred tetragonal lattice of the ζ-phase (Pd3Mn2), with static separation of the atoms in the lattice. The phase boundaries at the lower temperatures were determined .- J. H. W.

†An Investigation of Alloys of the Platinum Group Metals with Other Metals by Methods of Physico-Chemical Analysis. V. A. Nemilov (*Izvestia Sektora Fiziko-Khimicheskogo Analiza* (Ann. Sect. Anal. Phys.-Chim.), 1936, 9, 183– 192).—[In Russian.] A review.—N. A.

\*Magnetic Susceptibility of Binary Alloys of Thallium. Audrey W. David and James F. Spencer (*Trans. Faraday Soc.*, 1936, 32, (10), 1512–1516).— The susceptibility-composition curve for bismuth-thallium alloys shows definite maxima at points corresponding to the compounds  $Bi_5Tl_3$  and  $Bi_2Tl_3$ . Alloys with less than 40% thallium are more diamagnetic after annealing than before, whereas those with more than 40% thallium are less diamagnetic after annealing. The susceptibility-composition curve for cadmium-thallium alloys

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1937

shows no irregularities and hence the system contains no intermetallic compounds.—A. R. P.

\*Influence of an Excess of Tungsten on the Properties of the Alloy Pobedit and Substitution of Cobalt by Nickel. G. A. Meerson, A. N. Korolkov, M. M. Babich, and L. P. Nevskaia (Legkie Metalli (Light Metals), 1936, (3), 38-46).— [In Russian.] Addition of tungsten to cobalt-tungsten carbide alloys increases the hardness and improves their cutting properties. Substitution of tungsten for 10% of cobalt increases the bending strength from 155 to 158 kg./ mm.<sup>2</sup>, but further additions reduces it to 126 kg./mm.<sup>2</sup> at 25% tungsten, and the alloy is rendered more porous. For cutting without impact an addition of up to 25% tungsten may be used, but for surface stripping the permissible maximum is 11%. Sintering at 1400° C. in hydrogen gives the best results. Addition of tungsten to the corresponding nickel alloys also has a beneficial effect, the best properties being obtained when the free tungsten content is 15% of the nickel content, e.g. the alloy with tungsten earbide 91.4, nickel 7.30, and tungsten 1.30%. The cutting properties of the nickel alloys are as good as, and in some cases better than, those of the cobalt alloys.—D. N. S.

\*Electrical Resistivity of Single Crystals of Some Dilute Solid Solutions in Zinc. Harold E. Way (*Phys. Rev.*, 1936, [ii], **50**, (12), 1181–1185).—Single crystals were prepared of binary alloys of zinc with cadmium, copper, silver, gold, nickel, and iron. The electrical resistances at 20° C. were measured, and the results used to determine the principal resistivities  $\rho_0$ , and  $\rho_{30}$ . In any one series of alloys the relation between principal resistivity and concentration is definitely not linear, the effect becoming less for equal additions as the concentration increases. The ratio  $\rho_0/\rho_{30}$  is increased by about 0.4%, by the smallest addition of any solute, but is not changed very much by further additions. The initial increases in resistivity above that of pure zinc, in microohm-em. per atomic per cent. of solute are : cadmium 0.94, copper 0.4, silver 1.1, gold 2.3, nickel 51.0, iron 300. These are correlated with the nearness of the solute metal to zinc in the Periodic Table. Matthiessen's rule is satisfied to within 4% for all the alloys.—W. H.-R.

\*Thermal Investigation of the Intermetallic Compounds in the System Zinc-Magnesium. M. I. Zaharova and A. B. Mladzeevskiy (*Izuestia Sektora Fiziko-Khimicheskogo Analiza (Ann. Sect. Anal. Phys.-Chim.*), 1936, 9, 193-202).— [In Russian.] Alloys corresponding to MgZn and MgZn<sub>5</sub> were brought to equilibrium by prolonged annealing and subjected to thermal analysis. On the differential heating curve of MgZn<sub>5</sub> arrests occurred at 367° and 379° C., the first corresponding to the eutectic transformation and the second to the peritectic reaction liquid + MgZn<sub>2</sub> = MgZn<sub>5</sub>. For alloys near the composition of MgZn only one arrest (at 339° C., due to the eutectic transformation was found; there was no indication of a decomposition of MgZn into MgZn<sub>2</sub> and liquid.—N. A.

Survey of the Causes of Power Plant Failures—Air Line and Private Planes. — (Inter. Avia., 1936, (350), 1-3).—A report of the U.S. Bureau of Air Commerce.—S. G.

Non-Ferrous Castings at the Sixth Foundry Exhibition [Düsseldorf, 1936]. Erich Becker (*Giesserei-Praxis*, 1936, 57, (51/52), 567-570).—Describes the composition and properties of a number of non-ferrous alloys exhibited at the exhibition.—J. H. W.

Pre-Precipitation Hardening. — (Metallurgist (Suppt. to Engineer), 1936, 10, 178–179).—A brief review of recent developments of the theory of age-hardening and a summary of a paper by Morris Cohen, Met. Abs., 1936, 3, 518.—R. G.

\*The Quantum Theory of the Electrical Conductivity of Alloys in the Superlattice State. Toshinosuke Muto (Sci. Papers Inst. Phys. Chem. Res. Tokyo, 1936, 30, (653), 99–120).--[In English.] Theoretical. The quantum theory of electrical conductivity is extended to cover the case where two component atoms occupy ordered positions on a common lattice, the case of the  $Cu_3Au$ superlattice alloy being considered in detail. The probabilities of the scattering of the conductivity electrons are of three kinds, due respectively to the interaction with the thermal vibrations, and to the disturbances from alloyformation and lattice distortion. Whether the electrical resistance increases or decreases on passing through the critical range depends on factors which cannot be accurately evaluated, but approximate solutions are obtained, and compared with the experimental results of Kurnakow and Ageew (J. Inst. Metals, 1931, 46, 481) and Seeman (J. Inst. Metals, 1930, 44, 494; Met. Abs., 1934, 1, 8, 489).—W. H.-R.

\*Magnetic Properties of Superconducting Metals and Alloys. (Shubnikow, Chotkewitsch, Schepelew, and Rjabinin.) See p. 33.

\*Investigation of the Process of Formation of Liquid Eutectic Alloys. N. V. Geveling (Izvestia Sektora Fiziko-Khimicheskogo Analiza (Ann. Sect. Anal. Phys.-Chim.), 1936, 9, 63-83) .-- [In Russian.] Observations of the crystallization and melting of salt mixtures at temperatures up to 700° C. and magnifications up to ×500 in a special furnace connected to a microscope, established that melting is completed at the same nuclei at which crystallization had previously commenced. On slow cooling of an alloy the eutectic grows extremely rapidly from nuclei, which are impossible to detect by the cine-camera, and simultaneously separates into its components. When one of these is present in excess, crystallization of the eutectic commences from the grain boundaries of the primary crystals. On mixing eutectic proportions of preheated cadmium and bismuth in a thermostat at 350° C. a decrease in temperature occurs; if either metal is in excess the extent of this decrease is decreased. No change in temperature occurs when either metal is added to the eutectic mixture at constant temperature. It is suggested that these results indicate that the formation of eutectics is a chemical process since the decrease in temperature can be produced only by eutectic association in the liquid state.-N. A.

The Reactivity of Alloys in Transformations in the Solid State.—II. J. Arvid Hedvall and V. Rosén (Z. anorg. Chem., 1936, 229, (4), 413-417).—Cf. Met. Abs. (J. Inst. Metals), 1933, 53, 11. The rate of oxidation of CoSn increases suddenly at  $517^{\circ}-519^{\circ}$  C. at which temperature a change takes place in the structure. A similar effect occurs with AgCd at  $432^{\circ}-434^{\circ}$  C., but in this case there is a pronounced maximum at the transformation point (433° C.).—A. R. P.

The Influence of Temperature on the Potential-Concentration Curves of Binary Alloys. G. Tammann and H. Warrentrup (Z. anorg. Chem., 1936, 236, (1/2), 41-52).—Increase in temperature tends to make the potential of binary alloys less noble at concentrations just beyond the phase changes and to alter somewhat the shape of the curves. Numerous examples are discussed.

-A. R. P.

\*Representation of Polyphase Systems: The Method of Spiral Co-ordinates. V. J. Anosov (Izvestia Sektora Fiziko-Khimicheskogo Analiza (Ann. Sect. Anal. Phys.-Chim.), 1936, 9, 5-25).--[In Russian.] The method is described with reference to examples of metallic and other systems.--N. A.

# III.—STRUCTURE

### (Metallography; Macrography; Crystal Structure.)

### (Continued from pp. 5-7.)

Veining and the Mosaic Structure in Metals. II.—Connection Between Veining and Mosaic Structure. L. Northcott (Metallurgist (Suppt. to Engineer), 1936, 10, 184–186).—Cf. Met. Abs., this vol., p. 6. The various published data on a variety of materials are considered to support the hypothesis of association between veining and pre-existing mosaic structures.—R. G.

\*The Beilby Layer on Non-Metals. G. Ingle Finch (*Nature*, 1936, 138, (3502), 1010).—Examination by electron diffraction of a wide variety of polished non-metallic surfaces has shown that in some cases the surface consists of an amorphous layer while in other examples it is crystalline. The difference between the second type and the first (which is similar to the effect in metals), is ascribed to recrystallization during and immediately after polishing. When an amorphous layer is formed it can always be removed by etching.—B. C.

\*Surface of Copper Formed by Solidification in Vacuo. S. Dobinski and C. F. Elam (*Nature*, 1936, 138, (3494), 685).—Electron diffraction experiments on surfaces of copper prepared by solidification in a vacuum show that a layer of crystals is formed on the surface with their {111} or {100} planes parallel to the surface. Specimens of copper maintained at 950° C. for a long time show the same effect of preferred surface orientation.—B. C.

\*The Etching of Copper by Oxygen. C. F. Elam (Mrs. G. H. Tipper) (*Trans. Faraday Soc.*, 1936, 32, (11), 1604–1614).—When ordinary copper is heated in vacuo at 900°–950° C., the surfaces of the crystals develop lamellæ the direction of which varies with the crystal orientation. Since oxygen-free copper cannot be etched in this way but similar etch-effects develop on oxidizing the surface, it is suggested that these effects are due to attack by oxygen along crystal planes; the planes most readily attacked appear to be the [100] and [110] planes of the copper crystal. When copper is oxidized in air at very low pressure the first layer of oxide formed consists of small crystals arranged similarly to the copper and subsequent layers develop a fibre structure with a [110] direction agreeing with the first layer and with a [110] direction of the copper crystal. R. P.

The Modification of Eutectic Structures in Castings. E. Scheuer (Met. Ind. (Lond.), 1936, 49, (23), 553-559) .- A review of the various theories put forward to account for the refining of cutectics, particularly of aluminium-silicon alloys, by the addition of small amounts of other elements. No hyopthesis has yet been offered which fits completely all the observed facts. The characteristic phenomenon of modification is the abnormal reduction in grain-size of one of the constituents in the cutectic. On solidification of the modified alloy the crystallization of this constituent is hindered, while that of the other constituent is unaffected. A peculiarity of the solidification of the modified eutectic structure is the prolongation of supercooling throughout the whole freezing range. A considerable displacement of the cutectic concentration is thereby effected. It is of interest to note that the range of alloys which are fundamentally amenable to the treatment comprises those eutectic or approximately eutectic alloys in which the matrix is considerably softer than the crystal embedded in it, the latter forming with normal solidification grains which are brittle and not too small.-J. E. N.

\*The Theoretical Basis for Selecting Optimum [Annealing] Temperatures for Single Phase Metals. I.—The Question of Recrystallization Diagrams. A. A. Botchvar and G. G. Puzikin (*Izvestia Sektora Fiziko-Khimicheskogo Analiza* (Ann. Sect. Anal. Phys.-Chim.), 1936, 9, 153–158).—[In Russian.] In the rolling of metal sheets different parts of the sheet and even different parts of individual crystals undergo different degrees of reduction and therefore the degrees of reduction given in recrystallization diagrams must be regarded as mean values for the whole sheet. For each "mean" value two temperatures are of importance, that at which recrystallization commences in the most strongly deformed portion, and that at which it spreads throughout the specimen. The interval between the two recrystallization curves for copper and 68: 32 brass is small for high degrees of reduction, but increases considerably with decrease in the degree of reduction, being as much as  $100^{\circ}-300^{\circ}$  C. in some cases. Using the values obtained for the average grain-size of the recrystallized specimens after each heating period, spatial recrystallization diagrams for copper and brass have been constructed for the temperature interval between that at which the recrystallization just commences and that at which it has spread throughout the specimen.—N. A.

\*The Formation of [Crystal] Nuclei Associated with Recrystallization. III.— The Orientation of Recrystallization Nuclei. M. Kornfeld (*Physikal. Z. Sowjetunion*, 1936, 10, (2), 142–153).—[In German.] Experimental work concerned with the plastic extension of aluminium single crystals shows that the velocity of formation of crystal nuclei associated with recrystallization is very great in regions of plastically deformed crystals whose orientation differs considerably from that characterizing the crystals prior to their extension.—J. S. G. T.

