# METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

Volume 3

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Part 4

# I.—PROPERTIES OF METALS

(Continued from pp. 69-73.)

Beryllium. — (Metallurgist (Suppt. to Engineer), 1935, 11, (Dec. 27), 91-93).—A review of the results of recently published work on the extraction and properties of beryllium by Gadeau, Rohn, Sloman, and by Benford.—R. G.

\*The State of the Rare Earth Elements in a Metal Lattice [Cerium; Praseodymium]. V. I. Drožžina and R. I. Jaanus (*Physikal. Z. Sowjetunion*, 1936, 9, (1), 72-80).—[In English.] The relation between the magnetic susceptibility ( $\chi$ ) and temperature of the rare earth elements cerium and praseodymium is investigated experimentally at 90°-376° C. The following values of  $\chi \times 10^6$ were found: cerium, 92.5°, 57.0; 96.5°, 55.0; 223°, 22.6; 291°, 17.0; 351°, 14.3; 376.5°, 13.5; praseodymium, 90.5°, 101.1; 120°, 71.6; 198°, 44.2; 273°, 31.7; 289.5°, 30.1; 321°, 27.5; 366°, 24.1. The magnetic moment, (p), and the Curie temperature (0) of cerium are respectively 11.4 Weiss magnetons, and 6° abs.; for praseodymium p = 16.0 Weiss magnetons,  $\theta = 2°$ abs. In the metal lattice the elements are in the same state as when in trivalent chemical combinations.—J. S. G. T.

\*Ductile Chromium. W. Kroll (Z. anorg. Chem., 1935, 226, (1), 23-32).— Pure chromium powder may be made by reduction of the chloride with calcium in a bomb, or by heating a mixture of calcium shavings and chromium sesquioxide in fused calcium or barium chloride in an atmosphere of argon. The powder is pressed into a slug, which is sintered *in vacuo* or in a reducing or inert atmosphere at 1600°-1700° C. and rolled at 1250° C. The rolled metal is brittle at room temperature, but becomes mallcable on heating; the Brinell hardness of the annealed rolled metal is 150.—A. R. P.

\*The Determination of the Viscosity of Liquid Gallium over an Extended Range of Temperature. K. E. Spells (*Proc. Phys. Soc.*, 1936, 48, (265), 299– 311).—Apparatus, employing the capillary-flow method, for the determination of the viscosity of molten gallium between its melting point (about 30° C.) and 1100° C. is described. The values obtained agree, within about  $\pm 4\%$ , with those calculated by means of Andrade's formula  $\eta v^{1/3} = Ae^{c/vT}$ ,  $\eta$  denoting the viscosity at absolute temperature  $T^{\circ}$ , v the specific volume of the liquid at  $T^{\circ}$ , whilst A and c are constants having the respective values  $A = 246800 \times 10^{-8}$ ; c = 79.05. At 1100° C. the viscosity of gallium decreases by only 2% per 100° C.—J. S. G. T.

\*Magnetic Susceptibility of Single Crystals of Lead, Thallium, and Tin. S. Ramachandra Rao and K. C. Subramaniam (*Phil. Mag.*, 1936, [vii], 21, (141), 609-624).—The specific diamagnetic susceptibility ( $10^{-6}$  units) of lead (single crystal) at about 30° C. is 0.107 for field strengths 11-18 kilogauss; the value is constant up to the melting point (330° C.) and then decreases suddenly to 0.075, at which it remains up to 360° C. The specific paramagnetic susceptibility ( $10^{-6}$  units) of tin at 30° C. is 0.038, independent of field strength and crystal orientation. At the melting point (233° C.) the susceptibility changes suddenly to a diamagnetic value of 0.043 and is constant at this value up to 350° C. For  $\alpha$ -thallium the diamagnetic susceptibility parallel to the hexagonal axis is 0.412 (in  $10^{-6}$  units); the value normal to

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

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

this axis is 0.165. The magnetic anisotropy is therefore 2.5; the average value for polycrystalline thallium is 0.247. On heating,  $\alpha$ -thallium passes into  $\beta$ -thallium at 235° C. This has a cubic structure and a diamagnetic susceptibility equal to 0.158. At the melting point (300° C.) this decreases to 0.131, and remains constant up to 350° C.—J. S. G. T.

\*On the Atomic Heat of Nickel at Low Temperatures. Klaus Clusius and Jochem Goldmann (Z. physikal. Chem., 1936, [B], 81, (4), 256-262).—The atomic heat of nickel was measured at 10° and 30° abs. The results confirm the work of Clark and Keesom, and indicate that nickel shows anomalous decrease in atomic heat, which is not in agreement with either Bloch's law of ferromagnetism or Sommerfeld's law for free electrons.—K. S.

\*The Hall Effect in Nickel on Passage Through the Curie Point. I. K. Kikoin (*Physikal. Z. Sowjetunion*, 1936, 9, (1), 1-12).—[In German.] Values of the Hall effect in nickel at 20°-400° C. were determined. The values of the Hall coeff. range between 1.4 and 3.8 magnetic e.g.s. units between room temperature and the Curie point. The Hall effect decreases rapidly in the neighbourhood of the Curie point, but no sudden change in the temperature coeff. of the effect is found at this temperature. The Hall e.m.f. is found to be proportional to the magnetization of the metal.—J. S. G. T.

Electron-Optical Investigation of the Incandescence-Emission from Nickel in Cæsium Vapour. D. Schenk (Z. Physik, 1936, 98, (11/12), 753-758).—The electron emission from nickel, activated by heating in cæsium vapour, is observed by means of the electron microscope. The dependence of emission on temperature is found to differ for different crystallites.

-J. S. G. T.

\*Dispersion of X-Rays by Nickel.—II. J. Oumanski and W. Wexler (*Physikal. Z. Sowjetunion*, 1935, 7, (3), 336-342).—[In French.] See *Met. Abs.*, 1935, 2, 456. The effect of temperature on the intensity of the X-ray (311) diffracted by nickel was studied between 290° and 740° abs. Between 290° and 590° abs. the intensity is in accord with Waller's equation; a sudden decrease of intensity occurring between 590° and 690° abs. is probably associated with passage of the metal from the ferromagnetic to the paramagnetic state.—J. S. G. T.

\*The Refractive Indices of Metallic [Platinum] Films Showing Newton's Rings. K. Prosad and B. N. Ghosh (*Indian J. Physics*, 1936, 10, (1), 49-53).— The value of the ratio of the refractive indices of a platinum film for sodium light ( $\lambda$ , 5893) and for mercury light ( $\lambda$ , 5461) is found to be  $\mu_{Na}/\mu_{Hg} = 1.082$ . —J. S. G. T.

\*Photo-Electromotive Forces and Currents in Single Crystals of Selenium. R. M. Holmes (J. Opt. Soc. Amer., 1935, 25, (10), 326-329).—A study of the photo-e.m.f. and current in sclenium crystals grown from vapour at  $200^{\circ}$ - $215^{\circ}$  C., with electrodes of translucent sputtered platinum. The current and e.m.f. for various sources and wave-lengths are given.—R. G.

\*The Diffusion of Silver in Glass. O. Kubaschewski (Z. Elektrochem., 1936, 42, (1), 5-7).—Metallie silver and soda glass react with each other only in the presence of oxygen. The amount of silver entering the glass depends on the surrounding oxygen pressure. It is thus concluded that the silver migrates as ions in the way that Gunther-Schulze (Ann. Physik, 1913, 40, 335) assumed for the diffusion of silver from silver nitrate in glass.—J. H. W.

\*The Contact Difference of Potential Between Barium and Silver. The External Work-Function of Silver. Paul A. Anderson (*Phys. Rev.*, 1936, [ii], 49, (4), 320-323).—The contact p.d. between microcrystalline barium and silver surfaces (prepared by thermal vaporization in a gettered vacuum) is  $1.94 \pm 0.02$  v. at liquid air temperature. The work-function of barium being 2.39 v., the work-function of microcrystalline silver is  $4.33 \pm 0.05$  equivalent v. This compares with 4.08 v. found by Goetz, and 4.74 found by Winch.—J. T.

\*Experiments on Superconductive Tantalum. K. Mendelssohn and J. R. Moore (*Phil. Mag.*, 1936, [vii], 21, (141), 532-543).—The magnetic threshold and the induction penetration curves of superconductive tantalum are investigated experimentally; no sharp field strength was found at which magnetic flux penetrated the super-conductive surface, but penetration occurred gradually. Threshold and "penetration" curves, which according to Gorter should coincide, were found to be different; the difference is discussed in terms of the thermodynamical behaviour of small super-conductive regions.—J. S. G. T.

\*Research on Thin Layers of Tin and Other Metals. I.—The Influence of Thin Metal Layers on the Deterioration of Technical Insulating Oils. P. J. Haringhuizen and D. A. Was (*Proc. K. Akad. Wet. Amsterdam*, 1935, 38, (9), 1002-1006; and *Tech. Publ. Internat. Tin Res. Develop. Council, Series A*, 1935, (29)).—Copper is found to have the greatest, lead less, and tin the least effect on sludge formation and increase of acidity of technical insulating oils; tin, in some cases, may act as an anti-oxidant. The nature of the catalysis is investigated.—J. S. G. T.

\*The Mobility of Potassium on Tungsten. R. C. L. Bosworth (*Proc. Roy. Soc.*, 1936, [A], 154, (881), 112-123).—In continuation of previous work (*Proc. Roy. Soc.*, 1935, [A], 150, 58), B. investigated the surface migration of films of potassium on tungsten over a wide range of concentration; the diffusion coeff. increases while the associated activation energy decreases with increasing concentration. The activation energy of diffusion for an infinitely dilute film would be 0.72 v.; for films of mono-molecular thickness this energy is reduced to 0.29 v. The decrease is attributed to the existence of a spreading force due to the mutual repulsion of adsorbed ions.—J. S. G. T.

\*Thermionic Emission from Tungsten and Thoriated Tungsten Filaments. W. B. Nottingham (*Phys. Rev.*, 1936, [ii], 49, (1), 78-97).—The electron emission from pure and thoriated tungsten filaments is investigated as a function of the applied potential over the range between a few v. retarding to 1400 v. accelerating. A strip theory, simpler than Becker's patch theory, is found to interpret the results satisfactorily.—J. S. G. T.

\*The Tension Coefficients of [Electrical] Resistance of Hexagonal Crystals [of] Zinc and Cadmium. Mildred Allen (*Phys. Rev.*, 1936, [ii], 49, (3), 248– 253).—Values of the tension coeffs. of resistance of hexagonal crystals of cadmium and zinc were measured, and found to be independent of secondary orientation; this is in agreement with Bridgman's theory, revised by Cookson. —J. S. G. T.

\*The Photo[-Electric] Effect in the Case of Adsorbed Layers of the Alkali Metals. W. Gei and I. Truten (*Physikal. Z. Sowjetunion*, 1935, 8, (3), 342– 351).—[In German.] Films of the alkali metals of thickness a few atomic diameters, deposited by adsorption upon silica gel, obey Ohm's law and show a photoelectric effect. The respective limiting red wave-lengths for this effect are: potassium, 7800 A.; cæsium, 9550 A. The effect is normal in each case. —J. S. G. T.

The Possibility of Applying the Thomas-Fermi Method to the Problem of Metallic Cohesion. E. L. Feinberg (*Physikal. Z. Sowjetunion*, 1935, 8, (4), 416-424).—[In English.] The Thomas-Fermi theory is unable to explain the stability of the crystal lattice.—J. S. G. T.

Variation with Temperature of Young's Modulus for Certain Metals. J. E. Calthrop and J. T. Miller (*Amer. Phys. Teacher*, 1935, 6, (Oct.), 298-298; *Sci. Abs.*, 1935, [A], 38, 1672).—A simple method, involving the loading of a metal ring through which a heating current is passing, is used for the determination of the load-depression curves at different temperatures. From these curves is found the constant K in the usual expression  $E = /E_0 e^{-K_0}$ ,

where E is Young's modulus and 0 is the temperature. Values of K for 7 metals are given, including Nichrome and Manganin.—S. G.

\*The Variation with Temperature of the Hardness of Metals as Determined by means of a Cone subjected to Pressure [Tungsten; Molybdenum; Copper-Nickel Alloys]. J. Engl and J. Fölmer (Z. Physik, 1936, 98, (11/12), 702-708). —Values are tabulated for the hardness of polycrystalline tungsten and molybdenum, determined by means of a cone subjected to pressure, at 20°-1900° C. Similar data for 6 copper-nickel alloys containing, respectively, 0, 10, 20, 45, 67, and 100% of nickel are tabulated for temperatures up to their respective melting points. At all temperatures the maximum hardness number characterizes the alloy containing about 67% nickel.—J. S. G. T.

\*The Solubility of Metals in Crystals of Halides. G. Tammann (Z. anorg. Chem., 1936, 226, (1), 92–96).—The solubility of sodium in sodium chloride and of cadmium in cadmium chloride increases with increase in temperature; precipitation effects have been observed by quenching and tempering, but precipitation of the metal takes place rapidly and no hardening effects can be detected.—A. R. P.

The Change in the Energy of Emission [of Electrons] of Metals at the Melting Point. H. Kurzke (Z. Physik, 1936, 98, (11/12), 684-691).—The experimentally-determined change occurring in the energy of emission of an electron from a metal at the melting point is explained in terms of Rother and Bomke's electron theory combined with an assumption of a change in the binding force between "free" electrons at the melting point.—J. S. G. T.

\*Effect of Oxygen upon the Photoelectric Thresholds of Metals. H. C. Rentschler and D. E. Henry (J. Opt. Soc. Amer., 1936, 26, (1), 30-34).— When a small amount of oxygen is allowed to react with an active surface of certain metals such as thorium, uranium, calcium, barium, and cæsium, the photoelectric threshold is shifted towards the longer wave-length. A similar reaction of oxygen with other metals such as zirconium, silver, iron, and nickel shifts the threshold towards shorter wave-lengths, while there is no effect with gold. The effects are due to the activity of the oxygen-metal product.—R. G.

