METALLURGICAL ABSTRACTS

I.—PROPERTIES OF METALS

*Researches with Pure Aluminium Wire of High Tenacity. H. Röhrig and K. Schönherr (*Aluminium*, 1936, 18, (8), 374–375).—Specimens of aluminium wire containing iron 0·16 and silicon 0·10% and having a tensile strength of 28·8 kg./mm.² with an elongation of 0·2% were kept for various periods at 75°, 100°, and 130° C. and the tensile properties determined from time to time. At 75° C. the tensile strength decreased to 25·7 kg./mm.² in 16 days and to 25·5 kg./mm.² in 40 days, while the electrical conductivity increased by 1·4%. At 100° C. the strength decreased rapidly at first then much more slowly to 22·1 kg./mm.² after 30 days, and at 130° C. it had decreased to 20·2 kg./mm.² after less than 3 days. From these results it is concluded that the metal had been heated at too high a temperature during the early stages of rolling and then cooled quickly so that silicon was retained in supersaturated solid solution, thus giving rise to the unusually high tensile strength of the drawn wire.—A. R. P.

The Cold-Working of Metals and Its Influence on the Quality of Aluminium. —— (*Z. Metallkunde*, 1936, 28, (8), 240–242).—Curves are given showing the change in tensile strength, hardness, and elongation of 99·7% aluminium with the degree of reduction by cold-rolling. The change in properties is more marked the thinner and the narrower is the starting sheet.—A. R. P.

*The Behaviour of Three Single Crystals of Aluminium in Fatigue under Complex Stresses. H. L. Cox and W. J. Clenshaw (*Proc. Roy. Soc.*, 1935, [A], 149, (867), 312–326).—The development at the N.P.L. of a new type of combined flexural and torsional fatigue testing machine made it possible to carry out tests under alternating flexural stresses on single crystal specimens. Three single crystal specimens, all of the same orientation, were tested, one under alternating flexural, one under alternating torsional, and the other under a combination of alternating torsional and alternating flexural stresses. The distribution of slip bands on each specimen was entirely in accordance with that predicted from the calculated values of the shear stresses according to the resolved shear stress law, and the results thus afford evidence of the validity of this law in cases where the stress distribution is not simple. Measurements of the mean slip-band spacing were made and the relation between mean slip-band spacing and the value of the resolved stress was examined. The fracture of the specimens is shown to occur in the normal manner by the development of cracks formed on the site of the previous heavy slip, and the dependence of failure on the value of the resolved shear stress is demonstrated.—S. G.

*The Influence of Sodium and Calcium on Industrial Aluminium. B. F. Grashtchenko and V. Darovski (*Legkie Metalli* (*Light Metals*), 1936, (1), 17–37).—[In Russian.] Alloys with up to 0·1% sodium were prepared from aluminium containing silicon 0·1–0·58 and iron 0·14–1·5%, the amount of sodium retained increasing with the percentage of impurities. Up to 0·04% sodium had scarcely any influence on the mechanical properties, but larger amounts slightly reduced the hardness without affecting the tensile strength, and produced severe intercrystalline corrosion. Under the microscope the sodium particles appeared as dark spots in the corrosion centres. The

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

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sodium content was unaffected by annealing at 480° C., but could be reduced to 0·012% by repeated fusion. Up to 0·15% calcium only slightly affected the mechanical properties of aluminium at temperatures up to 480° C., provided that the silicon did not exceed 0·5%. With a lower silicon and higher calcium content the mechanical properties are somewhat improved, but the limiting overheating temperature is reduced, the effect being increased by iron. Calcium reduces the resistance of aluminium to corrosion. It is concluded that industrial aluminium should contain not more than 0·1% calcium, or not more than 0·08% if up to 0·04% sodium is also present.—D. N. S.

†**Properties and Alloys of Beryllium.** Louis L. Stott (*Metals Technology*, 1936, **3**, (5), 17 pp.; and *A.I.M.M.E. Tech. Publ.* **738**).—The physical properties of beryllium are described and tabulated. Beryllium-rich alloys have no commercial applications, but its alloys with copper, nickel, and iron, or with more complex alloys of these elements, have important applications and remarkable mechanical properties. Data for the mechanical properties (tensile strength, ductility, and hardness) are given for a number of alloys, together with the effects on the electrical conductivities of the copper-base alloys. The uses of the alloys are also briefly indicated.—W. H.-R.

*****Absolute Photoelectric Yield of Beryllium, Magnesium, and Sodium.** Marvin M. Mann and Lee A. DuBridge (*Phys. Rev.*, 1936, [ii], **50**, (4), 398).—Abstract of a paper read before the American Physical Society.—S. G.

*****The Electrical Resistance of Bismuth Single Crystals [Containing Lead, Tin, Antimony, or Tellurium].** Alfred B. Focke and John R. Hill (*Phys. Rev.*, 1936, [ii], **50**, (2), 179–184).—Single-crystal rods of bismuth containing up to 0·81 atomic-% of lead, tin, antimony, or tellurium were prepared with the principal axis parallel and perpendicular to the axis of the rod, and the electrical resistances were measured at temperatures between − 185° and + 100° C. The addition of lead or tin to bismuth causes a marked increase in the electrical resistance ; the increase is greater the larger the amounts of the impurity provided that recrystallization with the precipitation of a second constituent does not occur. The addition of tellurium usually causes a decrease in resistance until the point at which a second constituent is precipitated. The effect of antimony is complicated. These results are explained on the basis of the theory of H. Jones (*Met. Abs.*, 1935, **2**, 681), and the approximate solubility limits of tin, lead, antimony, and tellurium in solid bismuth are estimated.—W. H. R.

Investigations on Bismuth Crystals. II.—Change of the Thermoelectric Power in Transverse Magnetic Fields. E. Grüneisen and J. Gielessen (*Ann. Physik*, 1936, [v], **27**, (3), 243–255).—v. G.

*****The Theory of the Galvomagnetic Effects in Bismuth.** H. Jones (*Proc. Roy. Soc.*, 1936, [A], **155**, (886), 653–663).—Calculations are made of the change of resistance in a magnetic field and of the Hall coeffs. of bismuth single crystals. The estimate of the number of electrons overlapping the principal Brillouin zone for bismuth, previously given to account for the diamagnetic properties, is shown to lead to the very large galvomagnetic effects which are observed. Minute traces of impurity in bismuth are shown to have very great effect on the galvomagnetic properties, particularly at high magnetic field strengths. In this way the variation of the Hall coeff. with field strength is explained, and fair agreement is obtained between the calculated change of resistance at various fields and Kapitza's observations.—S. G.

Calcium. A. Schubert (*Russko-Germanskiy Vestnick Nauki i Tehniki* (*Deut.-russ. Z. Wiss. Tech.*), **1936**, (5), 3–7).—[In Russian.] A review.—N. A.

*****The Sorption of Hydrogen and Deuterium by Copper and Palladium. I.— The Behaviour of Copper and Copper Oxides.** H. W. Melville and Eric K. Rideal (*Proc. Roy. Soc.*, 1935, [A], **153**, (878), 77–88).—The following heterogeneous reactions of hydrogen and deuterium are investigated with these

results : CuO is reduced by atomic hydrogen and deuterium at 20° C. at the same velocity. This is in agreement with previous experiments showing that free atoms of hydrogen and deuterium react at identical velocities. CuO is more rapidly reduced by hydrogen than by deuterium at 156°–269° C. The difference in energy of activation is 0·4 k.cal. This is also in agreement with the observation that hydrogen reduces simple molecules on a metal (nickel) surface more quickly than deuterium. Hydrogen and deuterium are sorbed by and desorbed from copper at the same velocity at 71°–200° C., except that at higher temperatures hydrogen is sorbed slightly more quickly.—S. G.

*The Sorption of Hydrogen and Deuterium by Copper and Palladium. II.—The Sorption by Palladium and Diffusion Through Copper. H. W. Melville and E. K. Rideal (*Proc. Roy. Soc.*, 1935, [A], 153, (878), 89–103).—Cf. preceding abstract. The diffusion of hydrogen and deuterium through palladium, copper, and nickel is investigated at 150°–350° C. and at pressures from 1 to 200 mm. For each metal hydrogen diffuses more quickly, the difference in energy of activation for diffusion being 0·8 for palladium, 0·6 for nickel, and 0·8 k.cal. for copper, respectively. The copper and nickel are supported on palladium. In copper it is shown by employing composite films Cu–Pd–Cu and Pd–Cu–Pd that the rate-determining step, and therefore the step responsible for the difference in the velocity of diffusion, is not due to any process connected with the gas–metal interface. With palladium measurements of the solubility of the two isotopes are also made, hydrogen being the most soluble. Combining these results with the diffusion measurements it is shown that the difference in velocities of diffusion is due partly to the greater solubility as well as to the greater mobility of hydrogen on palladium. Potential barriers are constructed from diffusion and solubility data, and it is shown that there exists a definite barrier for the penetration of hydrogen from the surface to the interior. The barrier has the same height for both hydrogen and deuterium and a mechanism for the transfer of gas is suggested.—S. G.

†The Failure of Lead by Creep. J. Neill Greenwood (*Proc. Australasian Inst. Min. Met.*, 1935, (100), 477–497).—From a critical review of recent work and from the results of experiments which are not yet completed, evidence is adduced to show that lead can fail by intercrystalline cracking by the application of a steady stress in air and that at operating stresses it is probable that this cracking is accompanied by less general distortion than occurs at 500 lb./in.² and that, therefore, the possibility of failure occurring is not a remote one even in the absence of vibration or corroding liquids. The rate of creep of lead at stresses below 500 lb./in.² is very considerably influenced by its previous thermal and mechanical treatment and by very slight changes in composition ; thus even minute increases in the silver, zinc and, more especially, in the bismuth, antimony, and tellurium contents of commercial lead produce a considerable increase in the rate of creep, although a similar effect is obtained by removal of the ordinary impurities in lead.—A. R. P.