\*Growth of Crystals at the Expense of Neighbouring Nuclei. J. M. Anscheles (Z. Krist., 1936, 95, (1/2), 150–156).— [In German.] A note. Evidence is given in support of Fedorov's theory (Fedorov, "Der Kristallisationsprozess 'Priroda.'" December 1915) of the growth of crystals. The examples do not refer to metals, but the theory is of general interest.—W. H.-R.

Intensity Distribution in Electron Diffraction Patterns. K. Lark-Horovitz, H. J. Yearian, and J. D. Howe (*Proc. Amer. Phil. Soc.*, 1936, 76, (5), 766–770). —Diffraction patterns obtained by means of a new type of electron diffraction camera, adaptable for crystals, powders, liquids or vapours, show that Mott's wave-mechanical formula holds at high voltages, whilst at low voltages an intensity change in the ordinary Bragg reactions would appear to be produced, probably by dynamic scattering.—P. M. C. R.

\*The Structure of Thin Metallic Films. S. Rama Swamy (Proc. Indian Acad. Sci., 1936, [A], 4, (6), 656–660).—The structure of thin films of gold and silver obtained by evaporation *in vacuo* was studied by electron diffraction methods. Direct evidence was obtained of the existence of these metals in the amorphous state as suggested by S. in a previous paper. Films of gold and silver which are thin enough to scatter light, as discussed in the previous paper (Met. Abs., 1935, 2, 336), are found to give electron diffraction patterns corresponding to an amorphous structure. Thicker films having metallic reflection and high electrical conductivity give patterns corresponding to a polycrystalline structure.—S. G.

\*Structure of Cu<sub>2</sub>Sb and Fe<sub>2</sub>As. M. Elander, G. Hägg, and A. Westgren (*Arkiv Kem. Min. Geol.*, 1936, [B], 12, (1), 1-6; *Sci. Abs.*, 1936, [A], 39, 1249). —[In English.] A new study of these compounds was made by the X-ray powder method. The parameters of each atom in the tetragonal unit cell of each compound are tabulated. It is found that the interatomic distances in the lattices differ from the accepted values of atomic radii. It is suggested that this anomaly is due to a polarization effect.—S. G.

\*Structure of Plastically Deformed Crystals According to Laue Patterns. II.—Plastically Extended Single Crystals of Magnesium. A. Komar and M. Mochalov (*Physikal. Z. Sowjetunion*, 1936, 9, (6), 613–617).—[In English.] The existence of an angular width in the reflection of molybdenum  $K_a$ -radiation from the plane (0001) of a magnesium single crystal which was extended 10%, and the presence of tails in the Laue diagram of the crystal are attributed to regular inhomogeneity in the spacial distribution of parts of the crystal which are rotated during the plastic deformation. This rotation can be regarded as a mosaic curvature of the gliding plates around a direction normal to the direction of gliding.—J. S. G. T.

\*The Crystal Structure of  $Mg_2Zn_{11}$  and Its Isomorphism with  $Mg_3Cu_7Al_{10}$ [Structure of Magnesium-Copper-Aluminium Alloys]. F. Laves and St. Werner (Z. Krist., 1936, 95, (1/2), 114-128).—[In German.] The magnesiumzine compound which Chadwick (J. Inst. Metals, 1928, 39, 285), and HumeRothery and Rounsefell (J. Inst. Metals, 1929, 41, 119) thought to be  $MgZn_5$  is better represented by the formula  $Mg_2Zn_{11}$ . The structure is cubic with Laue symmetry  $O_A$ , and lattice constant 8.53 A. The translation group is simple cubic, and the unit cell contains 6 magnesium atoms, and 33, or perhaps only 32, zinc atoms. The same type of structure with lattice spacing 8.29 A. is found for the ternary compound  $Mg_3Cu_7Al_{10}$ , and the phases present in some ternary magnesium-copper-aluminium alloys of compositions in the region of this compound have been identified by X-ray crystal analysis.

-W. H.-R.

\*Structure and Magnetic Properties of Manganese Boride, MnB. Raymond Hocart and Maurice Fallot (*Compt. rend.*, 1936, 203, (21), 1062–1064).—The appearance, lattice constants, atomic and crystal structures, and magnetic properties of manganese boride are given.—J. H. W.

\*The Structure of Liquid Metals. W. Danilow and I. Radtschenko (*Physikal. Z. Sowjetunion*, 1936, 10, (2), 260).—[In German.] Prins, Debye, and Menkl have shown that the structure of liquid mercury corresponds with that of closest packing; the structure of liquid thallium is similar; liquid gallium has a different structure. X-ray examination of the liquid metals bismuth, tin, and lead reveals well marked maximum intensities in the respective spectra. The diffraction spectrum of lead resembles that of mercury; bismuth and tin in the liquid state have structures resembling those they possess in the form of crystals. No experimental details are given.—J. S. G. T.

\*The Scattering of X-Rays in Liquid Metallic Alloys. W. Danilow and I. Radtschenko (*Physikal. Z. Sowjetunion*, 1936, 10, (2), 261).—[In German.] The structures of liquid eutectic alloys of bismuth and tin, bismuth and cadmium, tin and lead, tin and zinc, lead and bismuth were investigated. In this very brief note it is stated that the tin-lead alloy gives a diffraction spectrum resembling that of lead; that of the bismuth-tin alloy exhibits some of the characteristic features of the bismuth X-ray spectrum. It is suggested that in this latter alloy there exist regions where X-rays are scattered, and possessing a structure resembling that of pure bismuth. No experimental details are given.—J. S. G. T.

\*Thermal Conductivity in Relation to Crystal Structure. W. A. Wooster (Z. Krist., 1936, 95, (1/2), 138-149).—[In English.] Theoretical. Crystal structures which have been studied by X-rays, and for which the thermal conductivities are known, are divided into 3 groups: (1) Crystals for which the bends are not of markedly different strengths in different directions except within molecular groups; these are studied in detail theoretically, but metals are not referred to. (2) Structures which may be classified as layer lattices; these include zine, antimony, bismuth, and graphite, and the thermal conductivity parallel to the layers is always greater than that perpendicular to them. (3) Structures classified as chain lattices; these include tellurium, and the thermal conductivity parallel to the chains is greater than that in directions perpendicular to them.—W. H.-R.

The Development of Crystal Analysis. (Sir) William Bragg (J. Roy Soc. Arts, 1937, 85, (4392), 228-240).—The Trueman Wood Memorial Lecture.

-S. G.

\*Effect of the Out-of-Centre Error on the Accuracy of Determination of the Constant in the Debye-Scherrer Method. A. I. Krasnikov, D. A. Orekhov, and A. D. Shulenina (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (9), 1103-1105).—[In Russian.] Geometrical constructions and mathematical calculations of the possible error in the determination of the lattice parameter caused by deviations from the true centre position of the specimen in a non-rotating Debye camera.—D. N. S.

Comparator for Evaluating Rontgenographs. A. D. Evseev (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (9), 1128).—[In Russian.] The comparator

consists of a frame in which the photograph is fixed, and which can be moved in two directions at right angles by means of micrometer screws. Observation is made with a lens with a magnification of 6 with an accuracy of 0.005 mm.

-D. N. S.

### IV.—CORROSION

#### (Continued from pp. 7-8.)

On the Corrosion-Resistance of Clad Duralumin. V. O. Kroenig and S. E. Pavlov (Tehnika Vosdushnogo Flota (Technology of Aerial Navy), 1936, (7), 60-67).—[In Russian.] Annealing of clad Duralumin at  $500^{\circ}$ -520° C. leads to the rapid diffusion of the constituents of the basis metal (especially copper) into the cladding. When the copper reaches the outer surface of the cladding. the resistance to corrosion is appreciably reduced; in sca-water and in the salt-spray test on such metal both aluminium and copper pass into solution and the copper is then redeposited on the surface of the metal with resultant severe local pitting. In the heat-treatment of clad Duralumin, therefore, the time of heating at 500° C. should be reduced to a minimum, e.g. 15 minutes for 0.5 mm., 30 minutes for 0.8 mm., and 1 hr. for 1.0 mm. sheet .- N. A.

Clad Aluminium Alloys. ---- (Metallurgist (Suppt. to Engineer), 1936, 10, 183-184) .- A review referring mainly to recent work on the corrosionresistance of Duralumin clad with magnesium-aluminium alloy .- R. G.

\*On the Microchemical Determination of the Corrosion Products of Aluminium

and Magnesium Alloys. (Nikitina.) See p. 54. \*Mutual Reactions of Metals [Copper] and Salts. Thaddeus Peczalski (*Phys. Rev.*, 1936, [ii], 50, (8), 785).—A note. When a copper bar is heated in cadmium chloride (CdCl<sub>2</sub>) below the melting point of the latter, the copper dissolves in the salt which becomes reddish coloured. When heated in molten cadmium chloride, the copper dissolves rapidly, and, after cooling, the crystals of the salt are covered with a thin sheet of metallic copper alloyed with cadmium. Analogous phenomena occur when copper is heated in vapours of subliming chlorides, and the theory is discussed.-W. H.-R.

\*Some of the Factors which Influence the Rates of Dissolution of Gold and Silver in Cyanide Solutions. Ernst Beyers (J. Chem. Met. Min. Soc. S. Africa, 1936, 37, (2), 37-88; discussion, (2), 89; (4), 148-152).-The rate of dissolution of pure gold or silver in dilute potassium cyanide solution increases with increasing cyanide concentration between 0.01 and 0.2% when the content of dissolved oxygen is constant and when the cyanide content is constant it increases with increasing oxygen content in the case of gold and decreases in the case of silver. The electrode potential of both metals increases with increasing cyanide and decreases with increasing oxygen content of the solution. There appears to be some relation between the rate of dissolution and the electrode potential of gold (but not of silver) as determined by the flowing-solution, but not by the stationary-solution electrode. In cyanide solutions saturated with air the rate of dissolution of pure gold is controlled mainly by the rate of attack of the reagents when the cyanide concentration does not exceed 0.05% and mainly by the rates of diffusion of the reagents and products when the concentration is greater; the latter process controls the rate of dissolution of silver at all evanide concentrations. The effects of various impurities in the cyanide solutions have been determined and the results of all the tests are summarized in tables and graphs.-A. R. P.

Electrogalvanic Phenomena of the Oral Cavity Caused by Dissimilar Metallic Restorations. Everett S. Lain and G. Sherrill Caughron (J. Amer. Dental Assoc., 1936, 23, (9), 1641-1652) .- When two dissimilar metals have been used in making dental restorations in any mouth an electrolytic cell is set up which acts as a chronic irritant and causes discoloration, erosion, and disintegration of the metals with the development of serious lesions in the mouth. Removal of the metals and their replacement with a single metal or with electrochemically balanced pairs results in complete recovery. Many examples are described.—A. R. P.

\*Mechanism of Diffusion Across Protective Oxides, and the Effect of Pressure on the Rate of Oxidation of Nickel. Gabriel Valenski (Compt. rend., 1936, 203, (22), 1154-1156).—It is shown mathematically that the rate of oxidation,  $\frac{dQ}{dt} = -\mu \frac{\delta x}{\delta z} \cdot S$ , where  $\mu$  is the coeff. of diffusion, x the concentration of effective atoms, z the thickness of the sheet, and S its area. By integration, Q is shown to vary as the square root of the time, t, and to be independent of the pressure at sufficient pressures. The thermal coeff., proportional to  $e^{-\frac{W}{RT}}$ , where W is the activation energy, satisfies the law of Arrhenius, except near the temperature of dissociation. It is shown with nickel sheets 0.1 mm. thick, at a fixed temperature and decreasing pressure, that  $Q^{\alpha}$  remains proportional to the temperature, and that the pressure has no effective influence down to a pressure of the order of 5 mm. of mercury, below which the reaction is strongly retarded.—J. H. W.

Tantalum Solves Severe Corrosion Problem. Harold W. Paine (Chem. and Met. Eng., 1936. 43, (9), 473).—One of the newer processes for the treatment of pyroxylin involves some severe corrosion and contamination problems which have been successfully solved by the use of tantalum sheathing. One stage of the process requires the use of a strong salt brine containing mineral acid, at a temperature somewhat above 100° C. For the steam inlet a brass pipe lined and sheathed with tantalum was adopted. A slowly rotating stirrer was made of stainless steel over which a sheet of tantalum 0.012 in. thick was welded together; tantalum was also used for the valve plug.—F. J.

\*The Corrosion of Assemblies. Jean Cournot and Marc Baudrand (Compt. rend., 1936, 203, (24), 1361–1363).—Using rivets of a high-resistance light aluminium alloy, the same cadmium electroplated and rustless steel, the riveting of 3 light alloys and 4 alloy steels was investigated. Pressure riveting was found to be distinctly superior to hammer riveting. In the light alloy assemblies the cadmium-plated aluminium rivets gave the best resistance to corrosion, and the steel ones the least. In the steel assemblies, the cadmium plated light alloy rivets gave the best autoprotection, and the steel rivets the worst, but they had a superior mechanical security.—J. H. W.