Physics of Very Low Temperatures. E. Justi (Z.V.d.I., 1936, 30, (5), 109-116).—Recent researches on superconductivity have afforded an insight into the nature of the specific heat of metals and non-conductors and the anomalies observed at very low temperatures. Surprising results have also been obtained in the determination of the electrical and thermal conductivities of solids at low temperatures.—K. S.

Transverse Effects, Due to Deformation, in the Conductivity of Metals. A. Perrier (*Helv. Phys. Acta*, 1935, 8, (6), 494–497; *Sci. Abs.*, 1935, [A], 38, 1232).—[In French.] P. discusses (1) the transverse mechano-galvanic effect and subject to confirmation he mentions a mechano-galvanic-thermal effect also; (2) a longitudinal mechano-thermoelectric effect; (3) a transverse mechano-thermoelectric effect. The transverse effects of deformation, as also the longitudinal effects, are more allied to elasticity than to plasticity. The rôles of elongation and slipping are defined. In all cases the effects observed conform to the theory of spontaneous anisotropy with regard to conduction. P. announces the forthcoming publication of a thermoelectric method for the determination of anisotropy of numerous ferromagnetic bodies; the method is simpler and more sensitive than the magnetic method. —S. G.

\*The So-Called Dependence on Temperature of Spontaneous Magnetization. Kotaro Honda and Tamotsu Nishina (Z. Physik, 1936, 98, (11/12), 657-665).—The variation with temperature of the remanent magnetization of an iron single crystal is determined along its three principal axes. The results differ considerably from the known variation with temperature of the induced magnetization; it is, therefore, suggested that the so-called variation with temperature of spontaneous magnetization is really a variation of induced magnetization.—J. S. G. T.

Nonorthogonality and Ferromagnetism. J. H. Van Vleck (*Phys. Rev.*, 1936, [ii], 49, (3), 232-240).—Mathematical. Discusses apparent difficulties in Heisenberg's theory of magnetism, to which attention has been directed by Inglis and others.—J. S. G. T.

\*Electron Theory of Metals.—I. S. Schubin and S. Wonsowsky (*Physikal.Z. Sowjetunion*, 1935, 7, (3), 292-328).—[In German.] Mathematical. The "polar" theory of metals, first proposed by Slater, is developed, and the electrical properties of ferromagnetics are briefly discussed.—J. S. G. T.

\*The Inertia of Electrons in Metals. C. G. Darwin (*Proc. Roy. Soc.*, 1936, [A], 154, (881), 61-66).—In the theory of metals it is believed that the effective mass of the free electrons is increased on account of the disturbance of their energy levels by the lattice field. It is shown, mathematically, that in conformity with the results of Tolman's experiments, such an effect will not be exhibited in experiments on electron-incrtia.—J. S. G. T.

#### **II.**—**PROPERTIES OF ALLOYS**

(Continued from pp. 73-75.)

\*Effect of Magnesium in Small Quantities on the Mechanism of Eutectoid Transformation in Aluminium-Zinc Alloys. Hiroshi Imai and Masami Hagiya (Tetsu to Hagane (J. Iron Steel Inst. Japan), 1936, 22, (1), 37-41) .--[In Japanese.] In a previous investigation (Met. Abs., 1935, 2, 50) on the cutectoid transformation in aluminium-zine alloys the authors studied the mechanism of the transformation and suggested a stepped transformation  $\beta \longrightarrow \beta' \longrightarrow \beta'' \longrightarrow \alpha + \gamma$ . In the present work small quantities of magnesium (0.002-0.3%), were added to alloys of approximately eutectoid composition, and the effects on the transformation were studied. The experiments were carried out on quenched specimens by hardness, electrical resistance, and dilatation methods. As little as 0.002-0.006% magnesium retards the changes in a remarkable way, but even in the case of the 0.3%alloy changes in properties were observed by ageing at room temperature. On the other hand, the unusual characteristic of the intermediate structure, which appears on tempering at 100°-150° C., fades away owing to the presence of magnesium. This effect is most noticeable with a magnesium content between 0.01 and 0.02%, showing that magnesium causes important changes in the crystal lattice.-S. G.

The Endurance Strength of Aluminium Alloys. R. Irmann (Aluminium, 1935, 17, (12), 638-643).—The importance of a knowledge of the resistance of aluminium constructional alloys to fatigue is stressed and a brief description is given of methods of determining it and of the effect of structure, mechanical and heat-treatment, and the presence of inclusions on the fatigue limit of various high-strength aluminium alloys.—A. R. P.

\*The Fluidity of Aluminium Casting Alloys. Takuity Morinaga (*Tetsu to Hagane (J. Iron Steel Inst. Japan)*, 1936, 22, (1), 41–43).—[In Japanese.] M. measured the fluidity of No. 12 alloy, Lautal, Silumin, aluminium-zinc (25%), German alloy, and "Y" alloy. Silumin has good fluidity, No. 12 alloy, Lautal, German alloy, and "Y" alloy coming next in order of fluidity. The aluminium-zinc (25%) alloy is inferior to the other alloys in this respect. —S. G.

\*The Oxidation of Cobalt Amalgam. F. P. Dwyer and J. W. Hogarth (J. and Proc. Roy. Soc. N.S. Wales, 1935, 59, 105-110).—Electrolysis of cobalt sulphate solution using a mercury cathode and removing the excess of mer-

eury by squeezing under pressure leaves a residue of  $\text{Co}_2\text{Hg}_3$  as a brittle crystalline solid which rapidly oxidizes on exposure to the air, the temperature increasing to  $50^\circ$ - $60^\circ$  C. in 10-15 minutes while a black powder separates. This powder appears to be  $\text{Co}_4\text{O}$  when first formed, but it rapidly decomposes into CoO and finely divided cobalt. Extraction of the powder with ammoniacal ammonium sulphate leaves a residue of pyrophoric cobalt.—A. R. P.

\*Investigations on the Solid Solubility of Alloys. V.—The Abnormal Phenomena of Cast Copper-Rich Antimony-Copper Alloys During Heating. Yoshio Tanaka and Masakatsu Iio (Nippon Kwagaku Kwaishi (J. Chem. Soc. Japan), 1935, 56, (11), 1293-1300; C. Abs., 1936, 30, 1011).—[In Japanese.] Cf. Taketani and Katori (Met. Abs., this vol., p. 74). The abnormal thermal expansion of alloys containing 2-9% antimony was studied by differential expansion measurements, with pure copper as standard. With decrease of antimony content the abnormal expansion near 460° and 490° C. decreases. The limit of solid solubility of antimony at 470° C. is found to  $9\cdot5-9\cdot75\%$ . —S. G.

\*Investigations on the Solid Solubility of Alloys. VI.—The Abnormal Phenomena of Cast Copper-Rich Magnesium-Copper Alloys During Heating. Eiichi Koizumi and Takehiko Kawaguchi (Nippon Kwagaku Kwaishi (J. Chem. Soc. Japan), 1935, 56, (11), 1300–1304; C. Abs., 1936, 30, 1011).—[In Japanese.] Cf. preceding abstract. The thermal changes of the alloys containing 0.2–10% magnesium, prepared by dic-casting, were studied. The alloy containing 0.8% magnesium shows noticeable expansion near 550° C.

-S. G.

\*Investigations on the Solid Solubility of Alloys. VII.—The Influence of Third Metals on the Normalization of Cast-Structures of Bronze. Saburo Katori and Yasushi Ogino (*Nippon Kwagaku Kwaishi (J. Chem. Soc. Japan*), 1935, 56, (11), 1305–1313; *C. Abs.*, 1936, 30, 1011).—[In Japanese.] Cf. preceding abstracts. 0.5–5% of zinc, manganese, silver, nickel, antimony, aluminium, magnesium, and silicon, respectively, were added to a 10% tinbronze, and the differential dilatation of the alloys was studied with pure copper as standard. Zinc appears to accelerate the normalization (homogenization) of the cast structure on annealing, but the other metals retard it.—S. G.

\*Electrical-Resistance Alloys of Copper, Manganese, and Aluminium. James L. Thomas (J. Res. Nat. Bur. Stand., 1936, 16, (2), 149–159; and Research Paper, No. 863).—An investigation was made of the electrical resistance of alloys containing manganese 4–15% and aluminium 0–10%, the remainder being copper. An alloy containing copper.85, manganese 9.5, and aluminium 5.5% has properties very similar to those of Manganin. Its thermoelectric power against copper is much smaller than that of Manganin and this thermoelectric power may be brought to zero by the addition of a very small amount of iron. Resistance coils constructed from these alloys, with or without iron, have been very stable in resistance. By proper baking, their temperature coeffs. of resistance at 25° C. may be made as near zero as is desired, and this coeff. changes less with temperature than does that of Manganin.—S. G.

\*The Equilibrium Diagram of the Copper-Tin Alloys. W. Broniewski, J. T. Jablonski, and Ste Maj (*Compt. rend.*, 1936, 202, (4), 305-307).—As previous diagrams show disagreement in the important region of the  $\beta$  and  $\gamma$  phases, due to the extremely slow attainment of equilibrium during cooling, a thermal analysis by heating was undertaken. The alloys containing up to 38% of tin were made homogeneous by annealing at 400° C. for 500 hrs., and the remainder at 200° C. for 2000 hrs. The existence of the compounds Cu<sub>4</sub>Sn, Cu<sub>3</sub>Sn, and Cu<sub>3</sub>Sn<sub>2</sub> was confirmed. Cu<sub>4</sub>Sn solidifies at 752° C., forming an extensive range of solid solutions, the  $\beta$ -phase with copper and the  $\gamma$ -phase; at 585° C., it undergoes an allotropic transformation forming a eutectoid at 28.5% tin,

analogous to the  $A_3$  transformation and the formation of pearlite in steels. Cu<sub>3</sub>Sn is formed from the solid alloy, becoming stable below 645° C. The alloys between 55 and 61% tin, the 0-phase, appear heterogeneous for some hours after solidification, and only become homogeneous after annealing at 200° C. for 9 months. The diagram constructed agrees materially with the results of a study of the physical properties of the alloys at room temperature.—J. H. W.

\*The Solubility Diagram of the Copper-Zinc Alloys. Witold Broniewski, J. T. Jablonski, and Ste Maj (Compt. rend., 1936, 202, (5), 411-414) .- This investigation followed the lines of that on the copper-tin alloys (preceding abstract). The compound CuZn melts at 875° C., and undergoes at 465° C. an allotriomorphic transformation which extends to its solid solution (B-phase) between 465°-455° C. CuZn<sub>2</sub> appears stable below the transition line at 840° C., on which, at the perifectic at 58% zinc, is formed the limiting solid solution on the copper side. The solidification of the compound thus begins by the primary precipitation of the crystals of the non-saturated solid solution richer in copper than the compound. CuZn<sub>6</sub> is formed in an exactly similar manner; it becomes stable below the transition line at 698° C., where the peritectic at 72% zinc marks the limit of the solid solution on the copper side (phase 8). At about 598° C., the compound appears to undergo an allotriomorphic transformation, which takes place in the solid solutions at the lowest temperatures. This transformation, corresponding to the  $A_3$  transformation in steels, forms for the same reason at 551° C. a eutectoid at 73% zinc, corresponding to pearlite. The solid solutions of CuZn<sub>s</sub> persist below the allotriomorphic transformation appearing in the form of phase  $\varepsilon$ .--J. H. W.

\*Properties of Metals at Low Temperatures [Iron and Copper Alloys]. A. S. Fal'kevich and B. A. Smirnov (*Khimistroi*, 1935, 7, 436-442; *C. Abs.*, 1936, 30, 707).—[In Russian.] Different iron and copper alloys, with and without electrically welded seams, were treated with boiling liquid oxygen and at - 183° to 50° C. either once or repeatedly for various periods of time, and then subjected to physical and mechanical tests. The results are given in curves and tables, and discussed.—S. G.

\*On Alloys of Platinum and Antimony. W. A. Nemilov and N. M. Voronov (Z. anorg. Chem., 1936, 226, (2), 177-184).—Cf. Met. Abs., 1935, 2, 216. PtSb<sub>2</sub> and PtSb are formed by peritectic reactions at 1210° and 1055° C., respectively, and PtSb<sub>4</sub> by a transformation in the solid state at 670° C. The eutectic is at 635° C., 66% antimony.—A. R. P.

\*On the Alloys of Platinum with Rhodium. W. A. Nemilov and N. M. Voronov (Z. anorg. Chem., 1936, 226, (2), 201-208).—Appears to be essentially a translation from the Russian (cf. Met. Abs., 1935, 2, 217). The hardness of platinum-rhodium alloys reaches a maximum at 70 atomic-% rhodium, the electrical resistance a maximum at 40 atomic-% rhodium. and the temperature coeff. of resistance a minimum at 50 atomic-% rhodium. Polished alloys with more than 40 atomic-% rhodium are unattacked by aqua regia, and alloys with more than 10 atomic-% rhodium are oxidized in the air at 750°-1150° C., but at higher temperatures the oxide decomposes again.—A. R. P.