*On the Conduction of Heat by Some Metals at Low Temperatures [Lead, Copper, Tungsten]. H. Bremmer and W. J. de Haas (*Physica*, 1936, 3, (7), 672–686 ; and *Comm. K. Onnes Lab. Leiden*, No. 243a).—[In English.] The heat conductivity was determined for lead, copper, and tungsten. For lead an increase of the heat resistance is found at very low temperatures. This resistance is higher in the superconductive state than in the state in which superconductivity has been disturbed by means of a magnetic field. This is in complete agreement with the results for other pure superconductive metals. The so-called ideal resistance of copper is still decreasing at the lowest temperature at which the determinations have been carried out. It is proportional to $T^{2 \cdot 1}$. The ideal resistance of tungsten approaches a minimum value.

—S. G.

*The Magnetization Curves of a Superconducting [Lead] Sphere and Ring. D. Shoenberg (*Proc. Roy. Soc.*, 1936, [A], **155**, (886), 712–726).—The (diamagnetic) magnetization curve of a superconducting pure lead sphere is measured by the Faraday method. The magnetization curves of a lead crystal sphere and an impure lead sphere are also measured, and the magnetization of an anchor ring of pure lead is described. The results are discussed in connection with the intermediate state recently proposed by Peierls.—S. G.

*Determination of the Heat Resistance of Mercury at the Temperatures Obtainable with Liquid Helium. W. J. de Haas and H. Bremmer (*Physica*, 1936, **3**, (7), 687–691; and *Comm. K. Onnes Lab. Leiden*, No. 243b).—[In English.] A new apparatus is described for the determination of the heat resistance of pure mercury. The measurements show that even this very pure substance has a minimum value for its heat resistance though this is found at a very low temperature ($3\cdot8°$ K.). Mercury shows a decrease of heat resistance when superconductivity is disturbed by means of a magnetic field, just as the other pure superconductive metals do.—S. G.

*The Relation Between Electron Field Emission and Contact Electromotive Force for Liquid Mercury. Dan H. Moore (*Phys. Rev.*, 1936, [ii], **50**, (4), 344–347).—The relation between the contact electromotive force and the impulsive potential necessary to initiate a vacuum spark has been studied for a liquid mercury cathode. For impure mercury no definite relation could be found, whilst for purified mercury the relation between the work-function and the breakdown field was only in qualitative, and not in quantitative agreement with theory.—W. H.-R.

Purification of Mercury. Biagio Pesce (*Annali chim. applicata*, 1936, **25**, 654–657; *C. Abs.*, 1936, **30**, 5844).—Two distillations, boiling with concentrated sodium hydroxide, and about 30 washings through a column of dilute nitric acid are recommended. The sp. gr. is checked with a special pycometer to $0\cdot0002$ grm.—S. G.

*The Transition Between the Superconductive and the Normal State. I.—Magnetic Induction in Mercury. K. Mendelssohn (*Proc. Roy. Soc.*, 1936, [A], **155**, (886), 558–570).—The change of induction of long-shaped mercury specimens is investigated when passing from the normal to the superconductive state. Experiments at constant temperature and constant field were carried out separately. An arrangement is described which permits the temperature to be kept constant to less than $0\cdot005°$ during the whole experiment. The change in induction from zero to its normal value when passing from the superconductive to the normal state is found to be discontinuous within the limits of accuracy. When passing from the normal to the superconductive state a more gradual change of induction is observed. This " hysteresis " is discussed with respect to a possible " supercooling " from the normal into the superconductive state. A change of induction in time with constant variables of state (temperature and magnetic field) is observed. This time effect cannot be explained by secondary causes, but seems to be a peculiarity of the transition between the superconductive and the normal state of the mechanism.—S. G.

*Hydrogenation by Adsorbed Hydrogen Atoms. K. S. Ablezova and S. Z. Roginskii (*Dokladi Akademii Nauk S.S.S.R. (Compt. rend. Acad. Sci. U.R.S.S.)*, 1935, **1**, (7/8), 490–492 (in Russian), 492–493 (in German); *C. Abs.*, 1935, **29**, 6826).—Metal films that are completely incapable of catalyzing the combination of ethylene and hydrogen molecules will, when covered at $-180°$ C. with a layer of adsorbed hydrogen atoms, effect the hydrogenation at or below room temperature. Further, if ethylene is added at liquid air temperatures to a fresh film of nickel saturated with atomic hydrogen, the ethylene remains adsorbed even on warming the film to room temperature, although in the absence of the layer of atomic hydrogen neither ethylene nor ethane is appreciably adsorbed by the nickel film at room temperature.—S. G.

*Magnetization of Nickel under Compressive Stresses and the Production of Magnetic Discontinuities [Barkhausen Effect in Nickel]. C. W. Heaps (*Phys. Rev.*, 1936, [ii], **50**, (2), 176–179).—The magnetization of nickel bars under compression has been studied at stresses up to 10 kg./mm.^{2}. A strictly rectangular hysteresis loop cannot be obtained by compression alone, although an approximation to this shape can be obtained by using sufficiently high pressures. The Barkhausen effect is not much affected by compression alone. In an elastically bent wire, much smaller stresses produce large magnetic discontinuities, but a composite specimen consisting of a nickel bar fixed inside a nickel tube so that the bar is in compression and the tube in tension behaves similarly to unstressed material. The existence of contiguous compressed and stretched regions appears necessary for the appearance of the large discontinuities, and the way in which these discontinuities are produced is discussed.—W. H.-R.

*Reversible Change of Thermal Energy Accompanying Adiabatic Change of Magnetization in Nickel. T. C. Hardy (*Phys. Rev.*, 1936, [ii], **50**, (4), 395).—Abstract of a paper read before the American Physical Society. The experimental method devised by A. Townsend (*Met. Abs.*, 1935, **2**, 139) has been so improved as to permit a study of the magneto-caloric effect in materials for which the total hysteretic energy increase is small in comparison with the reversible thermal energy changes which occur during a half cycle of magnetization. The specimen of nickel examined by H. was the same as that used by Townsend, except that it had been annealed at 1100° C. for 2 hrs. in hydrogen at atm. pressure and cooled to room temperature in 10 hrs. The hysteresis loss per half cycle is approx. 1200 ergs/cm.^{3}. As the magnetization is decreased from near saturation to approx. the knee of the magnetization curve, the thermal energy decreases almost linearly with magnetizing field by the amount, 9000 ergs/cm.^{3}. Below the knee of the curve, the magnetization decreases rapidly to zero and the thermal energy decreases by an additional 16,000 ergs/cm.^{3}. On remagnetization the same process is reversed, except for the addition of the hysteresis heat, which appears in the region of most rapid variation of magnetization with field. Throughout the entire process the decrease of thermal energy is several times greater than the external work done by the specimen on the magnetizing currents.—S. G.

On the Effect of Tensile Stress on the Magnetization [of Nickel] above the Curie Point. Gertrud Scharff (*Ann. Physik*, 1936, [v], **25**, (3), 223–232).—Tensile stresses have no effect on the Curie point of nickel.—v. G.

The Magnetic Behaviour of a Nickel Wire under Great Torsion. Richard Gans (*Ann. Physik*, 1936, [v], **25**, (1), 77–91).—The observed magnetic effects of torsion on nickel are explained theoretically.—v. G.

*On the Mechanism of Displacement of Noble Metals from Solutions of Their Salts by Hydrogen under Pressure. I.—Displacement of Palladium from Solutions of Palladium Chloride. V. V. Ipatiev and V. G. Tronev (*Dokladi Akademii Nauk S.S.S.R. (Compt. rend. Acad. Sci. U.R.S.S.*), 1935, **1**, 622–624 (in Russian), 624–626 (in German)).—S. G.

*On the Mechanism of Displacement of Noble Metals from Solutions of Their Salts by Hydrogen under Pressure. II.—Displacement of Noble Metals from Solutions of H_2PtCl_6, H_2IrCl_6, Na_3IrCl_6, and Na_3RhCl_6. V. V. Ipatiev and V. G. Tronev (*Dokladi Akademii Nauk S.S.S.R. (Compt. rend. Acad. Sci. U.R.S.S.*), 1935, **1**, 627–629 (in Russian), 629–632 (in German)).—S. G.

*Normal Energy Distribution of Photoelectrons from Potassium Films as a Function of Temperature. C. L. Henshaw (*Phys. Rev.*, 1936, [ii], **50**, (4), 398).—Abstract of a paper read before the American Physical Society.—S. G.

*Transition Phenomena in the Condensation of Silver Vapour on Clean and Gas-Covered Tungsten. Milo B. Sampson and Paul A. Anderson (*Phys. Rev.*, 1936, [ii], **50**, (4), 385).—Abstract of a paper read before the American Physical

Society. In a tube which had been subjected to severe out-gassing, sealed from the pumps, and gettered with vaporized barium, duplicate tungsten filaments, dissimilar only with respect to the condition of their surfaces, were bombarded with gas-free silver vapour supplied by a molybdenum foil oven which could itself be thoroughly outgassed by flashing. One of the tungsten filaments was cleaned by flashing at 2800° K., while the other was allowed to retain the oxygen coating which persists after flashing at 1400° K. Permanent condensation of silver on the gas-covered filament occurred only after its temperature had been decreased to 900° K. and typical transition effects appeared. At the same vapour stream intensity permanent condensation on the clean tungsten occurred at 1220° K., approximately the temperature of the vaporizing oven, and none of the characteristic critical phenomena could be detected. It is probable that transition ('' critical temperature '') effects in the condensation of metal on metal as observed by Estermann, Cockcroft, and others are conditioned by the presence of surface films of gas and vapour and disappear when such films are removed.—S. G.

*Preparation of Silver Sheet. The Tensile Properties of Sheet of Commercial Silver Alloys in Relation to the Method of Manufacture. H. Moser and E. Raub (*Mitt. Forschungsinst. Edelmetalle*, 1936, **10**, (2/3), 19–26).—The effects of rolling, forging, and forging and rolling on the tensile properties of 835- and 925-fine silver sheet prepared from flat skillets and round bars are shown in tables and diagrams. In all cases considerable variations were observed in parallel tests so that general conclusions could not be drawn from the results. Usually, however, sheet of 835-fine silver prepared from flat skillets showed a higher tensile strength and yield point but a smaller elongation than that prepared from round bars; these differences tended to become smaller the greater the amount of work put into the metal. In the case of 925-fine silver, only the elongation behaved similarly, the tensile strength and yield point varying little with the method of preparing the sheet. Lower tensile properties were obtained by hot forging than by rolling, but rolling after forging removed these differences. Oxide films produced by intermediate anneals had no effect on the final properties of the sheet provided that they were not allowed to become too thick.—A. R. P.