\*Soil Corrosion Studies, 1934. Rates of Loss of Weight and Penetration of Non-Ferrous Materials. Kirk H. Logan (J. Research Nat. Bur. Stand., 1936, 17, (5), 781-804; Research Paper No. 945) .- The soil corrosion investigation, which was started in 1922, had its origin in the need for information concerning the effects of soils on iron and steel. Specimens of protective coatings and of non-ferrous metals were added from time to time. A systematic study of the corrosion of non-ferrous materials was not begun until 1932, and in the latest tests the specimens represent only copper and copper alloys. The number of non-ferrous specimens exposed to soils has increased to approx. 9000, of which 2500 have not been removed. Differences in dimensions of the specimens buried prior to 1932, insufficient numbers of specimens of each material, and the introduction of too many factors that may affect corrosion have resulted in complications of the data to such an extent that in many cases positive decisions as to the rates of corrosion or the effects of possible influences on corrosion cannot be made. Nevertheless, although the dispersion of the data is large, certain tendencies are sufficiently well defined to be of practical importance. The results of the experiments should be of value also as indicators of the direction which more systematic investigations should take. This report summarizes the effects of a large variety of soils on many non-ferrous metals and alloys: lead and its alloys, copper, brasses, bronzes, copper-silicon, copper-nickel, copper-nickel-zinc, copper-aluminium, copper-aluminiumiron, zinc, aluminium, aluminium-manganesc, Duralumin, and galvanized steel. Data on the corrosion of iron subjected to the same conditions are also given. In general, the non-ferrous materials, with the possible exception of aluminium and its alloys, in certain soils corrode less than the ferrous materials in similar soil conditions, but none of the materials tested was free from corrosion in all soils. It appears, therefore, that in the choice of materials soil conditions should be given consideration. Unfortunately, there have been few systematic studies of soils from the point of view of corrosion and not many investigators can predict from the chemical or physical analysis of soils their effect on metals exposed to them. The proper selection of materials for uso underground requires special knowledge of soils, metals, electrochemistry, and economics.—S. G.

\*The Theory of the Mechanism of Corrosion. V.—The Application of the Pore Theory of Corrosion to the Balance Effect of Thiel and Eckell. W. J. Müller and E. Löw (Z. Elektrochem., 1936, 42, (11), 789–792).—By the application of Kirchoff's law of the current distribution of a local cell with a shunt, the equation:  $\Delta = i_E K = i_E \cdot \frac{W_P}{W_P + W_*}$ , can be deduced for the balance effect found by Thiel and Eckell (Z. Elektrochem., 1927, 33, 370) to be a linear function of the external current intensity. This provides further proof that the solution of the metal is a purely electrochemical process, and affords a direct confirmation of the propounded theory of corrosion. The numerical results of Thiel and Eckell's results with auxiliary cathodes of different overvoltage (platinum and copper) show that the magnitude of the balance effect is largely dependent on the over-voltage of the cathode, but that the constant, K, is independent of the composition of the auxiliary cathode, as the theory requires.—J. H. W.

# **V.**—**PROTECTION**

#### (Continued from pp. 8-10.)

Alumilite. W. Birett (Siemens Rev., 1936, 12, (4), 126-130).—Describes the practical application of anodically treated aluminium, and discusses the difficulties encountered in producing it on composite parts.—R. Gr.

Anodic Oxidation of Aluminium and Its Alloys. —— (Metallurgist (Suppt. to Engineer), 1936, 10, 182–183).—A brief review, referring particularly to the "Eloxal" product.—R. G.

Protective Action from Amalgamation of Chromium-Platings on Copper. V. I. Arkharov and M. V. Voienkov (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (6), 786).—[In Russian.] A chromium deposit 1 µ thick provides sufficient protection to copper from the action of mercury liquid and vapour. —D. N. S.

Lead Coating Processes. Rudolf Plücker (Illust. Zeit. Blechindustrie, 1936, 65, (44), 1297-1298).—Describes the hot-dipping process, and a method for making the coating so produced homogeneous and non-porous; short descriptions are also given of the galvanizing and spraying processes.—P. M. C. R.

tions are also given of the galvanizing and spraying processes.—P. M. C. R. Lead-Covered Steel Sheet for Pressings. E. E. Halls (Machinist (Eur. Edn.), 1936, 80, (47), 691E).—Describes the manufacture and corrosionresistance properties of terme plate. The lead coating is applied by dipping in molten lead containing, for instance, tin, tin and antimony, or tin 1, zinc 1, and mercury 0.5%; by hot spraying, or by electroplating in fluoride baths. The lead coating assists in drawing and forming operations, and affords a good foundation for organic finishes.—J. H. W. Manufacture of Galvanized Sheet-Iron Ware. Ernst Siebel (Stahl u. Eisen, 1936, 56, (47), 1382–1385).—The manufacture of galvanized pails and roof-windows is described. In the galvanizing operation an economy of 20-25% of zine is obtained by pickling the finished article, rinsing free from iron salts, immersing in zine chloride solution, drying without washing, and immersing in the molten zine which is not covered with ammonium chloride, in preference to the old process of passing the article, after the pickling and rinsing operations, without drying through an ammonium chloride layer into the zine bath.—A. R. P.

\*Increasing the Resistance of Steel to Corrosion by Sea-Water under Endurance Stresses by Surface Hammering, Nitriding, Gase-Hardening, and Electrodeposition of Zinc. A. Jünger (*Mitt. Forsch. Anst. G.H.H.-Konzern*, 1937, 5, (1), 1-12).—Coatings of zinc or lead applied by the hot-dipping process do not improve the fatigue limit of constructional steels under corrosive conditions (salt-spray) although they retard the rate of corrosion of the metal considerably. Electrolytic zinc deposits, however, considerably increase the endurance limit of nickel-chromium steels in sea-water, but not quite to such an extent as nitrogen case-hardening docs.—A. R. P.

The Spraying of Molten Metal. V. M. Moynahan (Metal Cleaning and Finishing, 1936, 8, (12), 833-836).—The production and uses of sprayed metal coatings are briefly described.—A. R. P.

\*The "Cumberland " Process for Combating Electrolytic Corrosion. Walther Schmid (*Rev. gén. Élect.*, 1936, 40, (15), 477–480).—In the Cumberland process, corrosion is prevented by polarizing the system by the use of an exterior source of current. Experiments with two electrodes of Muntz metal and iron immersed in water, using a third auxiliary iron electrode, are described, and the results discussed.—J. C. C.

Polish and the Prevention of Corrosion. — Plücker (*Illust. Zeit. Blech-industrie*, 1936, 65, (43), 1268–1269).—The heterogeneous outer skin formed in casting is more liable to corrosive attack than the close, coherent surface presented by polished material, though the latter may appear more susceptible because the effects are more readily visible. The characteristics of an effective polish are considered.—P. M. C. R.

Choice and Method of Surface Treatment from the Point of View of Corrosion Prevention and of the Possible Use of Substitute Materials. H. Krause (Illust. Zeit. Blechindustrie, 1936, 65, (50), 1494–1499).—The materials which replace certain metals, the use of which is now restricted in Germany, require special protective methods, the selection of which must be governed by the relative importance of appearance, corrosion-resistance, and mechanical properties. The advantages and limitations of electrodeposition, spraying, galvanizing, anodic oxidation, and coatings of phosphate, chromate, rubber, paint, or enamel are discussed in reference to a number of base materials.—P. M. C. R.

The Comparative Evaluation of Modern Finishes. Leo Roon (Monthly Rev. Amer. Electroplaters' Soc., 1936, 23, (8), 30-34).—Methods of testing the life of lacquer and paint finishes are described. Accelerated tests give little information as to the behaviour of the finish under ordinary weathering conditions. The important point in testing finishes is not so much the time required to produce cracking, peeling, or scaling, but the time during which the finish will retain most of its original appearance.—A. R. P.

### VI.—ELECTRODEPOSITION

#### (Continued from p. 10.)

The Future of Cadmium Plating. Gustaf Soderberg (Monthly Rev. Amer. Electroplaters' Soc., 1936, 23, (11), 33-37).—Cadmium plate is more resistant to corrosion by alkaline solutions and more serviceable as a protection of copper and brass than is zinc plate. Cadmium also solders more easily and plates more readily on malleable cast iron than zinc.—A. R. P.

\*The Electrodeposition of Sheet Chromium. R. H. Roberts (*Trans. Faraday* Soc., 1936, 32, (12), 1722–1723).—The metal was deposited on hollow brass cylinders rotated at 60 r.p.m., using lead cathodes and a bath containing 250 grm. of chromium trioxide and 3 grm. of chromic sulphate per litre operated at 42° C. After 7 days a deposit about 1 mm. thick was obtained; after making a vertical slit in the deposit the brass was dissolved away in nitric acid and the brittle chromium softened by heating first in hydrogen at  $1600^\circ$ – $1700^\circ$  C., then in vacuo at  $900^\circ$  C.—A. R. P.

\*On the Method of Determining the Quality of Bright Chromium Plate. S. M. Kochergin (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (7), 844-845). --[In Russian.] The relation between the external appearance of chromium deposits under the microscope and the distribution of porosity determined by the electrolytic deposition of copper, was noted. Photomicrographs of plates before and after copper deposition are shown.--D. N. S.

The Control of Chromium Plating Solutions. A. A. Pearson (J. Electrodepositors' Tech. Soc., 1936, 11, 191–197; and Met. Ind. (Lond.), 1937, 50, (1), 15–17).—William James Memorial Prize Essay. Methods are given for the determination of  $CrO_3$ ,  $SO_3''$ , Cr, and  $Fo^{\cdots}$  in Cr-plating baths.  $SO_4''$  can be determined rapidly by measuring the volume of  $BaSO_4$  precipitate when  $BaCl_2$ is added to the solution in a graduated contrifuge tube and the mixture centrifuged under standard conditions.—A. R. P.

The Bek Process: Gold Plating Followed by Heat-Treatment to Produce Diffusion. Louis Weisberg (*Met. Ind.* (N.Y.), 1936, 34, (8), 295–297).—The general principles of the Bek process of gold-coating base metal stock are outlined, and methods of controlling the composition structure and colour of the coating are briefly discussed.—A. R. P.

Electroplating on Lead-Antimony Alloys. Walter R. Meyer (Metal Cleaning and Finishing, 1936, 8, (12), 751-756).—The following procedure is recommended. The metal is cleaned in a solvent cleaner or vapour degreaser, then in an electrocleaner consisting of a solution of 4 oz./gall. of sodium silicate containing a wetting-out agent using 20-50 amp./ft.<sup>2</sup> for 1-3 minutes, and finally as anode for 10-15 seconds in a solution of sodium carbonate (4 oz./ gall.). Surface oxides are removed by dipping first in a warm caustic soda solution (2 oz./gall.), then in 20% hydrochloric acid, and finally in water. The article can then be plated directly with nickel from a warm sulphate bath, or copper from a cyanide bath, and eventually chromium plated for 3 minutes at 100 amp./ft.<sup>2</sup>,—A. R. P.

Effects of Composition and Structure on Corrosion of Nickel Anodes. A. Gorden Spencer (Mouhly Rev. Amer. Electroplaters' Soc., 1936, 23, (12), 21– 30; discussion, 30–32; and Met. Ind. (Lond.), 1937, 50, (4), 141–144).—The most even anodic corrosion is obtained when the nickel has a fine-grained structure, and is relatively free from inclusions of other metallic or nonmetallic constituents along the grain boundaries. Any impurities present should, therefore, be in solid solution or in the form of finely dispersed eutectic. Modern nickel anodes are of two types (a) oxidized, containing carbon <0-01, iron <0-15, copper > 0.06, silicon > 0.15, sulphur (preferably as MgS) > 0.1, oxygen 0.1-0.2, and nickel > 99.4%; (b) " carburized," containing carbon 0.08-0.3, iron > 0.15, manganese 0.05-0.15, copper > 0.1, silicon 0.05-0.35, sulphur 0.005-0.01, and nickel > 99%.—A. R. P.

Nickel and Chromium Plating of Tungsten Filament. V. D. Poljakov (Zhurnal Prikladnoi Khimii (J. Applied Chem.), 1936, 9, (6), 1033-1037).--[In Russian.] The superior performance of citric acid nickel baths is once more demonstrated; the deposits on tungsten are perfect so far as adherence and appearance are concerned, which indicates that nickel and tungsten are mutually soluble in the solid state. Chromium plating of tungsten filament gives similar results irrespective of the presence or absence of a nickel foundation.—N. A.

The Electrodeposition of Nickel on Zinc. J. M. Cosgrove (Monthly Rev. Amer. Electroplaters' Soc., 1936, 23, (12), 7-17; discussion, 18-20).—The following procedure has given satisfactory non-porous and strongly adherent deposits of nickel on zinc: the metal is buffed with a lime composition, electroeleaned in hot sodium metasilicate solution, rinsed, dipped in 5% hydrofluorie acid, rinsed, etched in 5% hydrochloric acid containing 0.6 oz./gall. of nickel, rinsed, and nickel-plated in a solution containing nickel 2.5, boric acid 2.5, ammonium chloride 2.5, and sodium sulphate about 8 oz./gall.—A. R. P.

Tin-Plating. C. C. Downie (*Electrician*, 1936, 117, (3052), 661).—It is suggested that iron sheets might be tinned in a scrap de-tinning plant. At intervals, after sufficient tin had been recovered as a deposit on the copper sides of the bath, the current would be reversed and clean iron sheets introduced as cathodes.—J. C. C.