\*The Equilibrium Diagram of the System Silver-Gallium. Friedrich Weibke, Karl Meisel, and Lotte Wicgels (Z. anorg. Chem., 1936, 226, (2), 201-208).—Tho system was examined by thermal, micrographic, and X-ray methods. The  $\alpha$ -phase contains 12% gallium at 619° C., 11% at 440° C., and 10.4% at roomtemperature; the  $\beta$ -phase extends from 12 to 17% gallium at 619° C. and from 11 to 23.7% gallium at 440°-438° C. below which temperature it is converted into the  $\gamma$ -phase (Ag<sub>5</sub>Ga<sub>2</sub>), which is homogeneous in the range 19.6-23.5% gallium but is not hexagonal like Ag<sub>5</sub>In<sub>2</sub>. The  $\delta$ -phase (Ag<sub>2</sub>Ga<sub>3</sub>) is formed by a peritectic reaction at 326° C. and has only a small range of homogeneity around 50% gallium. The solid solubility of silver in gallium is about 5% and the eutectic point is 25° C., 5% silver.—A. R. P. \*The Precipitation from Supersaturated Solid Solutions on Decrease in Temperature. G. Tammann and W. Boehme (Z. anorg. Chem., 1936, 226, (1), 87-91).—To examine the mechanism of the decomposition of supersaturated solid solutions a rod of an alloy of copper with  $6\cdot1\%$  silver was quenched from 750° C. and clamped in an insulated cover so that one end protruded into a furnace at 600° C. and the other into a vessel of cold water. After 10 hrs., the Brinell hardness was measured at various points along the rod, the temperature of which had previously been taken; the hardness started to increase at 210° C., reached a maximum at 300° C. and decreased slowly between 350° and 500° C. while the first visible precipitation of silver appeared at 250° C. The hardness of Duralumin (magnesium 0.5, silicon 0.5, copper 4%) showed a rapid increase at room temperature and then a slow increase up to 170° C., followed by a slow decrease, while precipitation was first visible at 300° C.—A. R. P.

A Special Phenomenon Associated with Transformations Extending over a Range of Temperatures. A. Schulze (*Physikal. Z.*, 1936, 37, (2), 41-43).— See Met. Abs., this vol., p. 39.—J. S. G. T.

<sup>†</sup>Thermal [and Electrical] Conductivities of Metals and Alloys. J. W. Donaldson (*Metallurgia*, 1936, 13, (77), 159–160).—A review of recent work on the thermal and electrical conductivities of metals and alloys, particularly thermal conductivity. Data are given for tungsten, molybdenum, silver, high-purity and commercial nickel, high-purity zinc, and for the binary alloys of copper with silicon, aluminium, manganese, and nickel.—J. W. D.

Experimental Test of Akulov's Theory of Coercive Force. W. S. Messkin and B. E. Somin (Z. Physik, 1936, 98, (9/10), 610-623).—Experimental measurements of the coercive force in iron-nickel, iron-aluminium, irontitanium, iron-tungsten, iron-molybdenum, iron-nickel-aluminium, and iron-manganese-aluminium alloys, subjected to various heat-treatments, are contrary to results to be anticipated from the present form of Akulov's theory (Z. Physik, 1933, 81, 790).—J. S. G. T.

### III.—STRUCTURE

# (Metallography; Macrography; Crystal Structure.)

#### (Continued from pp. 75-78.)

<sup>†</sup>The Rationale of the Phase Formation in Alloys. An Introductory Essay. E. H. B[ucknall] (*Met. Ind.* (*Lond.*), 1936, 48, (7), 203-208; (9), 273-277; (10), 303-307, 310).—A comprehensive survey of the attempts which have been made to correlate the constitution and properties of alloy systems and to obtain a generalized view of alloy structures. A *bibliography* of 67 references is appended.—J. H. W.

\*The Mechanism of Electrolytic Polishing of Copper. Pierre Jacquet (Compt. rend., 1936, 202, (5), 402-404).—See also following abstract. All the factors which favour the diffusion of the products of attack require an appreciable increase of the minimum current density necessary; such factors are decrease of the concentration of the acid solutions, increase of temperature and agitation, and position of the anode. The form of the intensity-tension curve at its extremities is explained by the progressive formation of a partly insulating anodic skin. These results are confirmed by microscopic observation of the profile of the anode during electrolysis. When the anode surface is smooth, the maximum thickness of the liquid film is 0-05 mm. for a horizontal surface; if the anode is rough, it is covered uniformly; the thickness of this partly insulating film being greater over deeper parts than over parts in relief, the latter are first attacked. When the electrolyte is an aqueous solution of metaphosphoric acid, a liquid film is formed right at the beginning, but it

follows the irregularities of the surface, and at once gives place to a solid crust. These differences between ortho- and pyro-phosphoric acids and metaphosphoric acid agree with the respective solubilities in acid solutions of the corresponding copper salts.—J. H. W.

\*On the Anodic Behaviour of Copper in Aqueous Solutions of Orthophosphoric Acid. P. A. Jacquet (*Electrochem. Soc. Preprint*, 1936, April, 17-38).—Cf. preceding abstract. A copper surface anodically etched in aqueous solutions of orthophosphoric acid becomes as bright as though it had been polished if voltage and current density are kept within definite limits. If properly controlled, anodic etching will reveal the crystalline structure of the metal. This phenomenon appears to be based on the passivation of the anode, and is a function of concentration polarization. The anodic etching method was applied to metal sections for metallographic examination; excellent results were obtained. As compared with the usual acid etching method, the anodic method has the advantages of being much more rapid and less expensive.

-S. G. \*Etch Planes of Tin. L. W. McKeehan and Harold J. Hoge (Z. Krist., 1935, 92, (5/6), 476-478).—[In English.] Suitable etching with hydrochloric acid develops etch planes on tetragonal tin so that the crystallographic axes of large crystals can be determined therefrom to within 1° of are by means of an optical goniometer. For pure tin, concentrated acid is used and a little potassium chlorate added; for alloys with as much as 0.6% antimony, dilute acid is used and the etching is carried out in stages; alloys with up to 1% cadmium or gallium are etched with acid of intermediate strengths. The results obtained by the method are exemplified. Chalmers's diagrams (*Met. Abs.*, 1935, 2, 424) of atomic positions in tin are incorrect.—J. S. G. T.

\*Diffuse Rings Produced by Electron Scattering [Amorphous Layer on Polished Metals]. L. H. Germer (*Phys. Rev.*, 1936, [ii], 49, (2), 163–166).—Two diffuse rings produced by electrons scattered from polished metal surfaces have been interpreted as evidence that such surfaces are amorphous. Similar rings are formed by electrons scattered from vaporized zinc sulphide, and from unpolished surfaces of silicon carbide and cuprous oxide, all of which are probably crystalline. These experiments apparently vitiate the previous interpretation, although they cannot be definitely accepted as evidence against the presence of an amorphous layer on polished metals.—J. S. G. T.

Quantum-Statistical Theory of Fusion. L. Tarschisch (Z. Physik, 1936, 99, (3/4), 259).—A mathematical theory of fusion is developed, based on Debye's quantum theory of specific heat, Born's theory of the dynamics of the crystal lattice, and Fermi-Debye statistics. The theory indicates that  $T_{i\chi_0}/R_0^3$  and  $T_i/Un$  are constants,  $T_i$  denoting the melting point,  $\chi_0$  the compressibility,  $R_0$  the inter-atomic distance, *n* the exponent of the interatomic repulsive force, and *U* the energy per mol. The degree of constancey of these expressions is indicated by data referring to 11 metals.—J. S. G. T.

\*The Virial Theorem and the Theory of Fusion. E. L. Hill (*Physikal. Z. Sowjetunion*, 1935, 8, (4), 401-406).—[In English.] The significance of the force function employed to describe the interaction between molecules is discussed, and it is emphasized that this function contains a contribution from the kinetic energy terms of the electrons. From this fact, a schematic explanation of the changes in kinetic and potential energies of the molecules along the melting curve is proposed.—J. S. G. T.

\*Crystallization of Thin Layers of Super-Cooled Liquids. F. K. Gorsky (*Physikal. Z. Sowjetunion*, 1936, 9, (1), 89-93).—[In German.] A two-dimensional theory of crystallization from supercooled liquids is developed, based on considerations of surface energy and association, and which enables the effect of an electric field on nuclei formation to be determined.—J. S. G. T.

\*The Kinetics of Recrystallization of Tin, Cadmium, and Iron. M. Kornfeld and F. Sawizki (*Physikal. Z. Sowjetunion*, 1935, 8, (5), 528-532).—[In German.] The production and growth of new grains in the recrystallization of these metals are shown experimentally to correspond with the phenomena characterizing the recrystallization of aluminium (*Met. Abs.*, 1935, 2, 684).

In each case a period of incubation of the grain is followed by growth of the grain at a constant rate.—J. S. G. T. Nucleus Formation in the Recrystallization Process. II.—The Nature of

the Incubation Period. M. Kornfeld (*Physikal. Z. Sowjetunion*, 1935, 8, (5), 533-535).—[In German.] Cf. Met. Abs., 1935, 2, 684. It is suggested that a recrystallization nucleus is produced either (1) suddenly in a small region of the deformed material in consequence of thermal fluctuation, or (2) in consequence of an irreversible process initiated at the commencement of annealing. Of these (2) only is shown to yield theoretical results agreeing with experimental results relating to the number of nuclei produced in a definite time in a given volume, and is, therefore, to be preferred.—J. S. G. T.

\*Theory of the Process of the Production of Order and of Diffusion in Solid Solutions of CuAu. Orderly Transformations in Alloys.—IV. W. S. Gorsky (*Physikal. Z. Sowjetunion*, 1935, 8, (4), 443–456).—[In German.] The change with time of the degree of orderliness and of the diffusion coeff. in the CuAu lattice is calculated taking into account, separately : (1) atomic migration in inter-lattice regions; (2) migration of vacant lattice regions, and (3) atomic interchange of places. A comparison of the theoretical results with the experimental results obtained by G. and Jost shows that not one of these mechanisms affords a sufficiently good explanation of the phenomenon of the orderly-disorderly transformation accompanying increase of temperature.

-J. S. G. T.

\*Theory of Elastic After-Effect in Disordered Solid Solutions (Elastic After-Effect of the Second Class). W. S. Gorsky (*Physikal. Z. Sowjetunion*, 1935, 8, (4), 457-471).—[In German.] Prevalent theories of the elastic after-effect, which attribute the phenomenon to non-uniform plastic deformation, are considered to be unsatisfactory; a theory of the effect in solid solutions attributing it to an association of diffusion under conditions of non-uniform stresses is developed. The flexure of solid solutions in the presence of infiltrating solutions is examined in some detail mathematically, and it is shown that the eleastic after-effect may amount to as much as 50% of the elastic deformation. In the case of bent single crystals the after-effect is established extremely slowly when the thickness of the crystal exceeds  $10^{-2}$ - $10^{-4}$  mm. An attempt to interpret the phenomenon in poly-crystalline metals and alloys is presented.—J. S. G. T.

Elastic After-Effect in Orderly CuAu Alloy. Elastic After-Effect of the First Class. W. S. Gorsky (*Physikal. Z. Sowjetunion*, 1935, 8, (5), 562-571). —[In German.] G.'s theory of the elastic after-effect in orderly crystals (*Met. Abs.*, 1935, 2, 338) is tested by application to the case of the CuAu lattice with orderly atomic arrangement. The after-effect amounts to 60-100% of the elastic deformation in poly-crystalline material; and 10 or 15 to 60% in single crystals. These experimental and the theoretical values are in agreement. The velocity of the process characterizing the phenomenon increases with temperature.—J. S. G. T.

\*The Diffraction of Slow Electrons by Zinc Single Crystals. S. G. Kalaschnikow and I. A. Jakowlew (*Physikal. Z. Sowjetunion*, 1936, 9, (1), 13-26). —[In German.] Eight diffraction maxima are found when slow electrons of velocities corresponding to 5-5-130 v. are diffracted by zinc single crystals. The limiting value of the equivalent internal potential of the metal is found to be 27 v. The effect of temperature on the diffraction is examined quantitatively, and is found to agree, to some extent, with results calculated by Debye's theory of the diffraction of X-rays.—J. S. G. T. The Determination of the Inner Potential of Crystals from Electron Diffraction. S. Kalaschnikow (*Physikal. Z. Sowjctunion*, 1936, 9, (1), 81–88).—[In German.] Bragg's formula for electron diffraction is modified to take account of a phase-change of the  $\psi$ -waves accompanying the diffraction, and the result applied to deduce the value of the mean potential of the crystal lattice. —J. S. G. T.

\*The Structure of Aluminium Boride AlB<sub>2</sub>. Wilhelm Hofmann and Walter Jaeniche (Z. physikal. Chem., 1936, [B], 31, (3), 214-222).—The compound AlB<sub>2</sub> crystallizes in hexagonal leaflets the structure of which corresponds with a new type for AB<sub>2</sub> compounds; the aluminium atoms form a simple hexagonal lattice, and the boron atoms a network analogous to that of graphite. The ideal structure corresponds with a ratio of the radii of metalloid : metal atom of 0.58 : 1.—K. S.

Lattice Constants and Allotropy of Beryllium. M. C. Neuburger (Z. Krist., 1935, 92, (5/6), 474-475).—[In German.] N.'s values for the lattice constants of beryllium differ from those found by Owen, Pickup, and Roberts (Z. Krist., 1935, 91, 70). N. directs attention to the existence of allotropic ( $\alpha$ - and  $\beta$ -) modifications of beryllium and mentions that the beryllium used by him was of spectroscopic purity. O., P., and R.'s samples were all heat-treated before being used, and N. suggests that the discrepancy between their results and his may be attributable to this fact. The best values of the crystallographic data of beryllium at 20° C. are given as  $a = 2\cdot2680 \pm 0\cdot0003$  A.;  $c = 3\cdot5942 \pm 0\cdot0004$  A.;  $c/a = 1\cdot5847$ .—J. S. G. T.