*The Formation of Blistery Silver. Ernst Raub, Fritz Distel, and Alice Schall (*Z. Metallkunde*, 1936, **28**, (9), 253–257).—The gases which cause blisters to form in annealed silver sheet have been analyzed after expelling them by fusion *in vacuo*. From a 10 : 90 copper–silver alloy melted in a graphite crucible in a coke fire the occluded gas consisted of sulphur dioxide 41–48, carbon dioxide 28–31, water 24–30, and nitrogen 0–6%; the corresponding figures for the same alloy melted in an oil-fired furnace were 62–68, 3–6, 29–30, and 0–2%, and in a gas-fired furnace 62–64, 19–20, 11–13, and 0–5%. From a 20 : 80 copper–silver alloy melted in a coke-fired furnace in such a way that the furnace gases were drawn over the surface and then cast through a luminous gas flame, the gas extracted contained carbon monoxide 45·8, hydrogen 27·2, methane 17·9, and carbon dioxide 9·1 vol.-%. The sulphur dioxide content is due to absorption of sulphur and oxygen from the furnace atmosphere and their interaction on solidification of the metal; the remaining gases are entrapped during casting. Thorough deoxidation of the molten metal with phosphorus or lithium removes the oxygen, and thus prevents formation of sulphur dioxide; at the same time both elements inhibit dissolution of hydrogen in the metal. In thoroughly deoxidized metal much of the sulphur is removed by volatilization as silver sulphide.—A. R. P.

*Micro-Plasticity in Crystals of Tin. Bruce Chalmers (*Proc. Roy. Soc.*, 1936, [A], **156**, (888), 427–443).—Experiments are described on the isothermal stress–strain–time relations of single crystals of tin of two grades of purity (99·987 and 99·996%), the stress being pure tension and the strain being measured to

10^{-7} cm./cm. on a length of 3 cm. Creep is found to occur under all stresses, its initial rate being proportional to stress for small stresses, and of the order of 3×10^{-9} cm./cm./minute per grm./mm.^{2} (micro-creep), while above a fairly definite stress of the order of 120 grm./mm.^{2} the rate of creep increases much more rapidly with stress (macro-creep). Micro-creep decreases with time in a roughly exponential manner, and macro-creep remains constant for a considerable time. The phenomena are considered from the point of view of the current theories concerning the mechanical strength of metallic crystals, and it is shown that micro-creep can be accounted for by an extension of G. I. Taylor's theory of fault propagation.—S. G.

Continuous Measurement of Changes in the Electronic Work-Function During the Fusion of Tin. Paul A. Anderson (*Phys. Rev.*, 1936, [ii], **50**, (4), 386).—Abstract of a paper read before the American Physical Society. A slight modification of the method for measuring contact p.d. (*Met. Abs.*, 1935, **2**, 368; this vol., p. 110) made possible continuous observation of progressive alterations in the work-function of a metal surface down to time intervals of a few seconds. Applied to study the change in work-function attending the transformation of γ-tin to liquid tin the method yields electron current–time curves which are similar to temperature–time fusion curves. The break in the current–time characteristic does not coincide with the disappearance of the solid phase but follows it after a measurable time interval. The shape of the curve beyond the break is finite, decreasing from a high positive value to zero as the temperature of the liquid tin is increased. If, as is unlikely, these effects are due to liberation of adsorbed gas the curves provide a means of following the desorption continuously. They may indicate a persistence of the regularly orientated lattice structure of solid tin beyond the melting point. The contact p.d. between γ-tin and liquid tin is found to be 0·17 v. The liquid tin has the lower work-function, in agreement with the photoelectric measurements of Goetz, which, uncorrected to the true thresholds at 0° K., yield the value 0·16 ev. for the difference between the work-functions.—S. G.

Influence of Crystal Structure on Electron Emission from " 218 " Tungsten Wire. W. B. Nottingham (*Phys. Rev.*, 1936, [ii], **50**, (4), 398).—Abstract of a paper read before the American Physical Society. The thermionic emission from " 218 " tungsten wire has been shown by Johnson and Shockley (*Met. Abs.*, this vol., p. 196) to vary with crystallographic direction. Single crystals of this wire average 0·25–1·0 cm. in length and present 6 strips of strong emission separated by 6 strips of weak emission as the filament circumference is explored. The electron energy distribution as indicated by retarding potential measurements becomes ambiguous near " zero field " because the currents received are coming in effect from a cathode of inhomogeneous surface structure to a single collector. In the case of thoriated filaments it is thought that the actual surface exposed may be much more uniform than that found in " 218 " wire, thus accounting for the accurate reproducibility of the energy distribution curves. In contrast, the curves observed with different samples of " 218 " wire have not been in exact agreement with each other and have generally shown an apparent reflection effect larger than that for thoriated tungsten. If it be assumed that the work-function varies sinusoidally from a minimum to a maximum differing by 0·5 v., an approximate theory gives good agreement with experiment.—S. G.

Cathode Ray Oscillography of Gas Adsorption Phenomena. I.—A Method for Measuring High-Velocity Approach to Certain Physical and Chemical Equilibria. M. C. Johnson and F. A. Vick (*Proc. Roy. Soc.*, 1935, [A], **151**, (873), 296–307).—The changes in electron emission from a solid surface are recorded by a cathode ray oscillograph and are used to study processes at a tungsten–oxygen interface.—S. G.

*Cathode Ray Oscillography of Gas Adsorption Phenomena. II.—Durations of an Adsorbed State of Oxygen on Tungsten. M. C. Johnson and F. A. Vick (*Proc. Roy. Soc.*, 1935, [A], **151**, (873), 296–316).—Cf. preceding abstract. The evaporation of a layer of oxygen atoms on tungsten was studied. The duration of the adsorbed state is 0·36 seconds at 2548° abs. and increases to 3·49 seconds at 2362° abs. The heat of evaporation of the oxygen layer is 147,000 ± 3000 cal./grm. atom. A numerical value of the τ_0 of Frenkel's theory is obtained. Ageing of the tungsten was found to increase the heat of evaporation of the oxygen, and certain contamination by added vapours was found to decrease it.—S. G.

*The Mobility of Sodium on Tungsten. Richard Charles Leslie Bosworth (*Proc. Roy. Soc.*, 1935, [A], **150**, (869), 58–76).—By depositing a small patch of sodium on the centre of a tungsten strip filament and traversing the strip from time to time with a well-defined spot of light, the photoelectric properties were used to measure the mobility of the sodium film. It was observed first of all that a clean strip absorbs sodium, a portion of which, however, reappears on the surface from which it evaporates when the strip is heated above 1300° K. There is a limit to the capacity of the strip to absorb sodium, and once that limit is reached any excess sodium is stable on the surface and, if deposited as the active patch, spreads or migrates over the surface at such a rate that the strip is approx. uniformly active after 1 or 2 hrs. at 300° K. or 5–10 seconds at 800° K. An activation energy of 0·25 v. is indicated for this migration, and within experimental error the same energy is associated with the absorption process, leading to the conclusion that this latter consists of migration down slip planes and intercrystalline cracks.—S. G.

*The Effect of Temperature, Degree of Thoriation, and Breakdown on Field Currents from Tungsten and Thoriated Tungsten. A. J. Ahearn (*Phys. Rev.*, 1936, [ii], **50**, (3), 238–253).—The field currents from thoriated tungsten with different degrees of thoriation have been studied. The measured currents are independent of temperature up to about 1040° K. At higher temperatures the results are accounted for completely by assuming that the observed current is due to the ordinary thermionic emission plus a field current independent of temperature. The characteristic field current curve is independent of the degree of thoriation of a thoriated tungsten filament. As the voltage is increased an electrical breakdown occurs which raises the field current by a factor which may be as high as 10^4–10^7. With pure tungsten this breakdown does not change the thermionic activity of the cathode, but with thoriated tungsten the thermionic activity is increased. A. concludes that the electric field applied to the cathode surface, rather than the applied voltage, is the important factor in producing breakdowns.—W. H.-R.

*Field Currents and Thermionic Currents from Thoriated Tungsten and Pure Tungsten. A. J. Ahearn (*Phys. Rev.*, 1936, [ii], **50**, (4), 398).—Abstract of a paper read before the American Physical Society.—S. G.

*The Photoelectric Properties of Zinc. Charles F. DeVoe (*Phys. Rev.*, 1936, [ii], **50**, (5), 481–485).—The long wave limit for zinc prepared by evaporation in a high vacuum varied between 2900 and 2930 A. in a number of experiments ; the corresponding work-function is 4·24 v. The effects of varying the pressure under which the distillation was carried out, and of foreign gases, were studied.
—W. H.-R.

*Reflecting Power of Evaporated Metal Films in the Near and Far Ultra-Violet. G. B. Sabine (*Phys. Rev.*, 1936, [ii], **50**, (4), 396).—Abstract of a paper read before the American Physical Society. The reflecting powers of evaporated metal films from the visible to 450 A. were determined for aluminium, antimony, beryllium, bismuth, cadmium, chromium, copper, gold, iron, lead, magnesium, manganese, molybdenum, nickel, palladium, platinum, silver, tellurium, tin, titanium, zinc, and zirconium. Photographic methods were

used. The accuracy of the work in the near ultra-violet was of the order of 3% and in the far ultra-violet not better than 5%.—S. G.

*The Polarimetric Determination of Optical Properties [of Films]. Richard Maury Emberson (*Phys. Rev.*, 1936, [ii], **50**, (4), 396).—Abstract of a paper read before the American Physical Society. A study was made of the polarimetric method for determining the optical properties of a surface. The experimental work was carried out with a polarimeter designed and constructed in university shops. The equations used in the computations of results were based on theoretical work of T. C. Fry. It was found that certain instrumental errors profoundly affect the results. When the observed data were freed from these errors a decrease was noted in the variation of the computed optical constants of a surface with the angle of incidence at which the data were obtained. Studies were made of thin metal films deposited on glass. The results indicated that, while the computed film thicknesses were of the correct order of magnitude, they were not independent of the angle of incidence of observation; also, the computed thicknesses were always complex, with the imaginary part negative and about the same size as the real part.—S. G.