Electrodeposition of Tungsten with Other Metals. —— (Metal Cleaning and Finishing, 1936, 8, (9), 660-661).—It is stated that a method has been developed in America for the plating of ferrous and non-ferrous metals with an alloy of tungsten with one or more of the metals iron, cobalt, nickel, molybdenum, tantalum, columbium. No details of the bath or operating conditions are given, but it is claimed that the deposits are hard, flexible, strongly adherent, and highly resistant to corrosion; they can also be carburized to obtain hard surfaces of great wear resistance.—A. R. P.

The Analysis of Zinc and Cadmium Plating Solutions. (Meyer and Daniels.) See p. 55.

The Electrodeposition of Zinc. George B. Hogaboom (Monthly Rev. Amer. Electroplaters' Soc., 1936, 23, (11), 19-26; discussion, 26-32).—A general discussion of the effects of variations in the zinc, cyanide, and caustic soda contents on the behaviour of the cyanide zinc-plating bath.—A. R. P.

<sup>†</sup>Throwing Power and Current Distribution in Plating Baths.—I.-III. Leonard C. Flowers (*Metal Cleaning and Finishing*, 1936, 8, (9), 571-576; (10), 683-686; (11) 767-768, 770).—Recent work on throwing power is critically reviewed and data for various commercial plating solutions are summarized; a bibliography of 30 references is appended.—A. R. P.

Summary of Studies on Electrodeposition at the [U.S.] National Bureau of Standards. W. Blum (Monthly Rev. Amer. Electroplaters' Soc., 1936, 23, (11), 5-8; discussion, 8-9).—Recent work at the Bureau on the protective value of plated coatings, the measurement of the thickness of deposits and their adherence, and the use of copper cyanide solutions is summarized.—A. R. P.

Report of Joint Committee on Exposure Tests of Plating on the Non-Ferrous Metals. William Blum (Monthly Rev. Amer. Electroplaters' Soc., 1936, 23, (11), 9-18).—The preparation of the specimens is described. The tests are being made on nickel- and chromium-plated copper and brass base metals and on zine and zine-base die-castings, the thickness of the two plates being varied over a wide range.—A. R. P.

The Use of Metal Rectifiers for Electroplating in England. Richard M. Wick (Monthly Rev. Amer. Electroplaters' Soc., 1936, 23, (8), 7-13; discussion, 14-29).—Various types of copper oxide rectifiers are described, and their performance as power units for plating baths is discussed. In the discussion the relative merits of the motor generator outfit and metal rectifiers are compared; American experience indicates that generators driven by synchronous motors are far more flexible and economical for plating purposes than metal rectifiers.—A. R. P.

Cost Determination and Route Planning in a Job Plating Plant. C. B. F. Young and A. Lakos (*Metal Cleaning and Finishing*, 1936, 8, (11), 757-760).— A system of job-cards for following a job through the various operations of a plating works and ascertaining the costs at the different stages is described.

-A. R. P.

Testing Plated Products for Quality. Sam Tour (*Met. Ind.* (N.Y.), 1936, 34, (6), 222–224).—Examples of the behaviour of poorly plated and highquality plated steel articles in the ferroxyl, salt-spray, bending, and micrographic tests are illustrated and briefly discussed.—A. R. P.

**Developments in Electroplating.** — (Nature, 1936, 138, (3495), 707-709). —Report of a symposium on electroplating before Section B of the British Association at its 1936 meeting.—B. C.

# VII.-ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

\*On the Anodic Potential of Chromium in Wave Current (Wellenstrom) Electrolysis. I.—Method of Measurement and Results. A. Geldbach and M. Schlötter (Z. Elektrochem., 1936, 42, (12), 889–900).—Wave current (Wellenstrom), or asymmetrical a.e., is the name given by Heinke to an electric current having a continuous component and an alternating component superimposed. The apparatus used to measure the anodic potential of chromium in wave current electrolysis is described in detail. The curves of  $\varepsilon - I_{\phi}$   $\varepsilon - I_{\phi}$  and  $\varepsilon - v$  (frequency) with rough and polished anode surfaces, in electrolytes of normal sulphuric and hydrochloric acids were determined.—J. H. W.

\*Temperature Coefficients of Single Electrode Potentials. J. Skotnicky (Coll. trav. chim. Tchécoslov., 1936, 8, (11), 496-519).—[In English.] Experiments with 5 different electrodes showed that the temperature coeffs. of the single electrode potentials, when the diffusion potentials are minimized to negligible values, depend chiefly on the activity of the ion which determines the potential of the electrode and on the relative change of this activity with change in temperature. In general terms  $dE/dT = dE_0/dT \pm (0.1984/\nu) \log a \pm (0.0257/\nu)\Delta a$  expressed in mv./1° C. The term  $dE_0/dT$  is constant within wide concentration limits for any given electrode and is practically independent of the other components of the electrode solution. The construction and standardization of a new and accurately reproducible electrode is described; it consists of the system: silver | AgCl |  $M \cdot NH_4$ Cl  $\neq$  cone. the solutions on either side has been eliminated. This electrode is defined by the expression:  $dE/dT = 0.194-0.1984 \log a Cl' - 0.0257\Delta a Cl'.—A. R. P.$ 

The Tellurium Electrode. O. Tomíček and F. Poupě (Coll. trav. chim. Tchécoslov., 1936, 8, (11), 520-531).—[In English.] The construction and use of the tellurium electrode is described; it is shown to be a reliable  $p_{\rm H}$  indicator within the range  $p_{\rm H}$  0-12 and to be unaffected by oxidizing agents and organic acids. In acid solutions a change of 1 in the  $p_{\rm H}$  value changes the potential by about 58 mv. and in alkaline solutions by about 87 mv.—A. R. P.

### IX.—ANALYSIS

### (Continued from pp. 10-11.)

\*Quantitative Spectroscopic Analysis of Alloyed Steels and Aluminium Alloys. K. A. Suhenko (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (6), 757-763).— [In Russian.] The apparatus used is described, together with its use in determining Si and Cr in Al alloys by means of visual photometry of the intensities of the Fe lines at 6400 and 5227:2 A (Fe) with the Si line at 6370.9 and the Cr line at 5208.7 A. The results are accurate to  $\pm 5\%$ .—D. N. S. \*Quantitative Spectroscopic Determination of Alkali and Alkaline-Earth Metals in Aluminium and Lead. A. K. Russakow and B. I. Bodunkov (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (7), 841-843).—[In Russian.] Al containing Li, Na, Ca, or Sr is dissolved in HCl and diluted to a 2% solution of AlCl<sub>3</sub>. Pb containing the same metals is dissolved in HNO<sub>3</sub> and the Pb precipitated with HCl. In either case the solution is blown at a uniform rate into a  $C_2H_2$  flame by means of a special apparatus. The absorption spectrum of the elements required is then examined by means of a wedge-shaped container filled with absorbing solution placed in front of the spectroscope slit, solutions of known concentration being used to establish the relation between the thickness of the wedge and the concentration of the element being determined. The accuracy of the determination was about 10%.—D. N. S.

\*Quantitative Spectrographic Analysis of Aluminium, Zinc, and Manganese in Elektron Alloy. L. E. Vedenski and S. L. Mandelshtam (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (8), 972-980).—[In Russian.] (1) The method described depends on a visual comparison of the intensity of the lines Al 5697 A., Zn 4811 A., and Mn 4824 A., with neighbouring lines of metals which are taken as a standard, viz. Mg 5711.5 A., Fe 4860 A. The accuracy obtained is 6-S%. (2) A new method is suggested involving photometric interpretation, which so far has been used only in astrophysics. The method consists in a step-wise reduction of the intensity of each spectral line and the comparison of their intensities with similarly reduced lines of elements taken as standards. A suitable reducing plate is prepared consisting of a quartz plate coated with a photographic emulsion film, which has been removed from a photographic plate after developing on it a photograph of the spark spectrum of Elektron. Photographs are taken using different exposures and the plate is moved each time by an amount equal to the width of the slit of the spectroscope. A reducing plate with 10 steps is thus obtained and calibrated using multiplets of different metals with known intensity ratios. By comparing the intensities of lines of the element to be estimated with the intensity of the basic element, the value of log I for any given line can be interpolated. Using a log I curve obtained with alloys containing a known proportion of the metal, the metal in the unknown alloy can be determined with an accuracy of 8-10%. -D. N. S.

The Spectrographic Analysis of Tin. D. M. Smith (*Tech. Publ. Internat. Tin Res. Develop. Council*, 1936, [A], (46), 1-26).—Al, Cd, and Zn within the range 0.001-1% may be accurately determined from examination of the spark spectrum produced under the following conditions: capacity, 0.006  $\mu$ F.; self-inductance, 0.03 mH.; spark length, 3 mm.; distance of spark from spectrograph slit, 20 cm.; width of slit, 0.02 mm.; exposure, 2 minutes after spark has run for 20 seconds. The plate should be developed until the Sn lines round 2100 A. are clearly visible on the plate. The Al lines used for comparison are 3082-2 and 3092-7, the Cd lines 2265-0, 2288-0, 2312-9, 3403-7, and 3466-2, and the Zn lines 2138-5 and 3302-6 + 3303-0 A.—A. R. P.

\*On the Microchemical Determination of the Corrosion Products of Aluminium and Magnesium Alloys. E. I. Nikitina (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (9), 1058-1063).—[In Russian.] The Mg is precipitated with 8-hydroxyquinoline, and the solution of the precipitate in HCl is titrated with KBr-KBrO<sub>3</sub> solution (accuracy  $\pm 0.02$  mg.). Cu is determined gravimetrically by the benzoinoxime method (accuracy  $\pm 0.03$  mg.), Zn by precipitation with K<sub>2</sub>Hg(CNS)<sub>4</sub> (accuracy  $\pm 0.04$  mg.), Fe by iodometric titration (accuracy  $\pm 3-4\%$ ). Mn by the colorimetric (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub> method, and Al by precipitation with 8-hydroxyquinoline in dilute CH<sub>3</sub>·CO<sub>2</sub>H.—D. N. S.

The Micro-Detection of Sulphides [in Tarnishes on Metals]. A. J. C. Hall (Soc. Chem. Ind. Victoria [Proc.], 1936, 36, (1/5), 1113-1117).—The presence of sulphides in tarnishes on metals or as inclusions in metals may be detected

by covering the surface with a solution of  $1.3 \text{ grm. of } \text{NaN}_3$  in 100 c.c. of 0.1N-I<sub>2</sub> solution. The formation of bubbles on the surface due to catalysis of the reaction  $2\text{NaN}_3 + \text{I}_2 = 2\text{NaI} + 3\text{N}_2$  indicates the presence of sulphides. Selenides, tellurides, or free S do not give the reaction. An alternative procedure consists in taking gelatin-HgCl<sub>2</sub> prints from the metal surface and testing these with the reagent. The test is extraordinarily sensitive and specific.

-A. R. P.

\*Rapid Method of Analysis of Tin Bronze. S. N. Shkotova (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (8), 1015-1016).—[In Russian.] Cu and Pb are removed by electrolysis in HNO<sub>3</sub> solution, the acid is reduced with CH<sub>2</sub>O and the Sn deposited by electrolysis on a Cu-plated cathode after addition of NH<sub>4</sub>Cl and N<sub>2</sub>H<sub>4</sub>·H<sub>2</sub>SO<sub>4</sub>. The solution is boiled with H<sub>2</sub>O<sub>2</sub>, rendered alkaline, and again electrolyzed for the deposition of Zn and Fe, the latter being subsequently determined with KMnO<sub>4</sub> after dissolving the deposit in H<sub>2</sub>SO<sub>4</sub>.—D. N. S.

The "Flouring" of Mercury as an End-Point in the Potassium Perman ganate Titration of Impurities in Mercury. H. P. Matthews (Soc. Chem. Ind. Victoria [Proc.], 1936, 36, (1/5), 1104–1106).—Many metals may be electrodeposited in a Hg cathode. The amount so deposited may be determined by washing the Hg free from electrolyte transferring it to a 100 c.c. stoppered conical flask, adding 100 c.c. of distilled H<sub>2</sub>O, a few drops of 0.1–0.02N-KMnO<sub>4</sub> and H<sub>2</sub>SO<sub>4</sub> until the liquid contains 2% of acid, and then titrating with the KMnO<sub>4</sub> with vigorous shaking between each addition until the colour just disappears and the Hg " flours."—A. R. P.

\*Electroanalysis of Silver-Copper Alloys. Walter L. Miller (Indust. and Eng. Chem. (Analyt. Edn.), 1936, 8, (6), 431-432).—The alloy (1 grm.) is dissolved in 30 c.c. of 1: 2 HNO<sub>3</sub>, the solution made alkaline with  $\rm NH_4OH$ , cooled, treated with 10 c.c. of  $\rm NH_4OH$  (d 0.88), and electrolyzed with a rotating Pt gauze cathode and a Pt spiral anode to deposit the Ag (10 minutes); 10 c.c. of 1% H<sub>2</sub>O<sub>2</sub> are added and electrolysis continued for 20 minutes at 0.2 amp. The cathode is washed first with water, then with alcohol, dried at 110° C., and weighed. The spent electrolyte is acidified with HNO<sub>3</sub>, an excess of 10 c.c. of acid added, and the Cu deposited with a current of 2.5 amp. using a rotating gauze cathode.—A. R. P.