(I) Relations Between Crystal Defects and Suspension of Crystal Growth. (II) The Structure of Real Macro-Crystals. E. Herlinger (Z. Krist., 1935, 92, (5/6), 372-379, 380-386).—[In German.] (I.—) A crystal lattice defect produced during crystal growth induces other lattice defects in its neighbourhood. The distribution and variation of the frequency of occurrence of these secondary defects during the process are investigated. Such defects may be either of amount or of habit of crystallization. Extremely small crystals permit only a minimum of lattice defects; real crystals permit a maximum of defects and a minimum of orderly arrangement. (II.—) Complete suspension of crystal growth may occur. This is associated with the decreased value of the energy of separation of a surface point of an irregular lattice compared with the lattice energy of the ideal crystal. Certain consequences of this conclusion are discussed, e.g. macrocrystalline and mosaic structures.—J. S. G. T.

\*The Calculation of Potential Distribution in Certain Crystal Lattices. W. E. Laschkarew and A. S. Tschaban (*Physikal. Z. Sowjetunion*, 1935, 8, (3), 240-254).—[In English.] The "equivalent" atoms, and the potential distributions for some planes, are calculated for the lattices of lithium, aluminium, sodium chloride, and diamond.—J. S. G. T.

Some Relationships Between Atomic Lattices. E. L. Feinberg (*Physikal. Z. Sowjetunion*, 1935, 8, (4), 407–415).—[In English.] An approximate representation of the metallic crystalline state by means of an ionic spacelattice, the inter-ionic space being filled with free-electron gas, and the crystal being divided into spherically-symmetrical cells, enables the inter-atomic distances in the crystal to be determined as a function of the valency z. The dependence of atomic volume on z is deduced.—J. S. G. T.

Relation Between the Symmetry of a Crystal Lattice and the States of Its Electrons. F. Hund (Z. Physik, 1936, 99, (1/2), 119–136).—The relation of the symmetry of a crystal lattice to the "energy bands" of the electrons is discussed mathematically.—J. S. G. T.

\*Statistical Theory of Superlattices with Unequal Concentrations of the Components. R. Peierls (*Proc. Roy. Soc.*, 1936, [A], 154, (881), 207-222).— The theory of order and disorder in alloys as developed by Bragg and Williams (*Met. Abs.*, 1934, 1, 384; 1935, 2, 589) and by others, contains a function, V(s), representing the dependence of the average ordering force on the degree of order already established. V(s) differs according to assumptions made as to the physical nature of the ordering force. P. shows that, on the assumption that the force acts only between neighbouring atoms, the mathematical problems can be approximately solved by a method due to Bethe. The method is generalized to apply to a cubic face-centred structure of composition  $AB_3$  (e.g. AuCu<sub>3</sub>). The energy and degree of order are obtained as functions of the temperature.—J. S. G. T.

\*Theoretical and Experimental Laue Patterns from Bent NaCl Crystals. A. P. Komar (*Physikal. Z. Sowjetunion*, 1936, 9, (1), 97-99).—[In English.] A method is described for calculating the Laue pattern given by sodium chloride crystals bent into a circular arc; theoretical and experimental patterns are in very close agreement.—J. S. G. T.

\*Theory of the Effect of Temperature on the Reflection of X-Rays by Crystals. I.—Isotropic Crystals. Clarence Zener and G. E. M. Jauncey (*Phys. Rev.*, 1936, [ii], 49, (1), 17-18).—A short derivation of the Debye-Waller temperature factor in the reflection of X-rays by isotropic crystals is given. The treatment brings out the assumptions made in the theory and paves the way for the treatment of anisotropic crystals.—J. S. G. T.

\*Theory of the Effect of Temperature on the Reflection of X-Rays by Crystals. II.—Anisotropic Crystals. Clarence Zener (*Phys. Rev.*, 1936, [ii], 49, (2), 122–127).—Cf. preceding abstract. In anisotropic crystals the temperature factor for the reflection of X-rays is a function of the orientation of the reflection plane. The complete solution is found for metals with hexagonal symmetry. The temperature factor is written as  $e^{-M}$ ; values of M are calculated for zinc and cadmium with results as follows: for zinc, 1-80; for cadmium, 1-73.

-J. S. G. T.

#### IV.—CORROSION

#### (Continued from pp. 78-80.)

The Action of Tap-Water on Aluminium. Tsunetaka Sasaki and Jitsusaburo Sameshima (Nippon Kwagaku Kwaishi (J. Chem. Soc. Japan), 1935, 56, (11), 1353-1358; C. Abs., 1936, 30, 1003).—[In Japanese.] Aluminium dissolves noticeably when boiled with tap-water. This is attributed to the action of  $H_2CO_3$  contained in the tap-water.—S. G.

\*Rate of Corrosion of Duralumin. G. Tammann and W. Boehme (Z. anorg. Chem., 1936, 226, (1), 82-86; and (summary) Light Metals Research, 1936, 4, (16), 265-266).—The rate of dissolution of Duralumin in 0.9N-hydrochloric acid is a measure of the degree of precipitation of CuAl<sub>2</sub>. After quenching from 500° C. the rate is almost the same as that of pure aluminium and remains practically constant after ageing for several days at room temperature although the hardness is thereby increased by 35%. The rate of dissolution increases with increase in ageing temperature, reaching a maximum at 300° C. and then decreasing to 400° C. The rate of dissolution-temperature of ageing curve is similar in shape to the lattice parameter-temperature of ageing curve.

-A. R. P.

**†Copper-Nickel** (70:30) Alloy. Mason S. Noyes (J. Amer. Soc. Naval Eng., 1936, 48, (1), 1-18).—Vertical rotating, electrolytic cell, and impingement resistance corrosion tests carried out by the U.S. Bureau of Engineering on copper-nickel alloys, Monel metal, copper, red brass, and silicon-manganese bronze are considered, and reasons given for the adoption of the 70:30 copper-nickel alloy for tubes for all salt-water piping under the Bureau's cognizance. Corrosion tests on joints of this alloy made with tin-lead (50:50) solder, and three silver solders are also dealt with. Reports on installations of this alloy in service are briefly described, and suggestions are made for the manufacture

of pipes and tubes for naval service from the rolled and drawn forms of the alloy.—J. W. D.

\*Študies on the Oxidation of Metals. III.—The Kinetics of the Oxidation of Molten Tin. L. L. Bircumshaw and G. D. Preston (*Phil. Mag.*, 1936, [vii], 21, (141), 686-697).—The rates of oxidation of molten tin were determined over the range 400°-800° C. with various initial pressures of oxygen; the rate increases rapidly within this range. At any particular temperature the rate varied greatly for similar specimens of the metal. The parabolic law suggested by various workers to represent the oxidation of solid metals is not obeyed by molten tin, more especially at low and high oxygen pressures; the rate of oxidation is apparently controlled by some factor other than the progressive increase of film thickness; it is suggested that crystal orientation in the oxide film is a determining factor.—J. S. G. T.

Corrosion in the Production of Ethylene Chlorohydrin. E. V. Iskra (Zhurnal Khimicheskoi Promishlennosti (J. Chem. Ind.), 1935, 12, 947-953; C. Abs., 1936, 30, 711).—[In Russian.] Mixtures of  $C_2H_4(OH)Cl$ , HCl,  $C_2H_4Cl_2$ , and chlorine such as are used in preparing  $C_2H_4(OH)Cl$  corrode lead very severely, and the degree of corrosion increases with increase of temperature. Acid-resisting lacquers and many alloys are badly affected. Acid-resisting cements and iron containing 13-17% silicon are not greatly corroded. A Haveg type resin alone is slightly corroded, but when deposited on an iron surface it resists corrosion.—S. G.

Metals in Wineries. Charles S. Ash (Indust. and Eng. Chem., 1935, 27, (11), 1243-1244).—The results are given of 30 years' plant and laboratory experience in the handling of wines, fruit juices, and vinegar. Metals and alloys are corroded by hot fruit juices and wine in the order : chromium-steel (18:8), high-silicon irons, bronze (Ambrac, Tobin), copper, Monel metal, brass, nickel, aluminium, aluminium alloys, wrought iron, steel, lead, tin, cast iron, zinc. Although chromium steel is superior to copper in all respects, it is doubtful whether its higher cost for apparatus and tubing is justified. Under the severe experimental conditions described, nickel corrodes more than copper, but nickel salts do not produce turbidity in small amounts nor do they alter the taste so much as copper salts do, moreover under certain conditions a protective coating is formed on nickel by fruit juices. Aluminium and aluminium alloys are not good for carrying wine. Lead and zine should never be used in wineries, nor should tin, owing to its high rate of corrosion in the presence of air and carbon dioxide.—F. J.

\*The Structure of Thin Films of Metallic Oxides and Hydrates. Newbern Smith (J. Amer. Chem. Soc., 1936, 58, (1), 173–179).—Strips of metal were warmed in air and the oxide films removed by anodic solution of the underlying metal. The isolated films were mounted across a hole 0·1 mm. in diameter and examined by X-ray diffraction. The films were polycrystalline, consisting of relatively large crystals of the normal metallic oxides—nickelous, cuprous, and, on iron, predominantly ferrosic oxide Fe<sub>3</sub>O<sub>4</sub>. The crystals were large enough to give sharp diffraction rings. The thinner films may consist of single layers of crystals. No preferred orientation was observed. Growth of large crystals at the expense of smaller ones was apparently a characteristic of copper oxide, since relatively large crystals were found in thick and in thin films. As electrolytic treatment forms a cuprous oxide film on polished copper, the question of the identity of the films before and after electrolytic treatment should be investigated. Metallic hydroxides formed on the surfaces of salt solutions had the same structure as the precipitated hydroxides.—R. G.

Inhibitors—Safe and Dangerous. Ulick R. Evans (*Electrochem. Soc. Preprint*, 1936, April, 1–15).—An attempt to inhibit the anodic reaction of a corrosion-change controlled by the cathodic reaction will usually diminish the corroded area more quickly than it diminishes the total destruction of metal,

and thus increase the intensity of corrosion if the addition has been insufficient to stop attack altogether; such methods of inhibition are dangerous. This intensification of attack will not occur where the corrosion is under anodic control, or where the inhibitor is one which smothers the cathodic reaction. The principles are applied in discussing the addition of alkali to hard, soft, and saline waters, and also the treatment of brine with chromate. The elassification of protective processes into safe and dangerous groups can be extended to protection by oxide films, paints, and metallic coats.—S. G.

Corrosion of Metallic Materials Used in Waterworks Practice. G. Wiegand (*Illust. Zeit. Blechindustrie*, 1936, 65, (2), 36-37).—From a lecture delivered before the Corrosion Congress, Berlin, Nov. 1935. Methods are described for minimizing various forms of corrosive attack on waterworks parts, including those of brass, copper, and galvanized iron.—P. M. C. R.

On Cylinder Wear. Richard Koch (Automobilitech. Z., 1936, 39, (2), 31-36).—A review of the factors influencing cylinder wear, including a discussion of suitable materials for pistons, cylinders, and rings, a description of finishing methods, and suggestions regarding lubrication and protection against corrosion—P. M. C. R.

### **V.**—PROTECTION

#### (Continued from pp. 80-81.)

Recent Developments in the Anodic Oxidation of Aluminium. E. Herrmann (*Schweiz. Tech. Z.*, 1935, 32, 633-639).—An instructive review of the history, present methods, and uses of the process.—W. A. C. N.

\*Corrosion-Protective Value of Electrodeposited Zinc and Cadmium Coatings on Steel. William Blum, Paul W. C. Strausser, and Abner Brenner (J. Res. Nat. Bur. Stand., 1936, 16, (2), 185-212; Research Paper No. 867) .- Atmospheric exposure of plated specimens in 6 locations showed that in a rural or purely marine climate, zinc and cadmium coatings both gave better protection against corrosion of steel than did nickel or chromium coatings of the same thickness, although the zine and cadmium rapidly lost their lustre. In an industrial atmosphere, where sulphurous and sulphuric acids are present, zinc and cadmium were attacked rather rapidly, and the life was about proportional to the thickness. Under these conditions the cadmium coatings failed in about two-thirds of the time required for failure of zine coatings of the same thickness. Zinc-cadmium alloys containing about 10% cadmium were superior to either zine or cadmium. Variations in the conditions selected for depositing the coatings had no marked effect on their protective value. Hot-dipped zinc coatings gave about the same protection as plated zinc coatings of the same thickness. In accelerated tests, such as the salt-spray or intermittent immersion in a sodium chloride solution, the time required for failure of a zinc coating is about proportional to its thickness. Cadmium coatings last much longer than those of zinc in a salt-spray, which is not, therefore, a true measure of their relative value in an industrial atmosphere. The protective value of a zinc or cadmium coating depends principally on its minimum thickness, which can be determined by dropping tests, microscopic measurements, and the chord method (see Met. Abs., this vol., p. 125) .- S. G.

\*Corrosion After Pickling Major Source of Galvanizer's Dross. Wallace G. Imhoff (*Iron Age*, 1936, 137, (8), 30-33, 51).—See also *Met. Abs.*, this vol., p. 43. The effect of the reducing action of molten zinc at galvanizing bath temperatures on magnetic iron oxide was investigated. Molten zinc reduces this oxide to form galvanizer's dross, but the action is not so effective as that on ferric oxide. There appear to be 5 distinct phases: (a) from the melting point to 900° F. (480° C.); (b) from 900° to 1100° F. (555° C.), during which the ZnFe alloy is formed; (c) from 1100° to 1300° F. (705° C.), when the action

becomes violent; (d) from  $1300^{\circ}$  to  $1565^{\circ}$  F. ( $850^{\circ}$  C.); and (e) above  $1565^{\circ}$  F. There are no rich segregated areas of granular ZnFe alloy; zinc oxide is first observed at  $1100^{\circ}$  F. ( $595^{\circ}$  C.). The increase in temperature causes the development of larger dross crystals. At  $1100^{\circ}$  F. ( $595^{\circ}$  C.) the melt becomes thick and pasty, and at  $1300^{\circ}$  F. ( $705^{\circ}$  C.) zine oxidizes very rapidly.