Comments on "Vapour Pressure Measurements of High Boiling Point Metals" by Baur and Brunner. Joseph Fischer. Emil Baur and Roland Brunner (*Helv. Phys. Acta*, 1935, **18**, 1028–1030).—Cf. *Met. Abs.*, 1935, **2**, 209. F. states that von Wartenberg's apparatus as used by B. and B. is not suitable for boiling point measurements. B. and B. reply.—S. G.

*Calculation of Various Physical Constants of Heterogeneous Substances. II.—Dielectric Constants and Conductivities of Polycrystals in the Non-Regular Systems [Antimony, Bismuth, Tin, Cadmium, Mercury]. D. A. G. Bruggeman (*Ann. Physik*, 1936, [v], **25**, (7), 645–671).—The relations between the electrical conductivities of single crystals and of polycrystalline aggregates have been determined mathematically for the non-cubic metals antimony, bismuth, tin, cadmium, and mercury.—v. G.

Magnetic Investigations of the Plastic Deformation of Metallic Substances. H. J. Seemann (*Metallwirtschaft*, 1936, **15**, (40), 931–936).—The present position of our knowledge of the influence of plastic deformation on the magnetic properties of non-ferromagnetic metals and alloys is reviewed.—v. G.

*New Determinations of Gyromagnetic Ratios for Ferromagnetic Substances. S. J. Barnett (*Phys. Rev.*, 1936, [ii], **50**, (4), 390).—Abstract of a paper read before the American Physical Society. See also *Met. Abs.*, 1934, **1**, 226. New and extensive measurements were made on a number of substances including electrolytic iron, cold-rolled steel, nickel, Permalloy, Hopkinson's nickel–iron alloy, pure cobalt, cobalt alloyed with a few % of copper, cobalt alloyed with nickel (Bloch's alloy), and Preuss's iron–cobalt alloy. All the work was carried out by methods differing only slightly from those used by B. in the last work on rotation-by-magnetization. The values of the gyromagnetic ratio obtained range from about $1 \cdot 02 \times m/e$ (nickel–iron) to about $1 \cdot 10 \times m/e$ (pure cobalt), with mean errors in a number of cases of much less than 1%. Earlier values have been confirmed. No certain difference has been found between results obtained with the magnetizing coil fixed to the earth and magnetizing coil fixed to the vibrating body.—S. G.

Theory of Surface Ionization on Glowing Metals. A. I. Anselm (*Dokladi Akademii Nauk S.S.S.R. (Compt. rend. Acad. Sci. U.R.S.S.)*, 1934, **3**, (5), 329–331 (in Russian), 332–334 (in German)).—Theoretical.—S. G.

*The Resistance and Thermoelectric Properties of the Transition Metals. N. F. Mott (*Proc. Roy. Soc.*, 1936, [A], **156**, (888), 368–382).—Explanations are given in terms of the quantum theory of metals of the following phenomena : the decrease in the temperature coeff. of resistance of palladium and platinum at high temperatures; the large negative thermoelectric power of palladium and platinum; the increase in the absolute magnitude of the thermoelectric

power of palladium when it is alloyed with copper, silver, gold, or hydrogen, and the sudden decrease for higher concentrations; the sudden change in the temperature coeff. of resistance of ferromagnetic metals at the Curie point; the behaviour of the thermoelectric power of nickel near the Curie temperature.
—S. G.

*Electromagnetic Equations of the Superconductor. F. and H. London (*Proc. Roy. Soc.*, 1935, [A], **149**, (866), 71–88).—S. G.

Magnetic Transition Curves of Superconductors. R. Peierls (*Proc. Roy. Soc.*, 1936, [A], **155**, (886), 613–628).—Theoretical. Discusses the magnetic properties of a superconductor for that range of external field strength in which some lines of force are passing the body, but in which their density is still less than outside.—S. G.

*The Thermodynamics of Magnetization. E. A. Guggenheim (*Proc. Roy. Soc.*, 1936, [A], **155**, (884), 70–101).—S. G.

Contact Potential, Energy of Emergence, and Thermoelectric Potential.—I. G. Mönch (*Erlanger Ber.*, 1934, **65**, 191–201; *Chem. Zentr.*, 1935, **106**, (II), 20; *C. Abs.*, 1936, **30**, 5089).—This first paper of a series reviews the work of others on these properties of metals and semi-conductors and outlines problems the solution of which is to be undertaken experimentally.—S. G.

*The Relation Between Energy of Emergence and Contact Potential.—II. G. Mönch (*Erlanger Ber.*, 1934, **65**, 202–207; *Chem. Zentr.*, 1935, **106**, (II), 20; *C. Abs.*, 1936, **30**, 5089).—See also preceding abstract. The difference between the energy of emergence and that of the contact potential of tungsten and platinum was experimentally determined as follows : An electrically heated platinum sheet was sputtered with tungsten on one side. By means of a screen system, small currents of electrons (equal portions on each side) were made to impinge on each side as an anode. The current of electrons on each side was absorbed in relation to the accelerating potential. The value of the saturation currents gives the value of the energy of emergence; the distance between the breaks (beginning of saturation) of the two lines gives the difference in contact potential. Such measurements substantiated the theoretical requirement that the energy of emergence in volts, disregarding sign, is equal to the difference in contact potentials, for the case of tungsten–platinum.—S. G.

*The Relation of the Contact Potential to the Condition of Strain of a Metal Surface. G. Mönch (*Erlanger Ber.*, 1934, **65**, 211–214; *Chem. Zentr.*, 1935, **106**, (II), 21; *C. Abs.*, 1936, **30**, 5089).—Cf. preceding abstracts. Experiments were carried out to determine any change in the energy of emergence with change in the strain of the metal surface. The difference between the energy of emergence for the strained and unstrained surface was measured by the difference in the contact potentials. A nickel sheet 0·8 mm. thick can be bent in a vacuum to a cylinder of 4 cm. radius without exceeding the elastic limit. Surface expansion amounts to about 1%; volume expansion to about 0·3%. Current-voltage lines were plotted before and after the bending of the metal for a current of electrons flowing from a glowing cathode to the metal under investigation as anode. The shift in such lines along the potential axis then gives the change in contact potential. The experiments showed that with an expansion of 1% the change in energy of emergence was certainly less than 4×10^{-3} v.—S. G

On the Application of the Dirac Matrix Method to the Theory of Metals. S. Shubin (*Dokladi Akademii Nauk S.S.S.R.* (*Rep. Acad. Sci. U.S.S.R.*), 1935, **3**, (1), 15–18 (in Russian); and *Compt. rend. Acad. Sci. U.R.S.S.*, 1935, [N.S.], **3**, 15–18 (in German)).—Theoretical. The method is applied to the problem of electron gas under the influence of an alternating electric field.—N. A.

*The Interaction of Atoms and Molecules with Solid Surfaces. I.—The Activation of Adsorbed Atoms to Higher Vibrational States. J. E. Lennard-Jones and C. Strachan (*Proc. Roy. Soc.*, 1935, [A], **150**, (870), 442–455).—The

behaviour of an atom or molecule adsorbed on the surface of a solid is investigated by wave-mechanics. Formulæ are found for the mean interval between successive excitations from the state of lowest vibrational energy to various excited states and for the mean time during which the atom remains in an excited state. An application is suggested to the theory of the migration of atoms along surfaces.—S. G.

*The Interaction of Atoms and Molecules with Solid Surfaces. II.—The Evaporation of Adsorbed Atoms. C. Strachan (*Proc. Roy. Soc.*, 1935, [A], **150**, (870), 456–464).—Cf. preceding abstract. A formula is obtained for the probability of evaporation of an adsorbed atom or molecule from a solid surface. The theory is applied to the evaporation of H_2, HD, and D_2 from a metal, and it is shown that over a wide range of temperature the average length of time spent by HD on copper is about 4–6 times that of H_2, while the time spent by D_2 is about 20 times as great as that of H_2.—S. G.

*The Interaction of Atoms and Molecules with Solid Surfaces. III.—The Condensation and Evaporation of Atoms and Molecules. J. E. Lennard-Jones and A. F. Devonshire (*Proc. Roy. Soc.*, 1936, [A], **156**, (887), 6–28).—Cf. preceding abstracts. A detailed theory of the evaporation and condensation of atoms and molecules at solid surfaces is worked out. Formulæ are found for the probability that an impinging particle will condense on to a solid surface and for the length of time that it will remain there. The theory thus provides explicit formulæ for the constants which occur in Langmuir's adsorption isotherm in terms of the physical properties of the solid and its surface field. The mechanism by which evaporation is supposed to take place is by the transfer of a quantum of the thermal energy of the solid to the adsorbed atom. As thermal quanta are as a rule small, the energy applies mainly to atoms and molecules held by weak forces such as van der Waals' forces. It is found that evaporation may, even at low temperatures, take place in two or more stages, an atom being first excited to a higher vibrational level and then, while in that excited state, receiving another quantum of energy sufficient to cause evaporation. To illustrate the effect of mass the probabilities of condensation and evaporation of H_2, HD, and D_2 are evaluated in typical circumstances. The coeff. of condensation is found in many cases to be quite small and not equal to unity, as is frequently assumed.—S. G.

*The Interaction of Atoms and Molecules with Solid Surfaces. IV.—The Condensation and Evaporation of Atoms and Molecules. J. E. Lennard-Jones and A. F. Devonshire (*Proc. Roy. Soc.*, 1936, [A], **156**, (887), 29–36).—Cf. preceding abstracts. A theory of evaporation of atoms from a solid surface is worked out for a model in which an adsorbed atom can vibrate radially and laterally about its point of attachment, but cannot migrate. Evaporation is controlled by the rate at which thermal energy is communicated from solid to the adsorbed atom. The condition for detailed balancing between adsorbed and evaporated states gives an equation for the adsorption isotherm in terms of the energy levels of the adsorbed state.—S. G.

*The Interaction of Atoms and Molecules with Solid Surfaces. V.—The Diffraction and Reflection of Molecular Rays. A. F. Devonshire (*Proc. Roy. Soc.*, 1936, [A], **156**, (887), 37–44).—Cf. preceding abstracts. A theory of the diffraction and reflection of molecular rays at crystal surfaces is worked out. It is shown that the minima in the diffraction and reflection curves of He and LiF observed by Frisch and Stern are capable of a simple explanation, and that they can be used to deduce information about the potential energy of the gas in the field of the solid.—S. G.