The Analysis of Zinc and Cadmium Plating Solutions. Walter R. Meyer and David D. Daniels (Metal Cleaning and Finishing, 1936, 8, (12), 821-824). -Zinc cyanide solutions : 50 c.c. of the filtered solution is diluted to 500 c.c. and 25 c.c. of this are evaporated with 10 c.c. of H<sub>2</sub>SO<sub>4</sub> to fumes, 2 c.c. of HNO3 are added and, after heating again and cooling, the liquid is diluted to 100 c.c. and electrolyzed for Cu. The Fe is then removed with NH<sub>4</sub>OH, the solution acidified with HCl and the Zn titrated with K<sub>4</sub>Fe(CN)<sub>8</sub>. Total cyanide is determined by using a second 25 c.c. of the diluted plating solution, adding 25 c.c. of H<sub>2</sub>O and 5 c.c. of 20% NaOH solution and titrating with 0.1N-AgNO<sub>3</sub> at 45° C. until a permanent turbidity forms. NaOH is determined on a third 25 c.c. by adding 25 c.c. of H2O and 15 c.c. of 10% BaCl2 solution, filtering off the BaCO3, adding K4Fc(CN)6 and AgNO3 1 c.c. in excess of the above, and titrating the filtrate with  $0.25N-H_2SO_4$  using nitrazine yellow as indicator; titration of the BaCO<sub>3</sub> with the same acid gives a measure of the Na<sub>2</sub>CO<sub>3</sub> present. Cadmium cyanide solutions : 10 c.c. of the solution is evaporated to fumes with 15 c.c. of 1: 1H2SO4 and 2 c.c. of HNO3, the Cu is removed by electrolysis and the Fe with NaOH as for the Zn solution and the Cd titrated similarly with 0.2N-K4Fe(CN)6. Free cyanide is determined by direct titration with AgNO3 and NaOH and Na2CO3 by similar methods to those used for the Zn solution.-A. R. P.

\*Oxine Derivatives as New Qualitative Reagents. C. Franklin Miller (Chemist-Analyst, 1936, 25, (4), 86-87).—Phenyl-5-azo-8-hydroxyquinoline, prepared by coupling quinoline in NaOH solution with diazotized  $C_6H_5 \cdot NH_2$ , gives characteristic precipitates with a number of metals : Hg, violet; Cu, brown; Pd, violet; Ni, red. Tartaric acid prevents the reaction with Cu, Pd, and Ni and chlorides inhibit the reaction with Hg and Pd. The precipitates from other solutions are obtained even in relatively strongly acid liquors.—A. R. P.

\*Microscopical Qualitative Analysis of Antimony and Bismuth. Tetraethylammonium Iodide as a Reagent. Francis T. Jones and Clyde W. Mason (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1936, **8**, (6), 428-431).—SbCl<sub>6</sub> gives purple hexagonal plates and BiCl<sub>3</sub> yellow granules with KI and  $N(C_2H_5)_4Cl$ . Directions are given for applying the tests to mixtures of the two metals with or without other metals.—A. R. P.

\*Separation of Strontium, Barium, and Lead from Calcium and Other Metals by Precipitation as Nitrates. Hobart H. Willard and Edwin W. Goodspeed (Indust. and Eng. Chem. (Analyt. Edn.), 1936, 8, (6), 414–418).—Sr cannot be separated from Ca by precipitation of  $Sr(NO_3)_2$  with HNO<sub>3</sub> in organic solvents since the precipitate is incompleto, slimy, and unfiltrable. Addition of 100% HNO<sub>3</sub> to an aqueous solution of the two nitrates until the solution contains more than 79% HNO<sub>3</sub> results in complete precipitation of  $Sr(NO_3)_2$  in a dense crystalline form. Ba is similarly precipitated in 76% HNO<sub>3</sub>, and Pb in 84% HNO<sub>3</sub>. All the precipitates should be filtered only after 30 minutes from the time of addition of the HNO<sub>3</sub>; they should be washed with HNO<sub>3</sub> of the same strength as that used in precipitation and then dried at 130°-140° C. for 2 hrs. before weighing. Sr and Ba can be separated by the method from Al, Be, Bi, Cd, Ce, Cr, Co, Cu, Fe, Mg, Mn, Hg, Ni, Ag, and Zn, and Pb from Cd, Cu, Hg, and As but not from Sn and Sb.—A. R. P.

The Use of Tin Amalgam in Chemical Analysis. Iv. Tananaev and E. Davitaschvili (Z. anal. Chem., 1936, 107, (5/6), 175–180).—In 1–2N-HCl at  $60^{\circ}$ -70° C. an 8% Sn amalgam reduces Sn<sup>IV</sup> to Sn<sup>II</sup>, Cu<sup>II</sup> to Cu<sup>I</sup> or metal, and Ag<sup>I</sup>, Pb<sup>II</sup>, and Hg<sup>II</sup> to metal. Titration of the solution with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> using diphenylamine as internal indicator affords a measure of the metal reduced or precipitated.—A. R. P.

\*Micro-Determination of Antimony, Arsenic, Iodides, and Thiocyanates. I. M. Korenmann and Z. A. Anbrokh (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (6), 749–751).—[In Russian.] As and Sb may be determined by titration of the HCl solution  $(2 \cdot 5 - 3 \cdot 5N)$  with  $0 \cdot 01N$  KIO<sub>3</sub> in the presence of CHCl<sub>3</sub>, until the colour of the CHCl<sub>3</sub> layer disappears by formation of ICl.—D. N. S.

\*Determination of Arsenic [as] Silver Arsenate. Austin Pomerantz and Wallace M. McNabb (Indust. and Eng. Chem. (Analyt. Edn.), 1936, 8, (6), 466).—As is frequently precipitated as  $Ag_3AsO_4$  and determined indirectly by titration of the Ag in the precipitate with KCNS after dissolution in HNO<sub>3</sub>. The Ag can also be titrated with KI using starch and ceric ammonium sulphate as indicators.—A. R. P.

Determination of Copper in Pure Aluminium. Anton Brenner (Chem.-Zeit., 1936, 60, (94), 957).—The metal is dissolved in 30% NaOH solution and the residue containing the Cu is collected and dissolved in HCl and Br. The solution is treated with H<sub>2</sub>S, the CuS collected, washed, and ignited to oxide which is dissolved in HNO<sub>3</sub>, and the solution evaporated to fumes with H<sub>2</sub>SO<sub>4</sub>. After dilution and filtration the solution is treated with CH<sub>3</sub>CO<sub>2</sub>·NH<sub>4</sub>, a little gum arabic and 1 c.c. of 2% K<sub>4</sub>Fe(CN)<sub>6</sub>, and the colour measured in a Hellige colorimeter.—A. R. P.

Determination of Lanthanum with 8-Hydroxyquinoline. Th. I. Pirtea (Z. anal. Chem., 1936, 107, (5/6), 191-193).—The slightly acid La solution is treated with  $CH_3$ ·CO<sub>2</sub>NH<sub>4</sub>, then with an excess of the reagent in  $C_2H_5OH$  and finally with NH<sub>4</sub>OH until definitely ammoniacal. The precipitate is collected, washed, and dried at 130° C. for weighing (24:33% La) or dissolved in HCl and titrated with KBr-KBrO<sub>4</sub> solution.—A. R. P.

\*Volumetric Determination of Magnesium by the 8-Hydroxyquinoline-Permanganate Method. L. D. Raskin and I. F. Drosd (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (7), 807-808).—[In Russian.] After separation of Ca, Mg is precipitated by 8-hydroxyquinoline and the precipitate titrated with KMnO<sub>4</sub> in dilute  $H_2SO_4$ .—D. N. S.

\*Determination of Magnesium in the Presence of Zinc by Using 8-Hydroxyquinoline. S. J. Fainberg and L. B. Fligelman (Zavodskaia Laboratoria (Works' Lab.), 1930, 5, (8), 942–945).—[In Russian.] The feebly ammoniacal solution is treated with KCN to convert the Cu, Ni, and Zn into complex cyanides and the Mg is then precipitated with 8-hydroxyquinoline—D. N. S.

A Note on the Treatment of Magnesium Ammonium Phosphate Precipitates [in the Determination of Magnesium]. S. R. Scholes (*Chemist-Analyst*, 1936, 25, (4), 86).—Mg is usually precipitated as  $Mg(NH_4)PO_4$  which is ignited to  $Mg_2P_2O_7$  before weighing; washing with ammonical 10%  $NH_4NO_3$  solution ensures a white product after ignition instead of the usual greyish one.

-A. R. P.

\*Determination of Mercury. An Indirect Volumetric Method Based upon a Critical Study and Improvement of the Bichromate-Pyridine Method of Spacu and Dick. N. Howell Furman and Harold M. State (Indust. and Eng. Chem. (Analyt. Edn.), 1936, 8, (6), 467-468).—The solution containing the Hg as HgCl<sub>2</sub> is neutralized and treated with 10 o.c. of 20% (NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> solution and 1 c.c. of C<sub>8</sub>H<sub>5</sub>N (free from other organic bases). After 10 minutes the yellow precipitate is collected on a porous filter, washed with acetone, dried for 10-15 minutes in a vacuum desiccator, and dissolved in  $1\cdot 2N$ -HCl. The Cr<sub>2</sub>O<sub>7</sub>" is then determined by titration with FeSO<sub>4</sub> (diphenylamine indicator) or iodometrically.—A. R. P.

\*Micro-Determination of Nickel. I. M. Korenmann, A. L. Tenenboim, and S. M. Lialiushko (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (9), 1051– 1053).—[In Russian.] The well-known cyanide titration of Moore is carried out in the presence of tartaric acid, Rochelle salt, or  $Na_2P_2O_7$  without separating metals other than Cu and Co; the accuracy is about 5%.—D. N. S.

Determination of the Oxygen Content of Copper. Erich Nitsche and Ferdinand Waibel (*Wiss. Veröff. Siemens. Werken*, 1936, 15, (3), 87-91).—The method consists in heating 1 grm. of fine drillings at 500° C. in a small tube furnace to remove adsorbed gases, admitting a definite volume of pure dry O<sub>2</sub>-free H<sub>2</sub> and heating the metal at 900° C. until all Cu<sub>2</sub>O is reduced to metal and the H<sub>2</sub>O has diffused out of the Cu (generally 5 minutes is sufficient); the H<sub>2</sub> and H<sub>2</sub>O are then exhausted from the combustion tube through a tube cooled in a mixture of solid CO<sub>2</sub> and acetone in which the H<sub>2</sub>O condenses to snow, and when all the H<sub>2</sub> is removed from the apparatus the cooling mixture is replaced by water at 15° C. and the melted snow is vaporized into a manometer tube in which the volume and pressure of the resulting H<sub>2</sub>O are measured. From these figures the O content of the copper can be calculated with an accuracy of  $3 \times 10^{-7}$ grm.—A. R. P.

Investigations into the Analytical Chemistry of Tantalum, Niobium, and Their Mineral Associates. XXXIII.—General Summary and Results. W. R. Schoeller (Analyst, 1936, 61, (729), 806–811).—The methods developed in the preceding 32 sections are summarized and indexed.—A. R. P.

\*Gravimetric Determination of Vanadium and Uranium by Ammonium Benzoate and Salts of Certain Other Organic Acids. F. M. Shemiakin, V. V. Adamovich, and K. P. Pavlova (*Zavodskaia Laboratoria* (*Works' Lab.*), 1936, 5, (9), 1129–1132).—[In Russian.] Precipitation of V with  $C_8H_8$ ·CO<sub>2</sub>NH<sub>4</sub>. NH<sub>4</sub> cinnamate, or HgNO<sub>3</sub> gives satisfactory results with pure salts and Al alloys containing up to 5.3% V. Precipitation of U with tannin or ethylenediamine gives better results than precipitation with NH<sub>4</sub>OH or  $C_8H_8$ ·CO<sub>2</sub>NH<sub>4</sub>.

-D. N. S.

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\*Determination of Zinc in Non-Ferrous Alloys with 8-Hydroxyquinoline. L. D. Raskin (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (9), 1129).—[In Russian.] The precipitate is dissolved in acid and the solution titrated with  $KMnO_4$ .—D. N. S.

Detection and Determination of Small Quantities of Zinc with Dithizone. Hellmut Fischer and Grete Leopoldi (Z. anal. Chem., 1936, 107, (7/8), 241– 269).—In the presence of Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> and KCN in slightly acid solution the dithizone test is specific for Zn and can be used for detecting and determining colorimetrically as little as  $10^{-2}-10^{-3}$ % Zn in all metals except Cd. Analytical details for specific cases are given.—A. R. P.

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

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

### (Continued from p. 11.)

Improvements in Metallurgical Microscopes. Richard Pusch (Stahl u. Eisen, 1936, 56, (45), 1330-1337; (46), 1362-1364; discussion, 1364-1365).— A comprehensive review of recent articles dealing with new types of micrographic apparatus and technique (64 references and 30 illustrations of apparatus, micrographs, and optical diagrams are included).—A. R. P.

A Magazine Plate Camera for Photography in Vacuum. K. E. Fitzsimmons (*Phys. Rev.*, 1936, [ii], 50, (4), 386).—Brief abstract of a paper read before the American Physical Society. A magazine plate camera which provides for 8 to 16 separate exposures on  $3\frac{1}{2} \times 4$  in. plates without breaking the vacuum has been built for use with a high magnification electron microscope. Visual focussing of the image formed by the electron beam on a fluorescent screen is possible before each exposure. The camera is compact and the mechanical operation is smooth and positive; it is presumably generally adapted to photography in vacuum apparatus. [Note: No other details are given.]—S. G.