-J. H. W.

Electric Pipe-Line Drainage [as Protection Against Electrolytic Corrosion]. G. I. Rhodes (*Electric J.*, 1936, 33, (2), 91–96).—The cathodic protection of buried pipe-lines, using carbon anodes installed at intervals, spaced according to the expected current requirements, and taking current from rectifiers, is described, and its economics discussed. By this scheme, bare as well as coated pipes can be efficiently protected against corrosion.—J. C. C.

Metals Rendered Heat-Resistant by Sprayed Aluminium. C. H. Daeschle (Schweiz. Archiv Wiss. Tech., 1936, 2, (1), 20-22).—A discussion of the reactions involved in the various processes for the aluminizing of iron: Calorizing, Krupp's Alite process, and the Alumet method. Above 900° C. the alloying of the aluminium proceeds rapidly. It has been shown that with lower aluminium content the thickness of the outer film is greater. Treated pieces are heat-resistant up to 1000° C., but then the aluminium film breaks down and agglomerates. Owing to chemical reactions between aluminium and graphite and sulphur at temperatures of about 800° C. the adhesion to iron may not be perfect.—W. A. C. N.

Metallizing—Its Scope and Limitations. J. W. Hishon (*Metallizer*, 1936, 4, (6), 2, 3, 4, 5, 15).—Discusses briefly the history of the process and its industrial applications. A short description is given of the types of corrosion met with in water tanks, and the influence of velocity and electrolysis. Metalsprayed aluminium coatings are recommended for protection against water at over 100° F., distilled water, soft water, water-saturated oxygen, or with carbon dioxide; for air-conditioning plants, and against the action of hot brine. Sprayed tellurium-lead coatings are recommended also for water at above 100° F., for chemically-treated water, and for steam below 450° F., and for cold brine.—W. E. B.

\*Comparing the Adhesion of a Paint Film on Different Materials [Duralumin]. H. L. Matthijsen (Verfkronick, 1935, 8, 276-278; C. Abs., 1936, 30, 881).—Abrasion tests with coarse silicon carbide revealed that the adhesion of 3 different oil paints applied to Duralumin was approximately doubled by anodic oxidation of the alloy.—S. G.

Surface Preparation and Painting of Magnesium Alloys. A. W. Winston, J. B. Reid, and W. H. Gross (*Indust. and Eng. Chem.*, 1935, 27, 1333-1337).— Paint adhesion and protection against sea-water are the main problems. Methods for securing permanent adhesion are: (1) development of special paints or paint schedules, and (2) treatment of the metal surface before painting. Methods of treatment, and the effect of the composition of the primer and finishing coats on adhesion and protection are discussed, and typical satisfactory paint schedules are given.—F. J.

#### VI.—ELECTRODEPOSITION

#### (Continued from pp. 81-84.)

<sup>†</sup>Cadmium Plating. W. P. Barrows and K. D. Williams (J. Amer. Soc. Naval Eng., 1936, 48, (1), 59–67).—A brief review of the bath composition and operating conditions; problems encountered in the use of cadmium; and recent developments in research, where thickness measurements of zinc and cadmium coatings are dealt with, and in the commercial field, which may restrict the use of cadmium and increase the use of zinc. Cadmium is the universal coating used on the steel parts of electrical fittings in the U.S.

Navy, and has been accepted as a coating for pipe-unions and pipe fittings on an equal basis with zinc.—J. W. D.

\*Alkaline Plating Baths Containing Ethanolamines. I.—Copper Plating from Triethanolamine Solutions. C. J. Brockman and A. L. Brewer (*Electrochem. Soc. Preprint*, 1936, April, 39–44).—The production of strike plates from solutions of copper salts containing triethanolamine is compared with those from other solutions. A new solution was developed which will not plate copper by replacement when brought in contact with iron. This solution will produce in 70 seconds a bright, adherent copper deposit at 0.4 amp./dm.<sup>2</sup>, capable of taking a good, adherent copper plate from the commercial acid copper sulphate bath. The solution contains copper sulphate 15 grm./litre, sodium oxalate 10 grm./litre, and triethanolamine 22 c.c./litre.—S. G.

\*Alkaline Plating Baths Containing Ethanolamines. II.- A Study of Baths Containing Triethanolamine for the Direct Niekel Plating of Zinc. III .--Cobalt Plating from Triethanolamine Solutions. C. J. Brockman and J. P. Nowlen (Electrochem. Soc. Preprint, 1936, April, 45-55) .- (II.--) Results are given of a study of plating baths for the direct nickel plating of zinc. The following solutions examined contained either just enough triethanolamine to give a clear solution or contained an excess of triethanolamine : (1) nickel ammonium sulphate; (2) nickel ammonium sulphate-nickel sulphate; (3) nickel ammonium sulphate-boric acid; (4) nickel sulphate; (5) nickel chloride; (6) nickel ammonium sulphate-nickel chloride. The plating conditions for the 6 solutions were determined at different temperatures, concentrations, and current densitics. Current density versus potential measurements were made during the plating processes. (III.--) From solutions of cobalt sulphate containing triethanolamine it is possible to plate cobalt successfully on copper, steel, nickel, and zinc at current densities of 0.5-25 amp./dm.<sup>2</sup> at or slightly above room temperature. The deposits are slightly darker than the corresponding nickel deposits .--- S. G.

Electrolytic Lead Plating of Chemical Apparatus. P. P. Belaiew and Ya. N. Birman (*Khimistroi*, 1935, 7, 426-428; C. Abs., 1936, 30, 685).--[In Russian.] Various iron objects can be directly electroplated with lead by the use of fluosilicic acid electrolyte on addition of ice, beryllium hydroxide, and some calcium carbonate to neutralize any sulphuric acid. In preparing the bath fluosilicic acid is neutralized with lead carbonate or oxide, and the filtrate, diluted to a definite concentration and treated with carpenter's glue, is used in the electrolysis at room temperature. Good results are obtained with: 87-261 grm./litre of 0.5-1.5N lead silicofluoride, 18-72 grm./litre of 0.25-1N fluosilicic acid, 5 grm./litre of 0.5% beryllium hydroxide, and 1-2 grm./litre of 0.1-0.2% glue. Benzene disulphonic acid and its derivatives, HOC, H4SO3H, and MeC, H3(OH)SO3H can be substituted for fluosilicic acid. Many technical and economic advantages are claimed for the electrodeposition of lead on iron as compared with the hot-dipping process. Among them is that the lead-electroplated objects can be stamped, machined, and formed without distortion. The method, however, requires further development and refinement .--- S. G.

\*Optimum Metal Concentration of Nickel Solutions. D. A. Cotton (Monthly Rev. Amer. Electroplaters' Soc., 1935, 22, (12), 6–18; discussion, 18–31).— The behaviour of nickel plating solutions containing from 2 to 12 oz. of total nickel, 3–6 oz. of nickel chloride, and 4 oz. of boric acid per (U.S.) gall. at 80° and 120° F. (27° and 49° C.) is shown in a series of 24 graphs. The results indicate that the cathode efficiencies are all in the region of 97–99% irrespective of temperature or current density, that throwing power varies from 25 to 35% being generally greater in hot solutions, and that the solution with 10 oz. of nickel per (U.S.) gall. gives about the best efficiency from all points of view. —A. R. P.

\*Corrosion-Protective Value of Electrodeposited Zinc and Cadmium Coatings on Steel. (Blum, Strausser, and Brenner.) See p. 122. Deposition on Non-Conducting Surfaces. E. A. Ollard (Met. Ind. (Lond.),

1936, 48, (6), 191-193).—The dry graphite, aqueous suspension of graphite, bronze powder, silver reduction, and cathode sputtering processes are out-lined. The method of ensuring satisfactory contact, the voltage required, the solution used, and a method for coating china and porcelain are described. -J. H. W.

\*Mesle's Chord Method for Measuring the Thickness of Metal Coatings. William Blum and Abner Brenner (J. Res. Nat. Bur. Stand., 1936, 16, (2), 171-184; and Research Paper No. 866) .- This study was made to improve methods for measuring the thickness of an electroplated coating at any specified part of the surface. The "chord" method depends on just cutting through the coating on a plane surface with a grinding wheel of known radius, or on a curved surface with a fine file. In either case the thickness, T, can be computed from C, the width of the cut, *i.e.* the chord, and R, the radius of the wheel or curved surface, by the equation  $T = \frac{C^2}{8R}$ . Tests on coatings

of known thickness showed that the results are accurate to within about 10%for coatings at least 0.0002 in. (0.005 mm.) thick. This accuracy compares favourably with the results obtained by measuring metallographic crosssections, a method that is more laborious and takes longer than the chord method.-S. G.

# IX.—ANALYSIS

#### (Continued from pp. 84-85.)

\*Testing the Purity of Spectrographic Carbons. Alois Gatterer (Z.V.d.I., 1936, 30, (5), 129-131) .- Various brands of carbons were examined for impurities, a new method for their quantitative determination is given, and the results obtained are critically discussed.-K. S.

\*Separation and Determination of Metal and Phosphate Ions in the Presence of Each Other .-- II. Saburd Ishimaru (Kinzoku no Kenkyu (J. Study Metals), 1936, 13, (1), 21-33).-[In Japanese.] The quantitative determination of 15 metal ions in the presence of phosphate ion was studied by the use of o-hydroxyquinoline. The method studied is in most cases simpler and more accurate than that in common use. Several examples are described.-S. G.

Critical Investigations on Organic Compounds as Analytical Reagents. II. --Cinchonine Iodide as a Reagent for the Determination of Bismuth. J. B. Ficklen, I. L. Newell, and N. R. Pike (Z. anal. Chem., 1936, 104, (1/2), 30-34). -The colorimetric method for Bi using cinchonine iodide gives good results only if the Bi is first separated from Sb, As, Cu, Cr, Pb, Mn, Mg, Hg, and Sn. -A. R. P.

\*Researches on the Determination of Lead and Antimony in Pure Metals and Alloys. H. Wdowiszowski (Z. anal. Chem., 1936, 104, (3/4), 94-107) .--The alloy is dissolved in 1:1 HNO<sub>3</sub>, the solution evaporated to dryness, the residue moistened with HNO3, dried again, and extracted with 2 drops of HNO3 and 50 c.c. of hot H2O, and the HSbO3 filtered off, washed with hot H<sub>2</sub>O, and dissolved in 48 c.c. of HCl (d 1.19). The solution is diluted to 250 c.c. and saturated with  $H_2S$  at 95° C. to obtain black  $Sb_2S_3$ , which is collected on a glass crucible, washed with  $C_2H_5OH, (C_2H_5)_2O$  and  $CS_2$  in succession, dried at 120° C., and weighed. The filtrate from the HSbO3 is treated with H<sub>2</sub>SO, and the precipitated PbSO, collected, dried, and weighed.

-A. R. P.

L

\*The Quantitative Determination of Lead by the Electrolytic Deposition of Lead Dioxide. I.—A Study of the Electrolytic Determination of Lead. Phillip Hall Delano and W. T. Schrenk (Bull. School Mines Met., Univ. Missouri, 1935, 12, (2), 9–29).—From a study of the effect of various factors on the electrolytic deposition of Pb as PbO<sub>2</sub> the following conditions are laid down for obtaining results correct to 0.2–0.4 mg. on amounts of Pb between 5 and 150 mg. The sample is dissolved in 35 c.e. of HNO<sub>3</sub> and, when brown fumes cease to be evolved, 0.25 c.e. of  $H_2SO_4$  and  $H_2O$  to 140 c.e. are added; after heating the solution to  $85^\circ$ –90° C. it is electrolyzed with 5.5–7 amp. for 1.5–2 hrs. using a sand-blasted Pt anode. The deposit is washed with hot  $H_2O$ , then with  $C_2H_5OH$ , dried at 130° C., and weighed; the stoicheiometric factor is used for converting the PbO<sub>2</sub> to Pb. Ag, Mn, Sn, As, Hg, CrO<sub>4</sub>'', and PO<sub>3</sub>'' interfere but K, Na, NH<sub>4</sub>', Ca, Mg, and Fe do not unless present in very large amounts.—A. R. P.

\*The Quantitative Determination of Lead by the Electrolytic Deposition of Lead Dioxide. II.—The Composition of Anodic Lead Dioxide and Its Use in the Quantitative Determination of Small Amounts of Lead. Thomas Gordon Day and W. T. Schrenk (Bull. School Mines Met., Univ. Missouri, 1935, 12, (2), 33-61).—As little as 0.5 mg. of Pb may be determined by the method described in part I (preceding abstract), provided that the anode area and volume of solution are kept small and the concentration of the HNO<sub>3</sub> in the solution is reduced to 15-20%, or the deposition is made on a PbO<sub>2</sub>-coated anode; if the solution is stirred during electrolysis deposition is complete in 15 minutes. Analysis of PbO<sub>2</sub> deposits showed the presence of small amounts of H<sub>2</sub>O replacing an equivalent amount of O<sub>2</sub>. If the weight of deposited PbO<sub>2</sub> is less than 50 mg. it can be determined volumetrically by the Fe(ClO<sub>4</sub>)<sub>2</sub>-KMnO<sub>4</sub> method.—A. R. P. \*The Use of a New Reagent for the Gravimetric Determination of Some

\*The Use of a New Reagent for the Gravimetric Determination of Some Metals. III.—Determination of Lead, Thallium, Bismuth, and Gold. G. Spacu and M. Kuraš (Z. anal. Chem., 1936, 104, (3/4), 88-93).—A 1% solution of mercaptobenzothioazole in 2.5% aqueous NH<sub>3</sub> precipitates Pb quantitatively as C<sub>7</sub>H<sub>4</sub>NS<sub>2</sub>Pb-OH from a hot neutral solution of Pb(NO<sub>3</sub>)<sub>2</sub>; the precipitate after drying in a glass filter crucible at 110° C. contains 53.09% Pb. From a cold TlNO<sub>3</sub> solution the same reagent precipitates (C<sub>7</sub>H<sub>4</sub>NS<sub>2</sub>Tl (55.17% Tl), and from slightly acid Bi(NO<sub>3</sub>)<sub>3</sub> solution (C<sub>7</sub>H<sub>4</sub>NS<sub>2</sub>)<sub>3</sub>Bi; from AuCl<sub>3</sub> solution the alcoholic solution of the reagent precipitates (C<sub>7</sub>H<sub>4</sub>NS<sub>2</sub>)<sub>3</sub>Au. The Tl compound can be dried at 110° C. for weighing, but the Bi compound must be ignited to Bi<sub>2</sub>O<sub>3</sub> and the Au compound to metallic Au.—A. R. P.