II.—PROPERTIES OF ALLOYS

Running Properties of Aluminium-Bearing Metals (Quarzal). Maximilian (Frhr.) von Schwarz (*Z. Metallkunde*, 1936, **28**, (9), 272–275).—The Quarzal alloys consist of aluminium with 5–15% copper and small amounts of heavy metals and constituents which produce precipitation-hardening. The running properties of 5 of these alloys are shown graphically, and photomicrographs of their structure are reproduced. The 5% copper alloy will withstand bearing pressures of up to 150 kg./cm.², but is most satisfactory at 80 kg./cm.² ; it can be used with running speeds up to 10 m./sec. and in well-lubricated bearings the running temperature averages 70°–90° C. Since the coeff. of expansion is about double that of steel, due allowance must be made for this in constructing the bearings. The Quarzal alloys have a low sp. gr., wear better than tin-base bearing metals especially under impact conditions, and withstand higher temperatures without seizing or melting.—A. R. P.

Vanadium and Zirconium as Constituents of Aluminium–Bronze. C. Panseri (*Alluminio*, 1936, **5**, (2), 37–45).—The effects of small additions of vanadium and zirconium to α-aluminium–bronzes has been investigated, and the results are shown in micrographs and in data for the mechanical properties. Vanadium is insoluble in both liquid and solid copper, but up to 0·25% can be introduced into aluminium–bronze to improve the tensile strength at the expense of the ductility. Zirconium tends to embrittle the alloy and even small additions greatly reduce the rolling properties.—A. R. P.

Influence of the Method of Deformation and Thermal Ageing on the Fatigue Strength of Aged Aluminium Alloys. H. Bohner (*Metallwirtschaft*, 1936, **15**, (35), 813–814).—Alternate bending tests have been made on an aluminium alloy with copper 5·65, manganese 0·67, silicon 0·14, and iron 0·23% after various heat- and mechanical treatments. With age-hardened rods, those produced by extrusion show an endurance limit of 1 kg./mm.² less than that of those produced by rolling or drawing, both of which give 14·5 kg./mm.². Quenching temperatures had no effect on the results, but increase in ageing temperature or time increases the endurance limit.—v. G.

Mechanism of the Decomposition of Aluminium–Magnesium Solid Solutions. Paul Lacombe and Georges Chaudron (*Compt. rend.*, 1936, **202**, (21), 1790–1792). —The difference of potential between the calomel electrode and an electrode of the alloy immersed in an aerated solution of 3% sodium chloride was measured with a Curie electrometer. A 9% magnesium–aluminium alloy made of very pure metals was quenched and tempered at 300° and 200° C. for periods of from 30 minutes to 400 hrs. After tempering below 280° C., the potential of the solid solution first rises and then, after prolonged treatment, reverts to its initial value. Corrosion measurements confirmed this. Curves representing the rate of corrosion as a function of the time of tempering were drawn by the Thyssen–Bourdouxhe method. For low temperatures, the rate of corrosion has a distinct and high maximum, but after prolonged tempering, the rate of attack tends towards the original value. Alloys made with commercial metals, and containing 0·2% silicon and 0·15% iron, have a higher rate of precipitation. It appears that the constituent precipitated at a low temperature and at the beginning of the phenomenon is unstable and richer in magnesium than the compound Al_3Mg_2, which constitutes the β-phase. Such a mechanism implies necessarily a magnesium content of the α-phase lower than that at equilibrium.—J. H. W.

Light Metal Alloys with an Aluminium–Magnesium Base for Use in Automatic Cutting Machines. Hans Bohner (*Z. Metallkunde*, 1936, **28**, (9), 290–293).—Hydronalium alloys are especially suitable for cutting on automatic

machines as they give short, brittle turnings owing to the presence of Al_2Mg_3. Addition of up to 2% manganese and small amounts of chromium, which form hard intermetallic compounds with magnesium, aluminium, and Al_2Mg_3, improves still further the cutting properties. The presence of Mg_2Si, Mg_2Zn, and the ternary aluminium–magnesium compounds with zinc or copper also acts favourably.—A. R. P.

*On the Question of Aluminium for Automatic Machines. Georg Masing and Günther Ritzau (*Z. Metallkunde*, 1936, **28**, (9), 293–296 ; discussion, 296–297).—Addition of lead to aluminium results in short brittle turnings when the metal is cut or drilled in a lathe. The lead may be added by stirring the molten metal with lead chloride or, in the case of Duralumin, by adding it as an alloy with copper and nickel, *e.g.* copper 62·5, nickel 12·5, and lead 25%. Segregation of the lead is very small in the second case, but may be fairly considerable in the first. The presence of lead reduces the resistance of Duralumin to corrosion somewhat but has no effect on its ductility.—A. R. P.

Influence of the Structure on the Working Properties and Cutting Surface of Aluminium Alloys for Automatic Cutting Machines. E. Vaders (*Metall-wirtschaft*, 1936, **15**, (35), 814–817).—The hardenable aluminium alloy Tordal (composition not given) is, on account of its good workability, a suitable substitute for lead–brass.—v. G.

*X-Ray Investigation of the Transformations in Aluminium–Silver Alloys. W. Hofmann and K. E. Volk (*Metallwirtschaft*, 1936, 15, (30), 699–701).—The compound Ag_3Al (aluminium 7·7%) is cubic face-centred above 600° C. (at 700° C. $a = 3·24$ A.), between 600° and 400° C., it is close-packed hexagonal (at 570° C. $a = 2·90$, $c = 4·71$ A., $c/a = 1·62$), and at lower temperatures it has a β-manganese structure.—v. G.

*On the Age-Hardening Mechanism in Silver–Aluminium Alloys. Masahide Kosaki (*Kinzoku no Kenkyu (J. Study Metals)*, 1936, **13**, (8), 342–348).—[In Japanese.] In order to investigate the mechanism of age-hardening in silver–aluminium alloys, a study was made with an alloy containing 40% silver quenched from 550° C. in water, after heating at that temperature for 30 minutes, followed by ageing at room temperature for 20 days and tempering for 6 hrs. at 60°, 100°, 150° C., &c., respectively, and then cooling slowly in the furnace. The variation in lattice constant, density, and hardness of the specimen due to the above-mentioned treatments was measured ; dilatation and electrical resistance curves of the quenched specimen during slow heating were also taken. As a result of these measurements it is concluded that in the course of ageing the hardness attains a maximum value just prior to the separation of the crystallites, while it decreases after their separation. This result is in agreement with the so-called solid solution theory of age-harden-ing.—S. G.

*The Influence of Sodium and Calcium on Industrial Aluminium. (Grasht-chenko and Darovski.)

*X-Ray Study of the Aluminium–Zinc System. Ichiji Obinata, Masami Hagiya, and Sigeyuki Itimura (*T'etsu to Hagane (J. Iron Steel Inst. Japan)*, 1936, **22**, (8), 622–629).—[In Japanese.] The aluminium–zinc alloys in the range of the β and the γ fields were studied by means of X-rays, with both ordinary and precision cameras. The powder photograms were taken not only at room temperatures but also directly at high temperatures. From the lattice constant–concentration curves obtained it is confirmed that the β-phase is merely a continuation of the γ-phase ; the solid solubility of zinc in the latter phase was determined. By adding a small amount of magnesium to the alloy, the intermediate stages during decomposition of quenched β due to ageing were studied. The results showed that the eutectoid transformation of the β phase is simply a process of decomposition into α and γ, which are in equilibrium concentration, and that no intermediate metastable phase exists

during the process. It should be noted, however, that the lattice constant of quenched β decreases anomalously during ageing and that the complete decomposition of the phase is scarcely attainable at ordinary temperature. The complicated changes in physical properties of the quenched alloys due to ageing are explained crystallographically.—S. G.

Endurance Impact Tests on Light Metals. Kurt Laute (*Z. Metallkunde*, 1936, **28**, (8), 233–236).—Results obtained with the Maybach impact bending machine on Duralumin, Bondur, Elektron, and Silumin are compared with those obtained with the Schenk machine. The higher results given by the first-named method are attributed to the increased rate of deformation in the impact test.—A. R. P.

†**Properties and Alloys of Beryllium.** (Stott.) See p. 440.

Cadmium–Silver–Copper Bearing Alloy. L. C. Blomstrom (*Machinist* (*Eur. Edn.*), 1936, **79**, (51), 768ᴇ–769ᴇ).—A cadmium–silver–copper bearing alloy has been developed to provide a higher melting point and greater fatigue-resistance than tin-base Babbitt. The addition of silver makes the cadmium less susceptible to oxidation at the casting temperature, improves the fluidity, and has a marked influence on the structural and physical characteristics of cadmium. The hardness increases with the silver content, but the addition of copper permits a reduction of silver for the same hardness. The alloy has a lower coeff. of friction than tin-base or copper-base alloys.—J. H. W.

*The System Iron–Chromium–Chromium Carbide (Cr_4C_3)–Cementite (Fe_3C).** Walter Tofaute, Carl Küttner, and Alfred Büttinghaus (*Arch. Eisenhütten-wesen*, 1935–1936, **9**, (12), 607–617).—The system iron–chromium–carbon up to 70% chromium and to the Fe_3C–Cr_7C_3 line has been examined by metallographic, thermal, dilatometric, magnetic, and X-ray methods. The existence of the cubic and trigonal chromium carbides discovered by Westgren, Phragmén, and Negresco was confirmed and their capacity to take up iron by atom exchange established. The γ-phase field of the iron–carbon system is restricted by addition of chromium, and no longer occurs in alloys with 20% chromium or more. 4 four-phase equilibria involving a liquid phase occur : (1) liquid (chromium 38·6, carbon 2·2%) + (Cr, Fe)₄C (chromium 76·0, carbon 8·34%) ⇌ α (chromium 50, carbon 0·1%) + (Cr, Fe₇)C₃ (chromium 80·0, carbon 5·44%) at 1300° C. ; (2) liquid (chromium 30, carbon 2·4%) + α (chromium 26, carbon 0·3%) ⇌ γ (chromium 20, carbon 0·6%) + (Cr, Fe)₇C₃ (chromium 76, carbon 8·26%) at 1260° C. ; (3) liquid (chromium 8, carbon 3·6%) + γ (chromium 3, carbon 1·5%) ⇌ (Cr, Fe)₇C₃ (chromium 54, carbon 7·68%) + (Fe, Cr)₃C (chromium 15, carbon 6·78%) at 1130° C. The four-phase equilibrium γ + (Cr, Fe)₇C₃ ⇌ α + (Fe, Cr)₇C₃ occurs at 790° C. in the solid state, the composition of the participating phases being chromium 2·6, 2·0, 62·0, and 9·6% and carbon 0·05, 0·70, 9·74, and 6·80%, respectively. Annealing at 800°–950° C. of alloys with 40–60% chromium results in the separation of the brittle, non-magnetic FeCr compound irrespective of the carbon content. Detailed equilibrium diagrams for alloys with a constant chromium content of 12, 15, 20, 30, 35, 40, 45, 50, and 60% are given, together with photomicrographs of numerous characteristic structures.—A. R. P.