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

#### (Continued from pp. 11-13.)

Lighting Design in the Examination of Polished Surfaces. W. R. Stevens and J. M. Waldram (*Metal Cleaning and Finishing*, 1936, 8, (12), 849–854, 870).—Methods of detecting tarnish, scratches, lack of smoothness, and pinholes in sheet and plated metal by means of light reflections are briefly outlined. —A. R. P.

Increased Safety and Improved Quality Through the Control of Structural Materials. Wilh. Marx (*Machines*, 1936, (Dec.), 5–12).—A review of methods and apparatus employed in the static and dynamic testing of materials and of certain special products. Particular reference is made to the high-temperature flow test developed at the Kaiser-Wilhelm Institut für Metallforschung, Düsseldorf, and to the testing of springs and wire.—P. M. C. R.

\*Influence of Annealing on the Behaviour of Zinc Sheet in Erichsen Deep-Drawing Test. A. A. Botchvar and L. I. Dmitriev (*Izvestia Sektora Fiziko-Khimicheskogo Analiza* (Ann. Sect. Anal. Phys.-Chim.), 1936, 9, 147-152).--[In Russian.] The Erichsen value of rolled zinc sheet was determined after annealing at 100°, 150°, 200°, 225°, 250°, 300°, and 350° C. for 30 minutes. The value decreases with increasing annealing temperature, although a slight increase occurs between 150° and 200° C. accompanied by abnormal variations in the Brinell hardness, and grain-size These anomalies cannot be ascribed to allotropic changes since they are irreversible. The unusual shape of the grain-size curve is attributed to some change in the recrystallization process. The variations in the Erichsen value during annealing are due to the hexagonal structure of zine; the pronounced twinning which occurs when hexagonal metals are deformed, produces a new slip plane almost perpendicular to that already present, and hence the capacity of the metal for deformation is increased. On annealing, the twinned crystals rapidly disappear and this reduces the Erichsen number. A similar behaviour may be expected in the case of magnesium, cadmium, and alloys of the Elektron type.—N. A.

Indentation Hardness Testing. Vincent E. Lysaght (*Čanad. Chem. Met.*, 1936, 20, (12), 380–382, 384).—The following methods of testing hardness are described : Brinell, scleroscope, Rockwell, Vickers pyramid, and monotron.

-A. R. P.

Impact Testing. Geo. F. Tanner (*Post Office Elect. Eng. J.*, 1937, 29, (4), 309-313).—A full description is given of the standard Izod testing machine and of the preparation of test-pieces, together with notes on modified Izod machines for special purposes. The principal types of impact fracture are correlated with the mechanical properties of the material. The striking energy and striking velocity of the Charpy, Izod, Frémont, Amsler, and Guillery machines are tabulated. Notes are appended on the effect of the form of notch and of the size of the test-piece.—P. M. C. R.

Standard Specifications for Round-Hole Screens for Testing Purposes (E 17-36). —— (Book of A.S.T.M. Standards, 1936, (II), 1411-1412).—S. G.

### XII.—TEMPERATURE MEASUREMENT AND CONTROL

### (Continued from p. 13.)

Automatic Furnace Temperature Regulator. —— (J. Sci. Instruments, 1936, 13, (11), 374–376).—A regulator is described intended to operate from a.e. mains for use with resistance furnaces run on a.e. The regulator consists essentially of a Wheatstone bridge network, one arm of which consists of a platinum resistance thermometer. Any lack of balance operates a sensitive moving coil relay, and this, through a valve amplifier, closes a further relay which controls the furnace current. Contact difficulties are overcome by an auxiliary circuit which applies to the relay coil regular current impulses sufficient to open the contacts against any adhesion. The impulses are supplied by a condenser which charges through a resistance and discharges through a neon lamp at intervals of 20 seconds. This device is equivalent to the mechanical tapping of the relay every 20 seconds. Furnace temperatures have been held at 600° C. to within  $\pm 0.1^{\circ}$  C. for several hrs., and to within  $\pm 0.5^{\circ}$  C. for periods of the order of a week.—W. H.-R.

\*A New Type of High-Temperature Thermoregulator. A. S. Mikhelson (Zavodskaia Laboratoria (Works' Lab.), 1936, 5, (6), 792-793).—[In Russian.] The instrument operates with a mercury-gas relay in conjunction with the galvanometer recording the furnace temperature, a movable contact being placed above the galvanometer scale in a position corresponding to the desired temperature. The relay is operated through two triodes from a 3-stage transformer supplied with current from the grid and maintains a temperature constant to  $2^{\circ}-3^{\circ}$  C.—D. N. S.

\*Time Lag in a Control System. A. Callender and D. R. Hartree (*Phil. Trans. Roy. Soc.*, 1936, 235, (756), 415-444).—Theoretical. Control gear is often used to keep some physical quantity such as temperature as nearly constant as possible when it is subject to random disturbances. In many cases the operation of the control gear is determined by the behaviour of the quantity to be controlled—as, for example, when rise of temperature expands a liquid in a bulb, and the expansion actuates a relay which diminishes the supply of

VOL. 4

heat—but there is a time lag between this behaviour, and the effect of the resulting control operation. The theory of such systems is investigated, and a law of control is developed. The conditions for stable control are investigated, and the means of putting the theoretical conclusions into practice are discussed. —W. H.-R.

Usefulness of Pyrometry in Smelting Works and Foundries. Edmund R. Thews (Met. Ind. (N.Y.), 1936, 34, (11), 421-425).-L. A. O.

### XIII.—FOUNDRY PRACTICE AND APPLIANCES

#### (Continued from pp. 13-14.)

\*Examples of Melting in a High Vacuum. W. Kroll (Z. Elektrochem., 1936, 42, (12), 873–875).—In general, metals cannot theoretically be melted in a high vacuum, although sufficiently slow heating causes sublimation. In practice, however, melting can be effected by the sufficiently rapid application of energy. This is a result of the large volume which the metal vapour occupies at low pressure and high temperature as well as of its specific weight. The metal sublimes and condenses on the upper part of the crucible, and thus constricts the further flow of the metal vapour and causes a damming-up which follows the increase of temperature and pressure below the melting point. Other causes are suggested for this damming-up, such as the dissociation of the chemical compounds with gases, the evolution of gases owing to chemical reaction, and the escape of dissolved gases from the metal. The reactions of the vaporization of the resistance elements on the lining, such as the sublimation of the carbon and the reciprocal action between the material of the crucible and the melt are discussed.-J. H. W.

**†The Modification of Eutectic Structures in Castings.** (Scheuer.) See p. 44.

\*Study of the Causes of Discontinuity of Metal in Sprues During Pressure Casting [of Dental Alloys]. Raymond E. Myers (J. Amer. Dental Assoc., 1936, 23, (4), 554–568).—Experiments on the casting of a dental gold alloy into a dental plate in a Solbrig type of pressure casting machine indicate that discontinuity of the metal in the sprues is due to insufficient pressure to complete the casting, insufficient heating of the metal so that the residual button of metal solidifies before the pattern chamber and sprue are filled, and the use of a deficiency of metal so that the sprue cannot be kept filled during casting. The effect of these factors is discussed theoretically.—A. R. P.

The Melting of Platinum. C. M. Hoke (Met. Ind. (N.Y.), 1936, 34, (11), 433-435).—Practical hints for melting small lots of platinum scrap with the oxy-hydrogen blowpipe are given.—A. R. P.

Phosphor-Copper is Deoxidizer. James Brinn (Foundry, 1936, 64, (11), 28-29, 74).—The use of phosphor-copper as a deoxidizing agent for cast bronzes is discussed, and the proportions recommended for the various American alloys are given. It is suggested that the phosphorus acts by reducing the oxides present and that the gaseous oxide of phosphorus forms a thin layer on the surface of the molten metal, and envelops and protects the stream during pouring. Treatment with phosphor-copper is not successful if porosity is due to reducing gases or the metal already contains phosphorus as an alloy constituent. Phosphor-copper should be used in conjunction with good melting and pouring practice and not as a remedy to make good deficiencies in these respects.—J. E. N.

Bronze Wings for the Sea Queen [Queen Mary]. A. Eyles (Machinist (Eur. Edn.), 1936, 80, (47), 945–947).—Describes the moulding, melting, casting, and machining of the bronze for the propellers of the liner Queen Mary.

—J. H. W.

Light Metal Castings at the Sixth Foundry Exhibition [Düsseldorf, 1936]. —— (*Giesserei-Praxis*, 1937, 58, (1/2), 10–12).—Describes the composition and mechanical properties of several commercial aluminium alloys.—J. H. W.

The Melting and Casting of Magnesium Alloys. Edmund R. Thews (Leichtmetall, 1936, (1), 8-12).—Four important factors are pointed out: (1) the low sp. gr. of magnesium; (2) its high affinity for oxygen and nitrogen; (3) the reactivity of magnesium alloys with silica at high temperatures (graphite or fire-clay crucibles cannot be used); and (4) the explosive reaction of these alloys with moisture. Typical examples of melting flux are given as: (1) 60% anhydrous magnesium chloride and 40% potassium chloride; (2) 65-70% anhydrous magnesium chloride, 4-5% sodium fluoride, 3-4% calcium chloride, and 23-25% potassium or sodium chloride. Tea-pot spout ladles are recommended for pouring.—H. W. G. H.

The Foundryman's Fight Against Loss of Material. —— (Giesserei-Praxis, 1936, 57, (49/50), 545-547).—Discusses the common causes of metal loss in the foundry, and methods of overcoming them.—J. H. W.

Magnetic Moulding Machines. — (Engineering, 1937, 143, (3704), 37-38, 40).—Describes moulding machines in which the power required for the squeezing operation is obtained by the use of a solenoid giving a pressure of 35 lb./in.<sup>2</sup>. A solenoid operated moulding machine of the jolting type is also mentioned.—R. Gr.

Modern Moulding Machines at the Sixth Foundry Exhibition at Düsseldorf. —— (*Giesserei-Praxis*, 1936, 57, (45/46), 495–508).—A large number of different types of moulding machine exhibited at the Exhibition are illustrated, and their construction and operation are described.—J. H. W.

Mould and Core Protective Facings at Atmospheric and Elevated Temperatures. R. F. Hudson (*Found. Trade J.*, 1936, 55, (1059), 427–430).—Read before the Scottish Branch of the Institute of British Foundrymen. Facings are divided broadly into two classes, carbonaccous and mineral; the advantages and disadvantages of each are discussed as length, particularly in relation to cast iron and steel. Graphite is recommended for most non-ferrous alloys.—J. E. N.

The Alteration of Moulds. R. Lower (*Giesserei-Praxis*, 1936, 57, (47/48), 530-533).—Gives examples of moulds which, if no longer required, can be altered satisfactorily and at a lower cost than the provision of new moulds.

-J. H. W.

Some Notes on the Use of Colloidal Clay in Foundry Practice. —— (Found. Trade. J., 1936, 55, (1062), 490).—Some brief recommendations on the use of Colbond, a colloidal elay, for introducing and maintaining the bond in synthetic moulding sand.—J. E. N.

The Preparation of Moulding Sand for the Casting of Magnesium Alloys. —— (Giesserei-Praxis, 1936, 57, (51/52), 564-565).—Discusses the composition and mechanical properties of moulding sands suitable for casting magnesium alloys, and their preparation before use in the mould.—J. H. W.

Modern Machines for the Preparation of Moulding Sand. —— (Giesserei-Praxis, 1936, 57, (45/46), 508-516).—A number of such machines exhibited at the 6th Foundry Exhibition at Düsseldorf in 1936 are illustrated, and their construction and operation are described.—J. H. W.

Is the Pattern Maker a Manual Labourer or a Skilled Workman? Richard Löwer (*Giesserei-Praxis*, 1936, 57, (51/52), 574-575).—Discusses the status of the pattern maker and describes the many and varied technical operations that he must be capable of carrying out.—J. H. W.

# XV.—FURNACES AND FUELS

(Continued from pp. 14-15.)

Of What Use Are Induction Furnaces to Aluminium and Light Alloys ? J. Bally (*Rev. Aluminium*, 1936, 13, (85), 433–439).—Briefly describes lowinduction furnaces of the Kjellin, Röchlung, and Ajax–Wyatt types, which are not, however, considered industrially practical for melting aluminium. On account of the relatively large movement of aluminium compared with that of heavy metals, and the oxidation that the agitation causes, the high-frequency furnace is also considered to be unsuitable for aluminium. The lowinduction furnace with indirect heating and auto-regulation of temperature has distinct applications, however, for the melting of light metals, and is discussed from technical and economic points of view.—J. H. W.