\*On the Gravimetric Determination of Lead as Lead Chromate. L. Guzelj (Z. anal. Chem., 1936, 104, (3/4), 107-117).—The effect of varying conditions and of the presence of impurities on the precipitation of lead as chromate has been investigated. The best results are obtained when  $(NH_4)_2CrO_4$  is used as the precipitant and the Pb solution contains  $CH_3 \cdot CO_2NH_4$  or  $CH_3 \cdot CO_2H$  or is 0.1N in  $HNO_4$ .—A. R. P.

\*The Quantitative Determination of Small Quantities of Zinc. Hermann Lux (Z. anorg. Chem., 1936, 226, (1), 1-20).—The method depends on the precipitation of the metal as ZnS, oxidation of this to ZnO, reduction of the latter by heating in a current of  $H_2$ , and collection of the distilled Zn into a globule the diameter of which is measured microscopically.—A. R. P.

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

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

#### (Continued from pp. 85-S6.)

Oil-Fired Assay Furnace. G. Spencer Compton and C. Meharry (Chem. Eng. Min. Rev., 1935, 28, (327), 53-54).—Cf. Met. Abs., this vol., p. 85.

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Describes further modifications in oil-fired assay furnaces, and the procedure followed in their use for cupellation.—J. H. W.

\*An Apparatus for the Determination of the Thermal Conductivity of Metal Plates. A. Eucken and Hildegard Warrentrup (Z. tech. Physik, 1935, 16, (4), 99–104).—Heat is supplied electrically at the central region of a circular plate, the rim is kept at a constant temperature, and measurements of temperature aro made at radial points in the plate by thermocouples built into the device supporting the plate. A device for measuring the electrical conductivity of the plate is also incorporated in the apparatus. Results referring to aluminium and copper by E. and W. and by other observers are in satisfactory agreement.—J. S. G. T.

\*Investigation of Thermionic Filaments with a Simple Electron Microscope. R. P. Johnson and W. Shockley (*Phys. Rev.*, 1935, [ii], 48, (12), 973).— Abstract of a paper read before the American Physical Society. A simple form of electron microscope is described, and its use in the investigation of the emission patterns on drawn wires is briefly illustrated.—J. S. G. T.

Method for the Quantitative Measurement of the Scattering of X-Rays by Micro-Crystalline Layers. J. Brentano (Z. Physik, 1936, 99, (1/2), 65–72).— Forms of X-ray cameras and method of their operation for the quantitative determination of the scattering of X-rays are described and illustrated.

-J. S. G. T.

Camera for the Determination of Identity Period in X-Ray Analysis. E. Bachmetew (*Tech. Physics U.S.S.R.*, 1935, 1, (4), 370–375; *Sci. Abs.*, 1935, [A], 38, 1069).—[In English.] A short description is given of a new camera which facilitates the determination of the identity period of the space lattice in different directions in oblong samples. X-ray photographs are given of NaCl oscillating about the axes [100], [110], [111], and [112], and of FeAl<sub>3</sub> about the axes [010] and [011].—S. G.

The Physical Society's Twenty-Sixth Annual Exhibition : Description of the Exhibits. R. S. Clay, J. E. Sears, C. V. Drysdale, and A. F. C. Pollard (J. Sci. Instruments, 1936, 13, (2), 54-71).—Describes instruments shown at the exhibition of the Physical Society, Jan. 7-9, 1936.—J. S. G. T.

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

#### (Continued from pp. S6-S7.)

\*The Form of the Flow Cone in Polycrystalline Test-Pieces under Various Loads. Gerhard Seumel (Z. Physik, 1936, 98, (7/8), 496-516).—The forms of the flow cone in circular test-pieces of aluminium and copper are investigated up to the load at which fracture occurs. It is found that during the production of the constriction in the test-pieces, the contours of the concave parts of the constriction are not hyperbolæ, but differ therefrom by 20-50% in the value of the ordinates. By rapid extension, the differences are reduced to 2-8%. The convex parts of the constructed contours are always logarithmic curves to within less than 1%.—J. S. G. T.

Plasticity and Practical Behaviour of Cast Light Alloys with Reference to the Bending Test. Luigi Locati (Industria meccanica, 1935, 17, 803-807, 892-898; C. Abs., 1936, 30, 709).—The plasticity of material helps the stresses of unforseen origin to remain in limits below the danger point even if they exceed the normal value. The other mechanical properties, however, such as elongation, must not be overlooked in this connection. The bending test alone will not give sufficient indication of behaviour under stress; it can only give a certain quality factor which must be considered together with ultimate strength, elastic limit, and maximum deviation in bending. 12 references are given.—S. G.

Indentation Hardness Testing for Weld Reinforcements. E. P. S. Gardner (*Elect. Welding*, 1935, 4, (22), 126–138; (24), 199–201; 1936, 5, (26), 44–54).— The Brinell, Vickers, and Rockwell tests are described, their relative merits discussed, and the relationships between their results are explained. Conversion tables are given, based on the work of Petrenko, Smith and Sandland, Hankins, Cook and Larke, and others.—H. W. G. H.

The Arthuis Universal Testing Machine. —— (Engineering, 1936, 141, (3660), 271).—Describes a hydraulic type of machine which embodies facilities for making tensile, compression, impact, hardness, and sheet-metal cupping tests. Two models, 3 ton and 10-ton, are available.—R. Gr.

Measuring Millionths of an Inch. R. W. Carson (*Electric J.*, 1936, 33, (2), 106).—An electronic micrometer, sensitive to 0-00001 in., in which needle points in series with a sensitive electric circuit are used to indicate contact, is illustrated. It has been used to measure the ercep of instrument spring alloys under load at room temperature.—J. C. C.

# XII.—TEMPERATURE MEASUREMENT AND CONTROL

#### (Continued from p. 87.)

\*A Precision Thermostat for Use Down to  $-20^{\circ}$  C. G. A. Benford (J. Sci. Instruments, 1936, 13, (1), 4–6).—A precision thermostat, incorporating a commercial refrigerator unit is described. The apparatus has been operated between 0° and  $-5^{\circ}$  C. with a maximum temperature variation of 0.002° C., and can probably be operated down to  $-20^{\circ}$  C. with comparable constancy. —J. S. G. T.

An Improved Thermo-Regulator. Robert D. Stiehler (Science, 1936, [N.S.], 83, (2141), 40).—A rapidly-acting toluene thermo-regulator, capable of controlling temperatures to within  $\pm 0.01^{\circ}$  C., incorporates a sheet of copper foil in the toluene of the ordinary regulator.—J. S. G. T.

### XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 58-90.)

Conditions in the Non-Ferrous Foundry Industry in 1935. F. Birchall (Found. Trade J., 1936, 54, (2), 25).—A brief general review.—J. H. W.

Difficulties in Metal Casting and Their Removal. Werner Frohlich and F. T. Richards (*Giesserei-Praxis*, 1936, 57, (3/4), 35-37).—The causes of "burning" frequently remelted brass are discussed. The addition of a deoxidizer to continually-remelted metal is as often harmful as beneficial. It is not always advisable to pour at the lowest possible temperature, even with copper alloys, nor does the use of a pyrometer for temperature control necessarily prevent "burning." The production of sand castings in aluminium and other light metal alloys, and the material for die-casting moulds are discussed. —J. H. W.

Revent Developments in the Light Alloy Foundry Trade. R. B. Decley (Found. Trade J., 1936, 54, (2), 29-30).—Recent technical developments and new Applications of light alloys in the foundry industry are surveyed.—J. H. W.

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

(Continued from p. 90)

\*Electrolytic Solder. R. P. E. Hermsdorf and Max Heberlein (Amer. Inst. Min. Met. Eng., Tech. Publ. No. 680, 1936, 9 pp.).—For the production of electrolytic solder from scrap white metal and other tin-lead alloys the greater part of the iron, copper, arsenic, and antimony are removed by liquation and treatment of the runnings with sulphur. The purified scrap should contain lead 50-85, tin 13-50, and antimony, arsenic, and copper together less than The electrolyte consists of a solution containing lead 25-35, tin 30-10%. 45, total hydrofluosilicic acid 120-150, and free acid 60-70 grm./litre, the cathodes consist of sheets of electrolytic solder and the bath is operated at 105° F. (40° C.). The electrolyte is circulated continuously through the bath and through a tank containing solder shot (70% lead, 30% tin) to remove accumulations of iron, nickel, and zinc. Electrolysis is conducted at 15 amp./ ft.<sup>2</sup> with a voltage drop of 0.34 v. between electrodes at an average current efficiency of 93%. The deposits contain as impurities copper 0-001, bismuth 0.003, iron 0.001, nickel 0.0001%, and silver 0.1 oz./ton.—A. R. P.

#### XV.—FURNACES AND FUELS

#### (Continued from p. 91.)

<sup>†</sup>Preheating Air for Furnaces Operated for Short Periods. Wilhelm Gumz and Gustav Meyersberg (Feuerungstechnik, 1936, 24, (2), 17-19).-The significance of various factors concerned in air-preheating is briefly discussed, and illustrated.-J. S. G. T.

The Deblanchal Rotary Melting Furnace. C. F. Herington (Blast Fur. and Steel Plant, 1936, 24, (2), 153-156).-Describes a furnace for melting iron. steel, and non-ferrous metals.-R. Gr.

The Possibilities of the Electric Furnace in the Cast Iron and Brass Foundry. A. G. Robiette (Found. Trade J., 1936, 54, (1019), 173-177; also (summaries) Met. Ind. (Lond.), 1936, 48, (9), 271-272; and Elect. Rev., 1936, 118, 247-248) .-- Read before the London Branch of the Institute of British Foundrymen. The place which the electric furnace does and could occupy in the cast iron and brass foundry is reviewed, and its possibilities from the points of view of economics and quality of material are indicated. The Detroit rocking-arc furnace is the only type of electric furnace with any widespread application in the brass foundry. The action of this furnace is described.—J. H. W. British Coals: Their Analyses and Uses. —— (Fuel Economist, 1936, 11,

(125), 201-202).—J. S. G. T.

\*Estimating the Properties of Solid Industrial Fuel. P. O. Roberts (Fuel Economist, 1936, 11, (125), 181-185) .-- Read at the National Coal Convention. Nov., 1935. The use of analyses in determining the coking, caking, or freeburning properties, and the extent to which bituminous coals are likely to emit smoke is discussed.-J. S. G. T.

### XVI-REFRACTORIES AND FURNACE MATERIALS

#### (Continued from p. 92.)

Refractories Industry in 1935. W. J. Rees (Found. Trade J., 1936, 54, (2), 32, 40).-A summary of developments during the past year.-J. H. W.

Fused Magnesia in the Non-Ferrous Industry. W. L. Patrick (Met. Ind. (Lond.), 1936, 48, (8), 231-232) .- The properties of crystalline magnesia and its use in immersion heaters and as a lining for melting furnaces for the higher melting point non-ferrous metals and alloys are discussed. The preparation of the lining for the furnaces is described. 10 references are given.-J. H. W.

Chilling of Refractory Materials. Method for the Simultaneous Determination of Resistance to Temperature Changes and to Corrosion. Adolf Möser (Feuerungstechnik, 1936, 24, (2), 20-24) .- In continuation of the previous part of this paper (see Met. Abs., this vol., p. 55), particulars are given of tests carried out on various refractories.—J. S. G. T.

# XVII.—HEAT-TREATMENT

(Continued from pp. 55-56.)

Non-Ferrous Nickel Alloys. L. M. Angus-Butterworth (*Engineer*, 1936, 161, (4181), 224).—Discusses briefly the properties obtainable by the heat-treatment of alloys containing compounds of nickel with aluminium, silicon, or beryllium. —R. Gr.

#### XVIII.---WORKING

(Continued from pp. 92-93.)

The Science and Practice of Machining Brass. M. Kronenberg (Met. Ind. (Lond.), 1936, 48, (6), 179-183).—As opposed to the case of other metals, the cutting pressure for brass does not increase in proportion to the area of chip, but at a lower rate. The specific cutting pressure is not constant, but decreases as the chip area increases; noither is the cutting speed constant, even for the same material and tool. If V = cutting speed and F = area of chip; log V =

 $-\frac{1}{\varepsilon_{r}}\log F + \log C_{r}$ , where  $C_{r}$  and  $\varepsilon_{r}$  are material constants having, respec-

tively, the following values: for Elektron 1800 and 1.37, wrought brass 480 and 1.62, cast brass 305 and 2.28, steel 137 and 2.44, cast iron 99 and 3.60. "Capacity diagrams" are constructed showing capacity and tool life for tungsten carbide and high-speed steel tools. The use of these diagrams in practice is illustrated.—J. H. W.