*The System Iron–Cobalt–Copper.** Werner Jellinghaus (*Arch. Eisenhütten-wesen*, 1936–1937, **10**, (3), 115–118).—In the molten state iron, cobalt, and copper are miscible in all proportions, but as is the case with the copper–iron and copper–cobalt systems separation of the metals takes place on solidification ; alloys in the iron corner solidify as δ-solid solution which changes to γ and then to α on cooling, all alloys with up to 8% copper except those in the iron corner solidify as γ-ternary solid solution, and alloys with 8–96% copper solidify as a heterogeneous mixture of γ and copper. The γ–α transformation occurs in all alloys the composition of which lies in the field between the iron corner of the ternary diagram and a straight line joining the copper corner

with the 79% cobalt, 21% iron point. The eutectoidal equilibrium of the iron–copper system is displaced to higher temperatures by addition of cobalt, reaching a maximum temperature in the section 100% copper–50 : 50 iron-cobalt, and falling to room temperature with further increase in cobalt. X-ray examination and density measurements have confirmed the existence of the compound FeCo.—A. R. P.

*X-Ray and Electrical Investigations in the Copper–Gold System. C. H. Johansson and J. O. Linde (*Ann. Physik*, 1936, [v], **25**, (1), 1–48).—A new phase with an ordered rhombic lattice with 40 atoms in the unit cell has been discovered in copper–gold alloys with 47–53 atomic-% gold after quenching from about 420° C. In alloys with 36–47 and with 53–65 atomic-% gold the new phase can be obtained by prolonged tempering at 200°–400° C. Alloys with 65–80 atomic-% gold after a similar treatment show only very feeble superstructure lines. The electrical conductivity has been measured throughout the system after various heat-treatments and the bearing of the results on the structural changes is discussed.—v. G.

*Constitutional Diagram of the Copper–Silicon–Aluminium System. Chiuyo Hisatsune (*Tetsu to Hagane* (*J. Iron Steel Inst. Japan*), 1936, **22**, (8), 597–622). —[In Japanese.] The constitution of the whole ternary system was investigated. No ternary intermetallic compound was observed. 15 definite constituents that have been determined in each binary system were also found to occur in the ternary system. There are 11 surfaces of primary separation, and 8 invariant points on the liquidus surface; among them 2 points are ternary eutectic, one point ternary peritectic, and 5 points peritecto-eutectic. Both the β-phases of the copper–silicon and copper–aluminium systems are completely soluble in all proportions in the ternary system, and decompose into $\alpha + \gamma_t$; the univariant reaction line of this decomposition has a minimum point at about 500° C. Two invariant reactions in the solid state, $\gamma_t + \gamma_s \rightleftarrows \chi + \alpha$, $\gamma_t + \chi \rightleftarrows \alpha + \varepsilon_s{}''$, are found to exist at 675° and 495° C. Five invariant reactions : $\gamma_t + \varepsilon_2 a \rightleftarrows \delta + $ Si, $\varepsilon_2 a \rightleftarrows \delta + \zeta_1 + $ Si, $\zeta_1 \rightleftarrows \delta + \zeta_2 + $ Si, $\varepsilon_2 a + \eta_1 \rightleftarrows \zeta_1 + $ Si, $\zeta_1 + \eta_1 \rightleftarrows \zeta_2 + $ Si, and two ternary polymorphic changes due to the $\eta_1 \rightleftarrows \eta_2$ phases take place at almost the same temperatures as in the binary system copper–aluminium. Four ternary polymorphic changes due to the $\varepsilon_s \rightleftarrows \varepsilon_s{}'$ and $\varepsilon_s{}' \rightleftarrows \varepsilon_s{}''$ take place at : 600° C., $\gamma_t + \varepsilon_s \rightleftarrows \varepsilon_s{}' + X$; 550° C., $\gamma_t + \varepsilon_s{}' \rightleftarrows \varepsilon_s{}'' + X$; 585° C., $\gamma_t + \varepsilon_s \rightleftarrows \varepsilon_s{}' + $ Si ; and 525° C., $\gamma_t + \varepsilon_s \rightleftarrows \varepsilon_s{}'' + $ Si, respectively. The limit of solubility of silicon and aluminium in solid copper was also determined.—S. G.

The Static Tensile Properties of German Standard Tin–Bronzes (Phosphor-Bronzes) in the Cast (Annealed and Unannealed) State at Room Temperature and at Higher Temperatures. Willi Claus and Claus Goetzel (*Giesserei*, 1936, **18**, (7), 154–158 ; (9), 206–219).—Tables are given showing the tensile properties of annealed and unannealed castings of phosphor–bronzes (containing 6, 10, 14, and 20% tin) at temperatures between 20° and 500° C. ; notes on the micro- and macro-structure are also included and the results summarized in a series of space models. Except in the case of the 14% tin alloy annealing the castings without previous deformation has little or no effect on the properties at any temperature. The 14% tin alloy has a tensile strength in the as cast state of 23 kg./mm.², a yield point of 15 kg./mm.², an elongation of 7%, and a Brinell hardness of 79 ; after annealing the corresponding values are 32, 13, 33, and 67. All the alloys can be heated to 300° C. without undergoing any appreciable loss of strength or ductility. Since all four alloys when properly cast have superior mechanical properties to those specified in DIN 1705, C. and G. suggest that the tin content in the specification be reduced by 2% (1% in the cast of the 6% alloy).—A. R. P.

*The Photoelectric Effect of Metallic Alloys.—I. [Copper–Tin]. Luigi Belladen and Giulio Galliano (*Annali chim. applicata*, 1936, **26**, 30–34; *C. Abs.*, 1936, **30**, 6636).—The photoelectric sensitivity to the entire range of radiation of a mercury arc of alloys of copper with tin with variation in composition was measured. A special cell was used which permitted comparison of the emission from 4 alloys, as well as from copper as reference, to be made simultaneously. A photoelectric sensitivity–composition diagram was constructed. There are singular points corresponding to the compounds Cu_4Sn, Cu_3Sn, and Cu_4Sn_2.
—S. G.

*On the Diffusionless Transformation of the β-Phase of Copper–Zinc Alloys. E. Kaminski and G. Kurdjumow (*Metallwirtschaft*, 1936, **15**, (39), 905–907).—At − 14° C. β-brass appears to undergo a transformation into a tetragonal phase with $a = 3\cdot755$, $c = 3\cdot586$ A.—v. G.

*Precipitation-Hardening of Gold–Nickel Alloys. Werner Köster and Walter Dannöhl (*Z. Metallkunde*, 1936, **28**, (9), 248–253).—Nickel and gold form a continuous series of solid solutions at high temperatures, but at room temperature the alloys containing 5–98 atomic-% nickel consist of 2 face-centred solid solutions, a nickel-rich and a gold-rich. The heterogeneous range extends from 8 to 97 atomic-% nickel at 400° C., from 22 to 95 atomic-% nickel at 600° C., and from 58 to 88 atomic-% nickel at 800° C. Alloys quenched from above 850° C. begin to decompose on reheating at 400° C., generally along the grain boundaries; on more prolonged heating new nuclei are formed in the grain centres and decomposition proceeds from these outwards and from the grain boundaries inwards; simultaneously the electrical resistance falls and the coercivity, remanence, magnetization, and hardness rise, the first and last much more rapidly than the second and third. The hysteresis loop of quenched alloys is very small, but rapidly broadens as precipitation occurs and then contracts again as the new phases coagulate. Maximum precipitation hardness is obtained with the 60 atomic-% nickel alloy; the quenched alloy of this composition has a lattice parameter of 3·77 A. instead of the theoretical 3·86 A. and appears to contain an unstable gold–nickel compound, possibly $AuNi_2$ or $AuNi_3$.—A. R. P.

*Effect of Silver on Lead. J. Neill Greenwood (*Chem. Eng. Min. Rev.*, 1936, **28**, (335), 384).—Small additions of silver to lead, although not greatly affecting the hardness, appreciably reduce the rate of deformation under stress. The alloys were tested under a stress of 500 lb./in.^{2} in direct tension in the " as rolled " condition and after annealing at 125° C. for 24 hrs. The percentage increase in length after 300 days was as follows : virgin lead, containing 0·0003% silver, 6·0 (as rolled) and 6·6 (annealed); silver 0·001%, 9·5 and 10·0; silver 0·01%, 3·0 and 3·2; silver 0·05%, 3·2 and 3·4; silver 0·10%, 6·4 and 7·3. Although 0·05% tellurium increases the Brinell hardness of lead from 3·5 to 7, as opposed to 3·5–4·5 for the same amount of silver, the hard tellurium alloy creeps at a much greater rate than virgin lead under a stress of 500 lb./in.^{2}. The properties of these silver alloys are appreciably altered by heat-treatment, and this is being further investigated.—J. H. W.

†New Equilibrium Diagrams for the Systems Lead–Thallium and Lead–Thallium–Cadmium. Correction. Ernst Jänecke (*Z. Metallkunde*, 1935, **27**, (6), 141).—Cf. *Met. Abs.*, 1935, **2**, 153. New experimental work by Ölander (*Met. Abs.*, 1934, **1**, 421) indicates that the two-phase field between the lead and $PbTl_2$ solid solutions should extend from 49 to 55% lead, and that the $PbTl_2$ field should end at about 10% lead on the thallium side. No changes are required for the lead–thallium–cadmium system.—S. G.