Electric Annealing of Brass and Copper. T. B. Bechtel (*Met. Ind.* (*N.Y.*), 1936, 34, (1), 12–14).—A double-chamber recuperative-type electric furnace for annealed coiled brass strip is described; it consists of a heating chamber 10.5 ft. long and a recuperative chamber 20.5 ft. long, each being 7 ft. wide and taking two trays across the width. The trays travel through the recuperative zone, then through the heating chamber and back through the recuperative zone, where part of their heat is given up to incoming trays. The furnace is operated with 240 kw. in 3 zones of automatic temperature control and anneals 6000 lb./hr. at  $410^\circ$ -675° C., the charge taking 4.25 hrs. to traverse the furnace. Copper wire spools are continuously annealed in a travelling grate type of a bright-annealing furnace using a burnt gas atmosphere and a long waterjacketed cooling chamber.—A. R. P.

Automatic Control of Electric Furnaces. Maurice Déribéré (*Technique* moderne, 1936, 28, (10), 367–372).—The advantages of automatic control are given under the headings: improvement of the work, saving in labour, protection of the plant, and reduction of voltage fluctuations on the supply line. Pyrometric controls of various types and the self-controlled induction furnace are described. The control of arc furnaces, however, occupies the greater part of the article. Four methods are discussed—constant current, constant voltage, constant power, and differential—involving displacement of the electrodes. The Brown-Boveri and Secomet-Vastel-Stein systems are explained in detail.—H. W. G. H.

Methods of Fuel Economy in Small Industrial Units. R. J. Sarjant (Fuel Econ. Rev., 1936, 13-14, 16).—Methods of controlling furnace operations to ensure the best utilization of the fuel are briefly discussed.—A. R. P.

Standard Method of Sampling Coke for Analysis (D 346-35). — (Book of A.S.T.M. Standards, 1936, (11), 439-443).—S. G.

### XVI.—REFRACTORIES AND FURNACE MATERIALS

Standard Definitions of Terms Relating to Refractories (C 71-36). —— (Book of A.S.T.M. Standards, 1936, (II), 255-256).—S. G.

Standard Definitions for Fireclay Refractories (C 27-35). — (Book of A.S.T.M. Standards, 1936, (II), 253-254).—S. G.

\*Expansion Measurements at Temperatures up to 2000° C. H. Ebert and C. Tingwaldt (*Physikal. Z.*, 1936, 37, (13), 471–475).—A method of measuring expansions of ceramic materials up to 2000° C. by observation with travelling microscopes is described. Results for corundum, magnesia, and zirconium oxide are included.—B. C.

Standard Method of Test for Refractory Materials under Load at High Temperatures (C 16-36). —— (Book of A.S.T.M. Standards, 1936, (II), 224– 228).—S. G. Standard Method of Test for Pyrometric Cone Equivalent of Fire Clay and Fire Brick (C 24-35). — (Book of A.S.T.M. Standards, 1936, (II), 229-232).—This method is intended for determining the P.C.E. of fireclay, firebrick, silica cement, and ground fireclay by comparison of test cones with standard pyrometric cones under the conditions specified.—S. G.

Standard Method of Test for Permanent Linear Change After Reheating of Refractory Brick (C 113-36). — (Book of A.S.T.M. Standards, 1936, (II), 222-223).—S. G.

Standard Method of Panel Test for Resistance of Refractory Brick to Thermal and Structural Spalling (C 38-36). — (Book of A.S.T.M. Standards, 1936, (II), 212-219).—This method of test is intended to show the resistance of refractory bricks to the separate and combined effects of structural and thermal spalling.—S. G.

Standard Method of Test for Particle Size of Ground Refractory Materials (C 92-36). — (Book of A.S.T.M. Standards, 1936, (II), 233-235).—S. G.

Standard Methods of Chemical Analysis of Refractory Materials (C 18-35). — (Book of A.S.T.M. Standards, 1936, (II), 236-252).—S. G.

### XVII.-HEAT-TREATMENT

#### (Continued from pp. 15-16.)

<sup>†</sup>Quenching Steel and Metallic Alloys. L. Grenet (*Métaux*, 1936, 11, (132), 156–165).—Universally admitted facts and differences of opinion on the subject of tempering are examined. It is considered that the hardening of steel and alloys by heat-treatment is bound up with a transformation with a change of phase at low temperature. The examination of equilibrium diagrams does not indicate any difference in action of the transformation points of steel or of non-ferrous alloys. When one phase out of equilibrium decomposes throughout into two phases, there is a period in this evolution when the material elements are in irreversible evolution towards the production of a small number of elements coalesced into a distinct phase. In the case of rigid alloys, the intermediate states between the state of one phase and that of many phase are maintained by the passive resistance bound up with the rigidity of the metal. Although very often a state of equilibrium can be defined in simple terms, there is no law of simple definition.—J. H. W.

Aluminium Bronzes and Their Heat-Treatment. M. G. Corson (*Met. Ind.* (N.Y.), 1936, 34, (7), 250–253).—Practical instructions are given for the melting, casting, working and heat-treatment of aluminium bronzes with 5–10% aluminium, up to 5% iron, and small amounts of tin, manganese, or nickel.

-A. R. P.

\*The Theoretical Basis for Selecting Optimum [Annealing] Temperatures for Single Phase Metals. I.—The Question of Recrystallization Diagrams. (Botchvar and Puzikin.) See p. 44.

On the Corrosion-Resistance of Clad Duralumin [Effect of Heat-Treatment]. (Kroenig and Pavlov.) See p. 47.

# XVIII.-WORKING

#### (Continued from pp. 16-17.)

A Swedish Metal Working Plant. Methods and Equipment of Svenska Metallverken. —— (Met. Ind. (Lond.), 1936, 49, (25), 601-605).—As the result of a rationalization scheme, the co-ordinated Swedish metal works divide production among the works according to a definite schedule. A concise description is given of the lay-out and plant at the Västeras works, handling semi-finished products, plates, sheets, tubes, rods, wire, and extruded sections

Vol. 4

in a large range of non-ferrous alloys, and at the Skultuna works, where finished products, such as kitchen utensils, tanks, vats, &c., are handled.

-J. E. N.

\*Intermetallic Compounds and Phases of Variable Composition in Ultra-Light Bimetals. V. A. Bobrov (*Izvestia Sektora Fiziko-Khimicheskogo Analiza* (*Ann. Sect. Anal. Phys.-Chim.*), 1936, 9, 99–127).—[In Russian.] The casting method of producing Elektron-aluminium bimetal was found to be inferior to the rolling method. The nature of the interface varies with the amount of brittle  $Al_3Mg_4$  and other intermediate phases of variable composition formed. To reduce these to a minimum the first hot-rolling should be effected at the lowest possible temperature to the smallest possible thickness avoiding intermediate annealing, and the Elektron should contain a minimum of elements which diffuse readily into aluminium to form solid solutions. Elektron of the V type is preferable to that of the AZM type.—N. A.

The Manufacture of Thin Sheet. K. Schönert (Illust. Zeit. Blechindustrie, 1936, 65, (50), 1483-1484).—This brief illustrated description emphasizes the importance of the three annealing processes, for the respective purposes of assisting recrystallization, removing stresses, and normalization.—P. M. C. R.

The History of Corrugated Sheet. O. Vogel (Illust. Zeit. Blechindustrie, 1936, 65, (44), 1294-1296; (45), 1324-1326; (46), 1354-1357; (47), 1388-1389; (48), 1415-1416).—A review of the manufacture of corrugated sheet from the earliest times. Tinned copper sheet of this type was first made on an extended scale in 1819, and iron sheet in 1830. The development of plant and machinery and of the applications of the material is traced, with illustrations. —P. M. C. R.

<sup>†</sup>Lubricants Employed in Deep-Drawing. J. D. Jevons (Met. Ind. (Lond.), 1936, 49, (24), 577-582; (25), 607-610; (26), 629-632; 1937, 50, (1), 9-10).— The lack of collected information on lubricants, especially those suitable for pressing operations on metals, is deplored, and it is pointed out that there is no standard by which to designate and compare the performance of different lubricants on similar metals, even on similar operations. Ten principal properties or attributes are suggested as desirable : slipperiness, film strength, heat-resistance, cost, ease of removal, spreading power, adhesiveness, stability, corrosiveness, psychological and physical effect on users, and these are discussed in detail. It is shown that most of the desirable properties " are the manifestation of one fundamental phenomenon, namely the existence and nature of what is termed the adsorbed film formed by certain lubricants upon the surface of most commonly used metals." Typical lubricants and the choice of a suitable drawing lubricant conclude the review.—J. E. N.

Aluminium Pressings. A New Type of Fabricated Shapes. H. L. Smith, Jr., and S. G. Maltby (*Machinist (Eur. Edn.*), 1936, 80, (46), 674-676E).— Describes the action of presses for the use of aluminium alloys, gives examples of shapes especially suitable for pressing, and discusses the advantages of pressing over dic-casting and the probable future development of aluminium pressings.—J. H. W.

The Forming of Light Metals. Max Thiele (Illust. Zeit. Blechindustrie, 1936, 65, (52), 1490–1491).—An account of the cutting, pressing, piercing, and drawing of aluminium, with a concluding note on the die-casting of aluminium and zinc.—P. M. C. R.

Screw Machine Performance on New Aluminium Alloy [115]. L. W. Kempf and A. Hartwell (*Metal Progress*, 1936, 30, (6), 34–37).—After an analysis of the cost of articles produced in a screw-machine, optimum angles and rates of feed for two standard light alloys (17S and 11S) and for a free-cutting brass are considered. It is found that less power is required in the working of the light alloys, "11S" permitting the widest variety of tool angles. The mechanical properties of "11S" are tabulated.—P. M. C. R.

# XIX.—CLEANING AND FINISHING

(Continued from pp. 17-18.)

The Shot-Cleaning of Metallic Surfaces. —— (Machines, 1936, (Dec.), 19-24).—The advantages of shot-cleaning over sand-blasting arc said to include increased output, improved quality of work, reduction in cost, and decreased dust. The method is described, and an estimate of costs is given. Brief instructions are appended for shot-cleaning various types of castings and forgings, for preparing surfaces for the reception of protective coatings, and for finishing motor and cycle parts.—P. M. C. R.

Modern Cleaning Machines at the Sixth Foundry Exhibition at Düsseldorf, 1936. —— (Giesserei-Praxis, 1936, 57, (49/50), 540-544).—Different types of tumbling machines, exhibited at the exhibition, are illustrated, and their construction and operation are described.—J. H. W.

Electrochemical Process Removes Scale Without Damaging Metal. Floyd T. Taylor (*Metal Cleaning and Finishing*, 1936, 8, (12), 825–828).—A brief description is given of the Bullard–Dunn process for descaling iron and steel prior to plating, and its advantages over chemical processes are discussed.

-A. R. P.

Grinding Hard-Faced Surfaces. R. K. Kennedy (Metal Cleaning and Finishing, 1036, 8, (9), 621–623, 626).—Suitable types of abrasive wheels for grinding surfaces faced with Stellite are tabulated and their method of use is described.—A. R. P.

Factors Influencing the Choice of a Burnishing Barrel. N. Ransohoff (*Metal Cleaning and Finishing*, 1936, 8, (11), 783-786).—Four types of modern burnishing barrels are illustrated and their use briefly described.—A. R. P.

Automatic Polishing Machines. Fred B. Jacobs (*Metal Cleaning and Finishing*, 1936, 8, (9), 637–640, 643–645).—Eight modern types of automatic polishing machines for finishing various types of metal surfaces are illustrated and briefly described.—A. R. P.

Light Metals and Their Treatment. R. A. Auchter (*Giesserei-Praxis*, 1936, 57, (51/52), 566–567).—Describes cutting and finishing machines for magnesium alloys.—J. H. W.

**Tumbling Small Brass Castings.** A. G. Arend (*Machinist (Eur. Edn.*), 1937, **80**, (51), 740E).—Briefly describes the precautions to be observed in tumbling small brass castings and the difficulties that are otherwise liable to ensue.

-J. H. W.

The Operation and Maintenance of Exhaust Systems. W. O. Vedder (Metal Cleaning and Finishing, 1936, 8, (11), 787-788).—Practical hints are given for obtaining maximum efficiency of exhaust systems connected with metal grinding, burnishing, and buffing operations.—A. R. P.

### XX — JOINING

#### (Continued from pp. 18-19.

How is Small Work Riveted ? A. Meyerhofer (*Werkstatt u. Betrieb*, 1937, **70**, (1/2), 10-12).—An illustrated account of the riveting of small parts of thin sheet, tubular pieces, &c., where ordinary riveting methods would result in excessive deformation.—P. M. C. R.

\*The Corrosion of [Riveted] Assemblies. (Cournot and Baudrand.) See p. 48.

Spot Welding Applied to Light Alloys.—H-III. From a Study by R.-H. Hobrock. G. Mandran (*Métaux*, 1936, 11, (133), 174–185).—Cf. Hobrock, *Met. Abs.*, 1936, 3, 599. (II.—) The form of the spot weld and the effect of the crystal dimensions of the metal to be welded are considered. (III.—)

VOL. 4

The effect of the time and the conditions of the surface on the quality of spot welds in light alloys is discussed. Generally speaking, spot welding, even more than pressure welding, depends on the recrystallization of the metal at a temperature below the melting point. This recrystallization is influenced by the deformation undergone by the metal as well as by the temperature at which it is produced.—H. J. W.

Bronze Welding in the Machine Shop. E. Andrews (*Machinist (Eur. Edn.*), 1937, 80, (50), 727E).—Very briefly sets out the advantages of bronze welding over oxy-acetylene fusion welding.—J. H. W.