American Nickeloid "Paper Adhered" Protection for Metal. — (Amer. Metal Market, 1936, 43, (36), 3).—A brief note. "Paper Adhered" is the name given to a new process by which a protective covering is placed over all lustrous-finished metals. The surface is thus protected from scratching and damage during fabrication, storage, &c. The paper can be peeled off and the part wiped clean with a soft dry cloth.—L. A. O.

# XIX.—CLEANING AND FINISHING

(Continued from p. 93.)

\*Effect of Alkaline Detergents upon Metals. Aluminium, Copper, Tin, and Zinc. Chester L. Baker (Indust. and Eng. Chem., 1935, 27, 1358–1364).— Cleaning methods are often a compromise between maximum cleanliness and minimum surface injury. Experiments on metal strips immersed in alkali solutions at  $60^{\circ} \pm 2^{\circ}$  C. are described. The range of concentration-immersion time conditions which produced no visible effect on copper and tin was established. The silicates of soda impaired the metal surface less than the other alkalis, except in the case of sodium carbonate on zinc. Among the sodium silicates, an increasing ratio of silica to sodium oxide seems to give greater protection. Sodium metasilicate (Na<sub>2</sub>SiO<sub>3</sub>·5H<sub>2</sub>O) is the silicate most commonly used for industrial metal cleaning, but the greater protection of the producets.—F. J.

\*Use of Cleaners in the Dairy Plant. H. J. Barnum, P. S. Lucas, and Bruce Hartsuch (*Mich. Agric. Exper. Sta., Special Bull.* No. 262, 1935, 24 pp.; C. Abs., 1936, 30, 1149).—Cleaners are classified on the basis of their composition, into modified or neutral soda, soda ash, special alkalis, sodium orthophosphate

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 $(Na_3PO_4)$ , and colloidal materials. Some of the cleaners were highly buffered and therefore resistant to reduction in their cleaning ability. The modified sodas were most stable in buffer action, next were soda ash and colloidal materials. The special alkalis were most caustic;  $Na_3PO_4$  was second; soda ash and colloidal cleaners were equal, and modified sodas least caustic. The emulsifying power was determined with butter fat. In order of decreasing emulsifying power the cleaners ranked : special alkalis, soda ash, colloidal cleaners, modified sodas, and  $Na_3PO_4$ . Soda ash was most efficient as a water softener; next were colloidal cleaners, modified sodas, special alkalis, and  $Na_3PO_4$ . Aluminium, copper, and tinned steel were severely scratched by the volcanic ash content of some cleaners. Chrome-nickel steel was not affected. Special alkalis were most severe in their tarnishing action and corrosiveness; next were  $Na_3PO_4$ , soda ash, and colloidal cleaners. Tinned steel and aluminium were corroded most severely. A table is given of the properties of the cleaners.—S. G.

The Electrolytic Degreasing of Metal Sheet. — (Illust. Zeit. Blechindustrie, 1936, 65, (3), 69-70).—A description of electrical degreasing practice; suitable bath compositions and concentrations are given.—P. M. C. R.

The Polishing of Metals. E. J. Dobbs (*Met. Ind.* (*Lond.*), 1936, 48, (8), 234-235; discussion, 235-236, 240).—Abstract of a paper read before the Midland Metallurgical Societies (Birmingham Local Section of the Institute of Metals, Birmingham Metallurgical Society, and Staffordshire Iron and Steel Institute). The grinding and polishing of metals, polishing implements, and compositions are described.—J. H. W.

# XX.—JOINING

#### (Continued from pp. 94-95.)

On the Soldering of Aluminium Conductors and Cables with a Soft Soldering Paste. W. Nicolini (Aluminium, 1935, 17, (12), 648-650).—The use of "Alutinol" solders and fluxes (compositions not stated) for soldering joints in aluminium conductors is described; the electrical and mechanical properties of the joints are shown to be satisfactory.—A. R. P.

\*Electrolytic Solder. (Hermsdorf and Heberlein.) See p. 128.

The Use of Soldering Greases in the Automatic Soldering of Tinplate. Hans Groth (*Illust. Zeit. Blechindustrie*, 1936, 65, (7), 199-200).—Greases are preferable to solutions or fluxes in soldering tinplate, since the excess grease affords some protection from corrosion and need not be so carefully removed as in the case of aqueous solutions. Greases appropriate to different standard types of machine are mentioned, and directions for use are given.—P. M. C. R.

Outline of the Recent Progress Made in the Welding of Aluminium and Its Alloys. Jacques Douchement (*Rev. Aluminium*, 1935, 12, (76), 3099-3107; and (summary) Light Metals Rev., 1936, 2, (16), 280-282).—Read before the 7e. Congrès Internationale des Mines, de la Métallurgie, et de la Géologie appliquée. The 4 methods of joining aluminium may be classified as: (1) fusion welding (blow-pipe and arc); (2) electrical resistance welding (spot and continuous); (3) soldering; and (4) hammering. The procedure in the case of (1) and (2), corresponding to welding proper, is described in detail for pure aluminium and for a number of aluminium alloys containing silicon, magnesium, and manganese.—J. H. W.

Resistance Welding of the Copper Alloys. Ira T. Hook (J. Amer. Weld. Soc., 1935, 14, (10), 20-25; and Met. Ind. (Lond.), 1935, 47, (24), 586-590, 595).—Since the copper alloys do not possess a long plastic range, resistance spot and seam welds are formed by fusion. The weldability by these methods is an inverse function of conductivity, the Everdur alloys being easily welded, and pure copper being at the bottom of the list. Typical alloys are tabulated in order of weldability; the effects of the alloying elements, manganese, zinc, silicon, nickel, tin, phosphorus, and beryllium are discussed; and the strength properties to be expected from welds in the various alloys aro indicated. The important variable of technique, welding time, resistance of interface, and pressure, are also discussed, and typical applications of resistance welding are briefly considered.—H. W. G. H.

Developments in Welding of Copper Alloys. I. T. Hook (*Iron Age*, 1936, 137, (8), 40-41).—Discusses the arc welding of copper, bronze surfacing, resistance welding electrodes, beryllium, copper, and Ambrac (20% nickel) and Supernickel (30% nickel) tubes.—J. H. W.

Fundamentals of Arc-Welding Plant. C. Stieler (*Elektroschweissung*, 1935, 6, 190–193).—Static and dynamic characteristics and their meaning are discussed. Various types of transformer and motor-generator welding plants are described and their relative merits are indicated.—H. W. G. H.

\*Welding and Cutting with Town Gas. R. L. Greaves (*Gas World* (*Indust. Gas Suppt.*), 1936, 8, (3), 18).—Read before the Manchester and Yorkshire Junior Gas Association. The use of a mixture of town gas and acetylene with oxygen for welding, and the use of oxygen-town gas mixture for metal cutting are described.—J. S. G. T.

Field of Arc-Welding Expands. George H. Hall (*Elect. World*, 1936, 106, (5), 338-341).—A brief survey of the outstanding features of representative portable, multiple, and automatic welding outfits, and the various methods of arc-welding with d.c. and a.c. using earbon, bare, and coated electrodes.

-J. C. C.

Oscillograms Assist in Study of Welding Arcs. S. C. Osborne and W. F. Bailey (*Electric J.*, 1936, 33, (2), 87–89).—A universal oscillograph, having contactors and oscillograph controlled by a motor-driven, cam-operated timer, is briefly described, and its application to the study of circuit conditions during welding indicated.—J. C. C.

Electrodes for Resistance Welding. J. Fassbinder (Technique moderne, 1936, 28, (4), 121-126).—A survey of the functions and working conditions of electrodes used in resistance welding is followed by an analysis of causes of failure, whether thermal or mechanical in origin. Methods of combating wear are considered and the form and dimensions of electrodes, especially of the water-cooled type, are discussed. In the selection of material, copper with suitable additions may be preferred on account of its high conductivity, or a measure of the latter quality may be sacrificed to superior hardness and durability, as in the case of the sintered 50-80% tungsten-copper "alloys." Cadmium, beryllium, and cobalt have been used in the manufacture of highcopper electrodes.—P. M. C. R.

Scientific Welding Developments. C. W. Brett (J. Coventry Eng. Soc., 1936, 17, (1), 24–28).—A description of some applications of the Barimar low-temperature welding method.—R. G.

#### XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 95-98.)

<sup>†</sup>The Application of Light Alloys in General Engineering Design. G. A. Clavey (*Trans. Inst. Eng. Ship. Scotland*, 1936, 79, (5), 238-255; and (abstracts) *Met. Ind.* (Lond.), 1936, 48, (6), 188; *Found. Trade J.*, 1936, 54, 140; *Iron Coal Trades Rev.*, 1936, 132, (3544), 226; *Machinery Market*, 1936, (1845), 25-26; (1846), 20).—The physical properties including strength, fatigue range, sp. gr., strength at high temperatures, thermal and electrical conductivities, and coeff. of expansion of Alpax, cast and forged Y alloy, cast and forged Ceralumin C; and cast and heat-treated Elektron are given, and those alloys are compared

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with steel and cast iron in regard to their specific tenacity (tensile strength/ sp. gr.), specific yield (proof stress/sp. gr.), specific endurance (fatigue range/ sp. gr.), and specific modulus (modulus of elasticity/sp. gr.). Consideration is also given to their corrosion and the efficiency of protective paints and anodic treatment; to their application for internal combustion engine parts and for general engineering construction, and to the conditions under which they are machined and finished. In the discussion special consideration is given to the limiting creep stress of these alloys and to their anodic treatment.—J. W. D.

Non-Ferrous Alloys Available for the Use of Industry. III.—Aluminium Alloys. — (Aluminium and Non-Ferrous Rev., 1936, 1, (4), 135-138).— See also Met. Abs., this vol., p. 98. Describes the characteristics of a number of work-hardened wrought alloys, heat-treated wrought alloys, and casting aluminium alloys, and of the iron-aluminium alloy, Ferraloy. This is available either as a binary alloy containing aluminium 12-14%, or a ternary alloy containing chromium up to 3.5% and aluminium 9-11%.—J. C. C. Aluminium Stringer Failures Due to Fatigue Loading. Henry D. Johnson

Aluminium Stringer Failures Due to Fatigue Loading. Henry D. Johnson (Eng. News-Record, 1936, 116, (9), 318-320).—Investigation of 8 failures in the top flanges of the aluminium alloy stringers of the Smithfield St. bridge showed that these were all normal fatigue failures, not associated with corrosion, and caused by load concentrations from misplaced ties. No evidence of electrolytic corrosion or corrosion at joints either between aluminium and aluminium or aluminium and steel was observed.—J. C. C. Fifty Years March of Aluminium. F. Reed Dallye (Elect. World, 1936,

Fifty Years March of Aluminium. F. Reed Dallye (*Elect. World*, 1936, 106, (7), 456–458).—The development of A.C.S.R. (aluminium cable, steel reinforced) for power transmission lines is outlined and reference made to the use of aluminium for busbars, conduits, and, as oxide-insulated wire, for motor windings.—J. C. C.

Uses of Aluminium in the Power Plant. T. W. Bossert (*Power Plant Eng.*, 1936, 40, (2), 93-96).—The uses of aluminium and its alloys in electrical work, engine construction, and for architectural purposes are summarized in their relation to power plant practice.—P. M. C. R.

Fifty Years of Aluminium and the Automobile Industry. G. D. Welty (Automotive Ind., 1936, 74, (7), 216-218).—A review of the development, to some extent parallel, of the automobile and light alloy industries, with special reference to advances in piston design.—P. M. C. R.

Investigating the Wear of Motor Vehicle Parts. Friedrich Hanft (Automobiltech. Z., 1936, 39, (1), 9-19).—Accurate measurements of the wear of 6 motor cylinders after runs of 4200, 16,500, and 28,300 miles showed that in flanged cylinders, the maximum wear occurred near the lower dead point. Wear appears to be caused largely by the piston rings. Comparative data are given regarding the influence of working pressure, gas temperature, effective load, cooling, speed of stroke, number of revolutions, and design of piston, and the wearing qualities of steel, cast iron, and light alloys are compared. Wear measurements in piston rods, crankshafts, and camshafts are described, and a bibliography is given.—P. M. C. R.

Aluminium and Its Uses in the Dairy Industry. Frank D. Goll (*Milk Plant* Monthly, 1936, 25, (2), 60-65; and Milk Dealer, 1936, 25, (5), 44-46).—The advantages of aluminium, light weight, non-toxicity, high resistance to corrosion, attractive appearance, are emphasized, and the sphere of application in dairy work is outlined. Precautions to be adopted in fabrication and use are explained: electrolytic corrosion owing to contact with other metals is to be avoided, and a careful choice of sterilizing and cleansing agents must be made. Lists of suitable agents, on the American market, are given.—H. W. G. H.

The Wrapping of Apples in Aluminium Foil. H. Kessler (Schweiz. Z. Obst- u. Weinbau, 1935, 71, (20), 347-353; Light Metals Rev., 1936, 2, (15), 264).—Investigations at the Swiss Federal Agricultural Experimental Station

showed that aluminium foil is superior to all other wrapping for apples, in view of the reduction of the weight loss. In cases when the plain foil cannot be used owing to the disease-provoking tendency of the accumulated moisture on the skin, perforated foil may be used. The reduction in weight loss is then not so great.—L. A. O.