*Physical Properties of Soft Solders and the Strength of Soldered Joints. B. W. Gonser and C. M. Heath (*Metals Technology*, 1936, **3**, (5), 23 pp.; and *A.I.M.M.E. Tech. Publ.* 727; also (summaries) *Iron Age*, 1936, **137**, (9), 30–33; and *Mech. World*, 1936, **99**, (8), 347–348).—Four series of solders were prepared

from lead and tin of different purities. In each series, solders of 7 or 8 compositions were prepared in the range 15–63% of tin, and the physical properties were systematically compared. Data are given for the electrical conductivity, impact strength, shear strength, tensile strength, and elongation values of the solder alloys, and also for the strengths of soldered lap joints of 70 : 30 brass. A method of soldering was devised which practically eliminated porosity in single lap joints ; this consisted in flowing solder into a properly prepared wide joint, and then squeezing the joint members to the desired standard narrow width whilst the solder was still molten. In all four series, solders containing 35 and 40% tin gave markedly superior joints. The electrical conductivity of all the solders increased by about 5% on ageing at room temperature for 6 months. No great differences existed between the four series, and the original must be consulted for details of the impurities and their effects

—W. H.-R.

*On the Heat Conductivity of Superconductive Alloys. H. Bremmer and W. J. de Haas (*Physica*, 1936, **3**, (7), 692–704 ; and *Comm. K. Onnes Lab. Leiden*, No. **243c**).—[In English.] The heat resistance of lead–tin alloy, Rose's metal, and indium–lead alloys of three different concentrations was determined. The heat resistance increases rapidly at very low temperatures, but more slowly than ζ/LT, which was predicted by theory. The influence of the magnetic field is complicated and gives rise to the hypothesis that the field penetrates at values which do not disturb superconductivity. Discontinuities may appear at the threshold values of either the alloy or of any of the superconductive components.—S. G.

Contribution to Our Knowledge of Magnesium Casting Alloys. H. Busch (*Giesserei*, 1936, **23**, (13), 290–295).—The structure of magnesium alloys containing up to 10% of aluminium, zinc, manganese, and silicon is described with reference to the equilibrium diagrams and micrographs. The mechanical properties and microstructure of Elektron containing aluminium 9·5, zinc 0·5, and manganese 0·3% after various heat-treatments are shown in tables and photographs. The following table illustrates the changes produced by various heat-treatments in a nitrogen atmosphere :

	Brinell Hardness.	Yield-Point, Kg./mm.².	Ultimate Strength, Kg./mm.².	Elongation. %.
As cast	67·5	11·8	16·75	1·6
½ hr. at 390° C., quenched .	65·9	11·7	17·6	2·25
32 hrs. at 425° C., quenched .	55·5	10·8	20·5	4·2
32 hrs. at 425° C., cooled at 10° C./hr. to 350° C., quenched	53·3	10·3	25·3	9·5
5 hrs. at 440° C., cooled at 4°–2° C./minute to 20° C. .	66·2	12·8	20·7	3·5

—A. R. P.

*Advances and Present Position of the Use of Elektron Metal. Walther Schmidt and Paul Spitaler (*Z. Metallkunde*, 1936, **28**, (8), 220–222 ; discussion, 222–224).—Elektron AZ855 contains zinc 0·5 and manganese 0·1% and has a tensile strength of 32·8 kg./mm.² at 20° C. and 19·2 kg./mm.² at 200° C. with corresponding yield points of 23·6 and 15·4 kg./mm.², elongations of 12·6 and 23·9%, and Brinell hardness values of 68 and 50. Alloy AV9 is a hardenable alloy for sand-castings and has a similar composition except that the manganese content is 0·3% ; after homogenization at 420° C. in a sulphur dioxide atmosphere or in a bichromate salt-bath (a 3 : 1 mixture of sodium and potassium bichromate, melting point 266° C.) and ageing at about 200° C. the alloy has

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a tensile strength of 24–27 kg./mm.², a yield point of 10–11 kg./mm.², and an elongation of 10%. Several examples of the use of these alloys for making drop forgings and other parts for aircraft work are illustrated.—A. R. P.

*Magnetic Atomic Moment of Manganese Dissolved in Copper, Silver, and Gold. Gotthard Gustafsson (*Ann. Physik*, 1936, [v], 25, (6), 545–560).—The magnetic susceptibilities of copper, silver, and gold containing up to 4–7 atomic-% manganese have been determined at temperatures between 20° and 450° C.—v. G.

*X-Ray Analysis of Manganese-Rich Manganese–Silicon Alloys. K. Åmark, B. Borén, and A. Westgren (*Metallwirtschaft*, 1936, 15, (36), 835–836). —Manganese alloys with 14–25% silicon quenched from 1000° C. show lines of the cubic phase Mn_3Si. After annealing at 600°–800° C. the X-ray diagram shows numerous feeble lines, difficult to interpret, but apparently indicative of complex transformations. The atomic arrangement in the hexagonal phase Mn_5Si_3 was also investigated.—v. G.

*Magnetic Anisotropy of Nickel–Cobalt Single Crystals. J. W. Shih (*Phys. Rev.*, 1936, [ii], 50, (4), 376–379).—The magnetic properties of single crystals of nickel–cobalt alloys have been studied in the face-centred cubic range with a pendulum magnetometer. The direction of easiest magnetization changes from ⟨111⟩ to ⟨100⟩ as the cobalt content increases from 3 to 10%, but changes back to ⟨111⟩ when the cobalt content is more than 20%. The theory of Powell and Fowler (*Proc. Roy. Soc.*, 1930, [A], 130, 167) is inadequate to explain these results. There is a discrepancy between the present results and those of Masumoto (*J. Inst. Metals*, 1927, 38, 413) for polycrystalline specimens.—W. H.-R.

A " Free Machining " Monel Metal. O. B. J. Fraser (*Iron Age*, 1936, 138, (7), 37).—Briefly describes the properties of " R" Monel metal.—J. H. W.

*X-Ray Investigations in the Ternary System Nickel–Copper–Zinc. J. Schramm and O. Vaupel (*Metallwirtschaft*, 1936, 15, (31), 723–726).—The phase fields at low temperatures in the system have been determined by X-rays.—v. G.

*Rolling and Recrystallization Textures of Iron–Nickel Alloys in Relation to the Magnetic Properties.—II. Otto Dahl and Franz Pawlek (*Z. Metallkunde*, 1936, 28, (8), 230–233).—The variations in the tensile strength, elongation, coercivity, and magnetic permeability of 60 : 40 iron–nickel alloy in directions inclined at various angles to the direction of rolling are shown in polar co-ordinates after different heat and mechanical treatments. After cold-rolling to 80% reduction, annealing at 1000° C., and cold-rolling to 50% reduction there is relatively little directionality in any of these properties ; the same is true for 50% cold-rolling before and 94% after the annealing operation, but this treatment increases the values of all the properties except maximum permeability. After cold-rolling to 50% reduction, annealing at 700° C., cold-rolling to 98·5% reduction, and annealing at 1100° C. to produce a fibre structure the elongation is a maximum at 45° to the direction of rolling and a minimum in the direction of rolling and perpendicular thereto while the remanence, permeability, and tensile strength behave conversely and the coercivity is constant in all directions. After 98·5% reduction by cold-rolling, annealing at 1000° C. and cold-rolling to 50% reduction the maximum permeability and remanence are very high perpendicular to, and very low in the direction of rolling, the converse being true for the other properties. Somewhat similar results are obtained with an alloy of nickel 34·8, copper 13, and iron 52·2% ; after quenching from 1000° C. and cold-rolling to 94% reduction the initial permeability is a maximum at 30° to the direction of rolling, the coercivity a maximum at 30° and 60° to this direction and a minimum at 45° while the tensile strength is fairly constant. The same alloy after furnace cooling from 1000° C. and cold-rolling to 94% reduction shows remarkable

increases in all the magnetic properties and a somewhat smaller degree of directionality.—A. R. P.

*The Influence of Elastic Stresses on the Magnetization Curve [of Nickel–Iron Alloys] with Alternating Current. Hans Littmann (*Ann. Physik*, 1936, [v], 27, (3), 186–200).—The effects of annealing and of tensile pulls and torsion on the magnetization curve of nickel–iron alloy wires have been investigated.
—v. G.

*On the Effect of Tensile, Compression, and Torsion Stresses on the Longitudinal Magnetostriction. Hermann Kirchner (*Ann. Physik*, 1936, [v], 27, (1), 49–69).—The results obtained on nickel, nickel–iron alloys, and nickel containing 0·5% beryllium are recorded.—v. G.

*On the System Nickel–Zinc. W. Heike, J. Schramm, and O. Vaupel (*Metallwirtschaft*, 1936, 15, (28), 655–662).—A re-examination of the system has confirmed the results obtained in the authors' earlier work (in 1933) in all the essential points, despite adverse criticisms of Tamaru and of Caglioti.
—v. G.

White Metal and Bronze Bearings from the Manufacturer's Point of View. M. Melhuish (*Proc. Inst. Automobile Eng.*, 1936, 30, 431–443; discussion, 444–452).—The manufacture of tin-base and lead-base white metals, the common impurities and their influence, and the effects of methods of alloying are discussed. The several methods of lining with white metals are compared and pressure die-casting is recommended. The properties and applications of leaded bronzes, and copper–lead are described, followed by a brief reference to phosphor–bronze in the cast and rolled conditions. In the discussion (at the 3 centres of the Institute where the paper was presented) adhesion of the lining metals, clearances and lubrication were the principal points raised.—J. E. N.

Steam, Dry Air Anneal, and Normal Ageing Test Data on the Zamak Alloys. —— (*Zinc Alloy Pot*, 1934, 2, (1), 8).—A table giving 3 types of data : 3-year indoor ageing data representing a direct service test under normal conditions ; 2-year ageing at 95° C. representing a service test under continuous exposure to the maximum temperature likely to be encountered ; and 10-year steam test—a reliable accelerated test accurately predicting the effect of long tropical exposure.—S. G.