Welding Practice for Non-Ferrous Alloys. Preparation for Welding and Choice of Method. John Stewart (*Met. Ind. (Lond.)*, 1936, 49, (26), 625–627).— For successful welding attention must be paid to many details such as purity of the oxygen and acetylene used, choice of suitable rods and fluxes, careful preparation of the edges to be welded and preheating. Welding technique for aluminium alloys, magnesium alloys, copper, brass, Monel metal, and nickel-brass is described and reference is made to possible causes of defective welds.—J. E. N.

For Arc-Welding, Generators are Necessary. R. Salelles (*Rev. Soudure autogène*, 1936, 28, (271), 7-10).—Ignorance of the electrical principles involved in arc-welding is thought to be the cause of many curious welding installations seen by S. The requirements of a supply for welding are shown to be (1) sufficiently high voltage for arc striking; (2) ability to stand short-circuits; (3) some system of stabilization. A simple explanation of the methods, used to obtain these, is given.—H. W. G. H.

High-Speed Motion Pictures of Flash Welding. W. E. Crawford and Walther Richter (J. Amer. Weld. Soc., 1936, 15, (10), 12-13, 20).—Photographs were taken, with a motion-picture camera, at speeds up to 1160 exposures per second. These show that the flashing operation is a series of short circuits causing expulsion of material from the plates being welded. Oscillograph records confirm this conclusion.—H. W. G. H.

Gases in Welds. A. Sonderegger (Bull. Assoc. Suisse Elect., 1937, 28, (1), 10-12).—A discussion of the influence of certain ingredients in limiting the absorption of atmospheric and other gases by steel during welding. The functions of magnanese, aluminium, copper, nickel, and chromium are briefly summarized in this connection.—P. M. C. R.

New Methods for Effecting Economy in Raw Materials. —— Nettmann (*Automobillech. Z.*, 1936, 39, (23), 607-611).—Emphasis is laid on the economy of effecting repairs by welding, and on the superiority of welded to riveted joints. The advantages of different types of flux are discussed, with special reference to light-alloy welding.—P. M. C. R.

### XXI.—INDUSTRIAL USES AND APPLICATIONS

### (Continued from pp. 19-21.)

The Cast-Aluminium-Base Denture. Dayton Durbar Campbell (J. Amer. Dental Assoc., 1936, 23, (7), 1264–1270).—An alloy of aluminium with 3.75% magnesium makes very satisfactory cast denture bases; it is self-cleansing, may be permanently dyed to a colour closely approximating that of gum tissue, is inexpensive, melts readily, and casts casily. The technique of making cast plates in the alloy is briefly described.—A. R. P.

Influence of the Permanent Elongation in Service of the [Aluminium] Conductors of Aerial Lines. S. Alber (*Rev. gén. Élect.*, 1936, 40, (1), 10–14).— Methods which have been suggested for overcoming trouble due to the permanent extension of overhead transmission lines include stretching the cable to work-harden it before erection, and making allowance for the permanent set by employing an empirical value of elastic modulus when calculating the stringing tension. A method is described for calculating, from a knowledge of the stress-strain curve of the metal, the correct stringing tension when permanent set is taken into account, and this is applied to a particular example of a 19-strand aluminium conductor.—J. C. C.

Columbium as a Commercial Product. James H. Critchett (Monthly Rev. Amer. Electroplaters' Soc., 1936, 23, (8), 4-6).—A brief account is given of the production of ferrocolumbium from columbite and of its use in preventing weld decay of stainless steel.—A. R. P.

Steel-Cored Copper. G. W. Preston (*Electrician*, 1936, 117, (3049), 569– 570).—The modulus of elasticity of a steel-cored copper conductor does not reach its final value until a number of load cycles has been applied. Approximate methods for its calculation are described. When these conductors are stressed to fracture, the copper wires break first, owing to their lower ductility. Average test results on typical conductors are given, and it is suggested that the approximate tensile strength may be calculated as 98% of the sum of the strengths of the copper wires plus 85% of the strengths of the steel wires.

---J. C. C.

Copper-Nickel Alloy Tubes. — (Metallurgist (Suppt. to Engineer), 1936, 10, 177-178).—A brief review of the development in the use of coppernickel alloy condenser tubes and recent work by J. A. Duma, Met. Abs., 1936, 3, 390.—R. G.

Standard Specifications for Pig Lead (B 29-35). — (Book of A.S.T.M. Standards, 1936, (I), 678-683).—Cover lead in pig form, made from ore or other material, by processes of reduction and refining, and not reclaimed lead. Lead complying with these specifications in intended to be refined lead, produced by lead producers who use well recognized and accepted processes of smelting and fully refining their products. Reclaimed lead, which is prohibited by these specifications, is a commercial product obtained by the recovery of metallic lead and its alloys by the simple reclaiming process of melting, drossing, and casting. These specifications cover 3 grades of pig lead : I.—Corroding lead, II.—Chemical lead, and III.—Common lead.—S. G.

<sup>†</sup>The Nickel Industry in 1936. Wider Applications on Non-Ferrous Alloys. Robert C. Stanley (*Met. Ind. (Lond.)*, 1937, 50, (2), 27-33).—A review of the extended uses of nickel and nickel alloys, particularly in the United Kingdom. The world's consumption of nickel is increasing steadily, and owing to improved equipment the British Isles are now producing larger quantities of nickel-bearing non-ferrous alloys. Credit is given to the Research Associations for improvements in electrodeposition. The transport industries, land, sea and air, and the electrical and textile industrics are all consuming more nickel alloys.—J. E. N.

\*Notes on Heating Wires. N. H. Roberts (*Electrician*, 1936, 117, (3050), 593-595).—Curves relating temperature with current, breaking stress, and resistance; showing resistance changes with time and temperature; and showing fusing currents and power radiated are given for several chromium-iron and chromium-iron-nickel resistance wires. The tests were made by students at Capetown University.—J. C. C.

New Overlay Material. Miles O. Smith (Inco, 1936, 14, (2), 16-17).—A description of an alloy (Colmonoy No. 6) of about 75% nickel with metallic boride crystals, used in the form of welding rods which are applied by oxy-acetylene or electric welding to produce an overlay or surface layer on steels. The boride crystals are of three varieties, two soluble in the nickel and a third of high hardness and melting point. The overlay method provides good resistance to wear and corrosive attack.—R. G.

Safety Fittings of Monel Metal Sheet for Pickling Baths and Plating Installations. Rud. Müller (*Illust. Zeit. Blechindustrie*, 1936, 65, (43), 1272-1274).—Excessive corrosive attack on safety fittings by acid fumes from pickling and plating solutions is prevented by the use of Monel metal parts, examples of which are described and illustrated.—P. M. C. R.

New Materials Prolong Life of Equipment. James A. Lee (Chem. and Met. Eng., 1936, 43, (7), 359–363).—In addition to 18:8 stainless steels and their numerous modifications, many other metals and alloys are used for chemical engineering equipment. The effects of adding copper, molybdenum, titanium, columbium, &c., on the chemical and physical properties of stainless steels are described. Monel metal is claimed to be commercially the most important of the nickel–copper alloys, possessing a useful degree of resistance towards more corrosive agents than most other materials of construction. A modification of this alloy contains 3.45% aluminium, and with no loss of corrosion-resistance, is stronger and harder (after heat-treatment). Deoxidized copper (99.9% copper) is used in the form of tubes for heaters, coolers, and evaporators. Copper containing 2% chromium, beryllium–copper alloys, silver-bearing copper, copper–nickel–aluminium alloys, lead containing tellurium, and other non-ferrous metals and alloys are extensively used in the chemical industry (including brewing).—F. J.

Operating Observations at T.V.A. Fertilizer Plant. Harry A. Curtis and Arthur M. Miller (*Chem. and Met. Eng.*, 1936, 43, (8), 408-412).—Production results are summarized and the operation of various pieces of plant equipment used in the manufacture of phosphoric acid and concentrated superphosphate in the Tennessee Valley Authority's plant are described and illustrated. Corrosion problems include the choice of suitable alloys for water-cooled tubes which are hung up along the side walls of the combustion chamber, in which gases, issuing from the furnace, burn, forming phosphorus pentoxide and metaphosphoric acid. These condense on the tubes, which are exposed to severe corrosion. Cast-iron tubes have the advantage of cheapness of service compared with various non-ferrous tubes tested. For electrode wires, molybdenum stainless steel has proved superior to silver and more economical than tantalum.—F. J.

Metal Lining Improves Concrete Tanks. Hugh E. Weightman (Chem. and Met. Eng., 1936, 43, (7), 373-374).—By lining the working surfaces of concrete storage and processing tanks with metals, it is possible to produce tanks of large size at much less cost than with all-metal construction. Details of the design and construction of such tanks and of the arranging for lead linings are described.—F. J.

Safety Heads. — (Chem. and Met. Eng., 1936, 43, (7), 388).—Safety heads for a wide variety of pressures made in a considerable number of corrosion-resisting metals are illustrated and described. They are recommended for use in protection of equipment against the possible failure of safety valves.—F. J.

Order No. 38 of the [German] Base Metals Control Department, Oct. 23, 1936; Use of Base Metals in the Building Trade. — (*1llust. Zeit. Blechindustrie*, 1936, 65, (46), 1362–1365).—The order contains a detailed list of restrictions imposed in the use of copper, nickel, and their alloys in Germany. —P. M. C. R.

XXII.-MISCELLANEOUS

#### (Continued from pp. 21-22.)

<sup>†</sup>Metallurgical Research in the U.S.S.R. Nicholas W. Ageew (*Met. Ind.* (*Lond.*), 1937, 50, (1), 3–8).—Researches are proceeding at several of the principal physico-metallurgical laboratories in Russia on non-ferrous thermal equilibrium systems. Special attention has been given to the noble metals (platinum, palladium, gold), light metals (aluminium, magnesium), and to alloys of the iron group (iron, chromium, manganese). Intermetallic com-

pounds have been examined by X-rays. In the light alloys research it is claimed that solubilities varying with temperature have been established for a number of systems, and that liquidus surfaces and boundaries of the ternary solid solutions of the more important industrial alloys have been fixed. Phase transformations have been studied, such as the  $\beta$ -phase in aluminium-copper alloys, and ageing of Duralumin and silicon-aluminium alloys. A bibliography of 35 references is given, of which about two-thirds relate to Russian publications.—J. E. N.

<sup>†</sup>Research on Mechanical Properties and Testing in the U.S.S.R. N. Davidenkov (*Met. Ind. (Lond.)*, 1937, 50, (2), 34–38).—A review of current rescarches in progress in the most important institutes in Russia. Much work has been done on questions relating to plastic deformation and tensile strength of crystalline (and amorphous) materials. Deformation of single crystals of zinc under extremely slow loading and twinning gave interesting results. Other subjects investigated include effect of size of grain and of specimen on impact brittleness, fatigue of metals, and elastic after-working.—J. E. N.

Some Information on the Metal Industries of Europe and America. Tokushichi Mishima (*Tetsu to Hagane (J. Iron Steel Inst. Japan*), 1936, 22, (12), 919-937).—[In Japanese.]—S. G.

\*Production of Aluminium Alloy in a Laboratory Blast Furnace. D. I. Lisovski (Legkie Metalli (Light Metals), 1936, (6), 53-63).—[In Russian.] Smelting of briquettes of bauxite and coke bonded with pitch in a laboratory blast furnace using coke as fuel and an oxygen blast afforded nuggets of an alloy containing iron 78-92, silicon 1-12, and aluminium 2.7-9% embedded in a viscous alumina slag. Neither slag nor metal could be tapped from the furnace.—D. N. S.

The Magnesium Industry in America. F. A. Philbrick (School Sci. Rev., 1936, 18, (70)).-S. G.

World Production of Magnesium. — (Bull. Imperial Inst., 1936, 34, (4), 453–458).—The activities of producers in various countries are briefly discussed.—S. G.

Minutes of the First All-Union Conference on Physico-Chemical Analysis. —— (Izvestia Sektora Fiziko-Khimicheskogo Analiza (Ann. Sect. Anal. Phys.-Chim.), 1936, 9, 375–388).—[In Russian.] A brief summary of papers read at the Conference held in Leningrad from October 24 to 29, 1933.—N. A.

\*First Report of the Pipe Flanges Research Committee. H. J. Gough (Proc. Inst. Mech. Eng., 1936, 132, 201-268; discussion, 269-340) .- (1) Tests are described to determine the limiting conditions required to preserve tightness of flanged joints submitted to internal fluid pressure at room temperature. The working pressure fluid was usually water, but sometimes air. Experiments were made with (a) clean scraped steel surfaces, (b) surfaces smeared with colloidal graphite mixed with grease or oil, (c) packing materials containing asbestos, and (d) metallic packings of various forms in copper and steel. Packings of corrugated sheet copper or iron were less effective than solid copper or steel rings. (2) The elastic flexibility of two pairs of flanges for 8-in. pipe has been determined; in one pair the flanges were screwed and welded to the pipes, and in the other the flanges were welded only. (3) Creep tests at 975° F. (523° C.) have been carried out on various assemblies of 3-in. diameter steel stud bolts, nuts, and washers. (4) Tests on a complete steam pipe assembly consisting of 8-in. piping and bolted flanges under high pressure and temperatures are described.-W. H.-R.

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