Recent Applications of Bismuth. —— Cournot (*Pratique Indust. mécaniques*, 1936, 18, (11), 423).—Metallic bismuth is used mainly in alloy form : certain of its eutectic alloys, notably the bismuth-cadmium-lead-tin alloy, possess exceptionally low melting points, whilst the expansion of the bismuth-lead alloys on solidification renders certain of the scries suitable for the reproduction of fine detail.—P. M. C. R. Enamelled [Copper] Wire : Its Use and Testing. N. H. Bentley (*Elect.* 

Enamelled [Copper] Wire: Its Use and Testing. N. H. Bentley (*Elect. Times*, 1935, 88, 679-680).—Stretching of enamelled copper wire, owing to excessive tension in winding, is the principal cause of short-circuits in coils wound from this material. A pinhole testing device is described, in which the wire is passed through a mercury bath before and after stretching by 12½%. An account is also given of a method for determining the number of shortcircuited turns in a wound coil.—J. C. C. Graphited Bronze Bearings. H. J. Shaffer (*Machinist (Eur. Edn.*), 1936,

Graphited Bronze Bearings. H. J. Shaffer (*Machinist* (Eur. Edn.), 1936, 80, (7), 39-30E).—By the use of a new binder material, unaffected by any temperature the bronze itself will withstand, and by a new form of groove, graphited bushings have been designed to stand conditions of speed and heavy loads and to eliminate the problem of oil or grease lubrication for speeds of 2000-3000 r.p.m. or lower. The bearing surface is divided into diamond-shaped areas by grooves filled with graphite, the grooves occupying about 25% of the total bearing area.—J. H. W.

Lead in the Building and Construction Industry. George O. Hiers and Carlton H. Rose (*National Lead Co. Lab. Bull.*, 1935, 3, (18), 217-227).— Presented at a Symposium on Materials in the Building and Construction Industry held by the Industrial and Chemical Engineering Division of the American Chemical Society. See Met. Abs., this vol., p. 96.—S. G.

Nickel-Clad Steel Plate. — (Metallurgia, 1936, 13, (77), 139-140, 158).—The manufacture of nickel-clad steel plate and its fabrication with special reference to its subsequent heat-treatment are discussed. Consideration is also given to the welding of plates of varying thicknesses, and to the applications of nickel-clad steel for the storage and transportation of caustic alkalis, for tanks and other parts in the textile industries, and its uses in soap manufacturing equipment.—J. W. D.

Sodium Alloy Lamps. Gorton R. Fonda (J. Opt. Soc. Amer., 1935, 25, (12), 412-416).—Discharge lamps with an alloy containing (about) cadmium 45, mercury 45, and sodium 10% gave a white discharge with good colour values except in the red. Iso-efficiency and radiation curves are given for the ternary alloys. Variation in composition had a distinct influence on the spectral characteristics.—R. G.

Tantalum as a Constructional Material. —— (Chem. Trade J., 1936, 98, (2546), 190).—A short note. Tantalum has been successfully used in spinnerets, radio valves, and heat exchangers. Its use is suggested for the manufacture of chemical plant owing to its resistance to corrosion by acids and by all the halogens except fluorine.—L. A. O.

Die-Cast Radiator Grilles. —— (Automotive Ind., 1936, 74, (2), 44–47).— Several designs for zine alloy die-cast grilles and ventilator louvres are reproduced, and a table shows the weight of the various models.—P. M. C. R.

Fixture Aid Servel in Finishing [Metal Spraying]. F. H. Colvin (*Metallizer*, 1936, 4, (2), 6).—Briefly describes the use of metal-sprayed zinc coatings in the manufacture of the absorber unit of the Electrolux Refrigerator.

-W. E. B.

The Influence of Metals in Bleaching. A. H. Pettinger (*Textile Manuf.*, 1935, 61, 472; C. Abs., 1936, 30, 1236).—In peroxide bleaching it is essential to avoid iron, copper, and chromium salts. Tin and titanium have no deleterious effects. Monel metal vessels can be used.—S. G.

# XXII.-MISCELLANEOUS

(Continued from pp. 98-99.)

Rarer Elements in Metallurgy. — (Metallurgist (Suppt. to Engineer), 1935, 11, (Dec. 27), 93-94).—The progress made in the use of the lesser known metals is briefly reviewed; it is pointed out that metallurgical research on rare metals and alloys is deserving of national support, since the possibility of practical application may be too remote for its pursuit by industrial organizations.—R. G.

Incidents in the History of Aluminium. — (Aluminium and Non-Ferrous Rev., 1936, 1, (4), 142-145).—J. C. C.

History of Aluminium. — (Amer. Metal Market, 1936, 43, (37), 5, 6).— A history of the development of a practical process of extraction of aluminium from bauxite.—L. A. O.

<sup>†</sup>A Great Pupil and a Great Discovery—Both Supported by a Great Teacher. Harry N. Holmes (*Science*, 1936, [N.S.], 83, (2147), 175–177).—The history of the production of aluminium, from its isolation by Oersted in 1825, is interestingly told. The present method, based on the electrolysis of a solution of alumina in cryolite was discovered by Charles Martin Hall in 1886. Hall's experiments and his relationship with his teacher, Frank Fanning Jewett, are recounted.—J. S. G. T.

Sources of Nickel Eczema. Report on Two Examples and Review of the Pertinent Literature. Paul D. Foster and Franklin I. Ball (Arch. Dermatol. Syphilol., 1935, 31, 461–469; C. Abs., 1936, 30, 758).—The literature on nickel eczema produced by plated objects and alloys is brought up to date and two cases are described in detail. Hypersensitivity to nickel appears to be acquired rather than inherent in all cases known.—S. G.

Early Chinese Metallurgy. Thomas T. Read. E. A. Smith (Met. Ind. (Lond.), 1936, 48, (10), 308-309).—In a letter, R. disputes some of the statements in an article by S. (see Met. Abs., this vol., p. 98), and S. replies.

-J. H. W.

The Geographical Distribution of the Industries in Kobe and Its Environs. Enju Odagiri (*Tetsu to Hagane (J. Iron Steel Inst. Japan)*, 1936, 22, (1), 1–16).— [In Japanese.]—S. G.

The Functions of a Research Department. T. M. Herbert (J. Inst. Fuel, 1935, 8, (40), 229-233; discussion, 233-238; and (summary) Mech. World, 1935, 97, 223-224).—The purpose and organization of the research department of a commercial company are discussed.—P. M. C. R.

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[Consists of three separate tentative specifications for the deposition of (1) zinc, (2) cadmium, and (3) nickel and chromium on steel; see *Met. Abs.*, this vol., pp. 43 and 44.]

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# XXIV.-BOOK REVIEWS

### (Continued from pp. 105-108.)

Metallographie. Herausgegeben von W. Guertler. Zweiter Band, Zweiter Teil, Zehnter Abschnitt, Erster Heft. Die mechanisch-technologischen Eigenschaften der reinen Metalle. Von A. Burkhardt, unter Mitarbeit von G. Sachs. Sup. Roy. 8vo. Pp. xx + 494, with 619 illustrations. 1935. Berlin: Gebrüder Borntraeger. (R.M. 54.)

When you have disentangled the description of the book as "second volume, second part, tenth section, first number," and when you learn that 23 such numbers are either already published or will appear shortly, you will understand the difficulty of adequately describing the completed treatise on metallography which the publishers contemplate. The term "monumental" has been overworked in describing such works; none other is adequate, however, and I must be permitted its use with qualification.

This part (or number) deals with the mechanical and technological aspects of the pure metals, and, in some cases, deals with the effects of impurities on these properties. Everything is grist to the mill. Among matters discussed are: the plasticity of single crystals, elastic limits, tensile strength, torsion modulus, Brineil and other hardness figures, Poisson's ratio, lattice constants. It would the me to write, and you to read, a detailed list of all the contents of this book; suffice it to say that here will be found details of all the physical (and a good many of the chemical) properties of all the metals. For information on any such subject, this is the book to which reference should first be made. Are you interested in the deep-drawing and rolling of nickel, the isotopes of silver, or tungsten casting? Well, this is the book for you —the metallographist's *rade mecum*. The section on aluminium is almost entirely the work of Dr. G. Sachs, who is well known to members of the Institute of Metals.

The book has been conceived and executed with characteristic Teutonic thoroughness. Credit is here given, in full measure, to workers in all countries. A bibliography of about 1400 references and an adequate subject-index are provided. The price, about £4 10s. in English money at the present rate of exchange, is extremely high.—J. S. G. THOMAS.

Lehrbuch der allgemeinen mechanische Technologie der Metalle. Von Hermann Meyer. Siebente, neu bearbeitete Auflage. Demy Svo. Pp. viii + 361, with 403 illustrations. 1935. Leipzig: Max Janecke. (Geheftet, R.M. 5.40; ganzleinen, R.M. 6.20.)

The seventh edition of this book follows closely the plan of its predecessor. Improvements in technique which have been developed since the latter appeared have been included, and special attention has been devoted to the use of non-metallic materials produced in Germany in preference to that of metallic goods which would normally be purchased in foreign countries. Among such non-metallic raw materials are wood, leather, and rubber.

The general scheme of the book is to deal in sequence with the production, properties, and principal engineering uses of the important ferrous and non-ferrous metals and alloys, mechanical testing, iron-founding, various types of moulding machines, steel castings, types of melting furnaces for non-ferrous metals, forging, rolling, tube-drawing, wire-drawing, pressing, welding, and soldering. There are many clearly drawn figures to illustrate the text.—W. A. C. NEWMAN.

Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 35: Aluminium. Teil A, Lieferung 3. Sup. Roy. 8vo. Pp. 451-534, illustrated. 1936. Berlin: Verlag Chemie G.m.b.H. (R.M. 14; Ausl. Pr. R.M. 10.50.)

This section of the work deals entirely with the preparation and properties of protective and decorative coatings on aluminium and its alloys. The first 53 pages are devoted to nonmetallic coatings, consideration being given almost exclusively to the commercially important oxide films. The various electro-chemical and chemical methods of forming the film are described in detail, and after a brief section dealing with dyeing, scaling, and other methods of impregnation, a full account is given of the physical and mechanical properties of the oxide layer. The remainder of the book deals with metallic coatings. Electrochemical and chemical methods of depositing other metals on aluminium are given, with brief notes of the properties of the product, and the book concludes with a short account of the processes used for protecting the stronger aluminium alloys with a coating of pure aluminium or of one of its more corrosionresistant alloys.

The material has been compiled with the thoroughness which is usual in Gmelins "Hand-

buch": it is presented in an interesting manner and is up-to-date, the literature having been reviewed up to August, 1935. The book can, therefore, be warmly recommended, not only as a needed work of reference, but as a text-book dealing with a subject of increasing importance and interest .- H. W. L. PHILLIPS.

Aluminium-Legierungen. Patentsammlung. Von A. Grützner, unter Mitar-beit von G. Apel. 1 Teil. Zugleich Anhang zu Aluminium, Teil A, in Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Pp. viii + 342. 1936. Berlin : Verlag Chemie G.m.b.H. (R.M. 35; Ausl. Pr. R.M. 26.25.)

This volume forms an appendix to the previously published volumes on aluminium in Gmelins "Handbuch," and a second volume similar to the present one is in preparation. It consists solely of a classified list of the patents which have been taken out in Germany, England, France, Austria, Switzerland, and U.S.A. covering aluminium alloy compositions, and particulars and references are given for some 4000 patents which have been registered between the years 1887 and May, 1935.

The arrangement is somewhat peculiar, as the alloys are listed in purely alphabetical order of the symbols of their components (always excluding the aluminium) and always under the letter symbol nearest to the end of the alphabet; thus an alloy consisting of Cu, Mg, and Si is listed under heading "3SI" indicating that there are three alloying components of which the Si is last in alphabetical order. Such compositions as La, Li, Mg, Mn, Si, Sr, Te (listed under "7Te")-and there are any number almost equally amazing-must surely be a striking tribute to the perennial optimism of mankind in general and of inventors in particular. The present volume takes us down to "7Th."

In a task of such a magnitude as that of compiling this list, mistakes and omissions are inevitable. It is probably without significance that the first patent we happened to think of proved to be missing. The book is well printed and well produced. It will be invaluable to libraries, patent agents and their clients, but hardly to the ordinary reader. Considering the limited circulation that may be expected the price is not unreasonable .- H. W. L. PHILLIPS.

Galvanotechnik (Galvanostegie und Galvanoplastik). Von Hugo Krause. Siebente, vollständig neu bearbeitete und vermehrte Auflage.  $15 \times 21$  cm. Pp. viii + 275, with 21 illustrations. 1936. Leipzig : Max Jänecke. (R.M. 5.40.)

This handbook gives a full summary, written from a practical point of view, of available knowledge on electroplating. The new edition (the seventh) has been revised and enlarged and has been brought well up to date, many developments only recently reported being described; for example, baths for bright nickel and for bronze plating. The deposition of nickel and chromium are fully dealt with. In addition to sections dealing with all of the metals deposited commercially, brief accounts are given of allied electrolytic processes such as the anodic oxidation of aluminium, the deposition of lead peroxide, and the deposition of rubber. Only isolated references to original literature are made, but the author is evidently thoroughly familiar with advances made in Great Britain and America.

The book is probably the most comprehensive and up-to-date manual on practical electrodeposition available .- A. W. HOTHERSALL.

Chromium Plating. Applications of the Process for Imparting Hardness and Wear Resistance to Gauges, Cutting Tools, Dies, Moulds, and Wearing Parts of Machinery. (Machinery's Yellow Back Series, No. 5.) Demy 8vo. Pp. 56, illustrated. [1935.] London : The Machinery Publishing Co., Ltd. (2s. 6d.)

Chromium coatings can be electrodeposited in an extremely hard condition in which they afford considerable resistance to wear. Advantage has been taken of this property for some years, and in certain industries chromium facings are widely used to increase the life of parts subject to wear. Some of these applications are described in this little book, which is an anonymous compilation written from an engineer's point of view. Two of the five chapters are devoted to a detailed description of the chromium plating of gauges, cutting tools and dies, and give an account of the results obtained : this portion of the book is specially useful. Other uses are briefly described in a third chapter.

The outline of the plating process which is given is too inadequate to be of much practical value : both in this chapter and elsewhere in the book, examples of incomplete or inaccurate directions on plating technique were noticed .- A. W. HOTHERSALL.