†Diffusion in Solid Metals. Robert F. Mehl (*Metals Technology*, 1936, 3, (5), 46 pp. ; and *A.I.M.M.E. Tech. Publ.* No. 726).—In the Institute of Metals Division Lecture for 1936, M. gives a complete and critical review of the phenomena of diffusion in solid metals, with a *bibliography* of references to 302 original papers. The paper deals with (1) the fundamental diffusion equations and methods of determining the constants, (2) the physical theory and the equations of Dushman and Langmuir, (3) rates of diffusion, (4) results of metallographic investigations of structures produced by diffusion, (5) anisotropic effects, (6) lattice distortion effects, (7) grain boundary diffusion, (8) surface diffusion, and (9) applications to industrial processes of the results of research work on diffusion. The lecture is an exceptionally interesting review of the subject.—W. H.-R.

Precipitation from Cast and Worked Material. —— (*Metallurgist* (Suppt. to *Engineer*), 1936, 10, 134).—Discussion of work by H. Bumm and V. Dehlinger, *Metallwirtschaft*, 1936, 15, (4), 89 ; see *Met. Abs.*, this vol., p. 301.—S. G.

III.—STRUCTURE

(Metallography ; Macrography ; Crystal Structure.)

†The Boundaries of Metal Crystals. A Critical Review. E. H. Bucknall (*Met. Ind. (Lond.)*, 1936, 49, (13), 311–316; (15), 369–373; (16), 396–399).— The properties of crystal boundaries have been the subject of speculation and

research for 35 years. The various theories are critically reviewed in the light of most recent knowledge, and the development of Rosenhain's theory is traced. The properties of thin films and electrodeposited metals have been studied, and led to the hypothesis that an adsorbed film is the material between metal grains. It is suggested that a consideration of inter-crystalline penetration by diffusing elements has indicated the importance of active adsorption and points to the probability of formation of adsorbed layers at grain boundaries as well as external surfaces. A *bibliography* of 125 references is given.
—J. E. N.

*Some Studies in Microstructure of Zinc Coatings. W. E. Buck (*J. Amer. Zinc Inst.*, 1936, **17**, 70–75).—Samples of hot-dipped spelter-coated or galvanized sheets of long and short service were sectioned and examined microscopically. Coating weights were determined either by the standard $2\frac{1}{4}$ in. × $2\frac{1}{4}$ in. spot test of the American Society for Testing Materials, stripping the coating with hydrochloric acid and antimony chloride, or by a variation of Cushman's hydrogen evolution test. It is shown that the microscopic confirmation of the nature of the coatings may throw much light on unexplained coating failures.—J. H. W.

*The Influence of Valency Electrons on the Crystal Structure of Ternary Magnesium Alloys. F. Laves and H. Witte (*Metallwirtschaft*, 1936, **15**, (36), 840–842).—The connection between the concentration of valency electrons and the structure of some ternary magnesium alloys has been detected. (Analogy to the Hume-Rothery Rule.)—v. G.

*The Crystal Structure of β-Titanium. W. G. Burgers and F. M. Jacobs (*Z. Krist.*, 1936, **94**, (4), 299–300).—[In English.] β-titanium which is stable above about 900° C. (882° $\pm$ 20° C. according to de Boer, Burgers, and Fast (*Proc. K. Akad. Wet. Amsterdam*, 1936, **39**, 515), has a body-centred cubic structure with 2 atoms in the unit cell. The lattice constant just above the transition temperature is $a = 3.32$ A.—W. H.-R.

*Energy Bands in Metallic Tungsten. Millard F. Manning and Marvin Chodorow (*Phys. Rev.*, 1936, [ii], **50**, (4), 399).—Abstract of a paper read before the American Physical Society.—S. G.

*Anisotropy in the Atomic Vibrations of Zinc Crystals. I.—Evidence from X-Ray Scattering. G. E. M. Jauncey and W. A. Bruce (*Phys. Rev.*, 1936, [ii], **50**, (5), 408–412).—W. H.-R.

*Anisotropy in the Atomic Vibrations of Zinc Crystals. II.—Diffuse Scattering of X-Rays from Single Crystals. G. E. M. Jauncey and W. A. Bruce (*Phys. Rev.*, 1936, [ii], **50**, (5), 413–416).—W. H.-R.

*Anisotropy in the Atomic Vibrations of Zinc Crystals. III.—The (0002) and (10$\bar{1}$0) Reflections of MoK_α X-Rays from Powdered Zinc. D. D. Miller and E. S. Foster, Jr. (*Phys. Rev.*, 1936, [ii], **50**, (5), 417–418).—W. H.-R.

*On the Intensity of X-Rays Reflected from Zinc. Clarence Zener and S. Bilinsky (*Phys. Rev.*, 1936, [ii], **50**, (5), 489).—A theoretical note.—W. H.-R.

Comparison of Linear and Volume Contraction in Intermetallic Compounds. F. Laves (*Metallwirtschaft*, 1936, **15**, (27), 631–639).—The lattice dimensions of intermetallic compounds can be predicted only within certain limits.
—v. G.

*The Elimination of Systematic Errors in Powder Photographs. M. U. Cohen (*Z. Krist.*, 1936, **94**, (4), 288–298).—[In English.] A general method is developed for eliminating the most important systematic errors in X-ray powder photographs when the camera is of such a type that the X-ray beam enters the camera at the middle of the film. If the camera construction is such that the X-ray beam enters at the ends of the film, a further correction for film shrinkage must be made. The adverse criticism by Straumanis (*Met. Abs.*, this vol., p. 306) of C.'s method is due to a misunderstanding.
—W. H.-R.

*The Calculation of Precise Lattice Constants from X-Ray Powder Photographs. M. U. Cohen (*Z. Krist.*, 1936, **94**, (4), 306–310).—[In English.] The details of C.'s method (preceding abstract) for eliminating errors in powder photographs are further discussed.—W. H.-R.

Determination of Parameters in Debye Photograms of Polished Sections. L. S. Palatnik (*Zhurnal Tehnicheskoy Fiziki* (*J. Tech. Physics*), 1935, **5**, (8), 1353–1355).—[In Russian.]—N. A.

Analysis of Material by X-Ray Diffraction Method.—I–II. Herbert R. Isenburger (*Machinist* (*Eur. Edn.*), 1936, **80**, (28), 422–424E; (29), 477–479E).—(I.—) Discusses the theoretical considerations of X-ray diffraction analysis and describes the equipment required. (II.—) Describes the method of carrying out the analysis and the interpretation of the results.—J. H. W.

*Theory of the Effect of Temperature on the Reflection of X-Rays by Crystals. III.—High Temperatures. Allotropic Crystals. Clarence Zener and S. Bilinsky (*Phys. Rev.*, 1936, [ii], **50**, (2), 101–104).—W. H.-R.

IV.—CORROSION

*Corrosion Tests with Pure Aluminium and Aluminium Alloys. E. Zurbrügg (*Gas- u. Wasserfach*, 1935, **78**, 946; *C. Abs.*, 1936, **30**, 2156).—Experiments were made with aluminium of varying purity in Neuhausen water. Aluminium of 98–99% purity was distinctly attacked by carbon dioxide, but 99·3% aluminium was not. In the past, corrosion of aluminium has been attributed to the presence of copper or lead on the aluminium surface, due to introduction during rolling, &c. These metals may also come from water previously passing through lead or copper tubing. Weakly acid water, containing as little as 0·05 mg. copper per litre, precipitated copper on the aluminium and caused corrosion.—S. G.

*Intensification of the Tower Process and the Corrosion of Lead. I. E. Adadurov, A. I. Dmitrieva, and V. M. Zinovich (*Zhurnal Khimicheskoi Promishlennosti* (*J. Chem. Ind.*), 1936, **13**, 660–663; *C. Abs.*, 1936, **30**, 6515).—[In Russian.] Cf. *Met. Abs.*, 1935, **2**, 596. Lead is more strongly attacked in the tower system the higher the temperature, strength of acid, and amount of N_2O_3 present. To obtain a minimum loss of lead, the acid in the Glover tower should not be stronger than 58°–59° Bé, and the N_2O_3 should be 2·3–3%. The acid entering the Gay–Lussac tower should not be weaker than 59° Bé at not over 30°–35°. The intensity of the process is not effected by these limits.—S. G.

Corrosion. V.—Corrosion and Water Mains. —— Thiesing (*Gas- u. Wasserfach*, 1935, **78**, 429–431; *C. Abs.*, 1936, 30, 3389).—The phenomenon associated with the corrosion of iron and lead water mains and the preventive means adopted are briefly reviewed.—S. G.

The Chemical and Electrolytic Corrosion of Subterranean Conductors. R. Gibrat (*Ann. Postes, Télégraphes Téléphones*, 1936, **25**, (8), 717–743).—Corrosive attack on underground conductors may be initiated either by chemical action between the metal and the soil, or through the influence of stray currents from an external source. The conditions governing both types of attack are reviewed, and a description is given of the use of the " differential " soil-corrosion apparatus of Schlumberger in the investigation of 2 cases of electrolytic corrosion, which are both due to stray currents.—P. M. C. R.

Corrosion Tests on Galvanized Sheet. W. Rädecker and R. Haarmann (*Illust. Zeit. Blechindustrie*, 1936, **65**, (36), 1073–1074).—The Schreiber boiling test, in which the corrosion products are retained on the surface of the test-piece, is considered preferable to other methods (salt-spray, copper sulphate,

solvent attack) which involve the removal of the corrosion product. The Schreiber method is described. It is emphasized that actual atmospheric exposure is necessarily more valuable than any accelerated method, and the results of a series of such tests are given in the case of sheet manufactured by different methods.—P. M. C. R.

*The Action of Cream and Butterfat on Metals and the Influence of Metals on the Quality of Butter and Butterfat. W. Mohr and A. Eichstädt (*Molkerei-Zeit. (Hildesheim)*, 1936, **50**, 1480–1482; *C. Abs.*, 1936, **30**, 6837).—Cf. *Met. Abs.*, 1935, **2**, 384. Of numerous metals and alloys studied, V2A steel, aluminium, and chromium-plated or tinned copper strips were corroded least when exposed in heated or soured cream. The same metals had least effect on the flavour of butter. Chromium-plated copper and tinned copper were corroded less than other metals by cream when exposed in combination with V2A steel, aluminium, and copper. No flavour defects were produced in butterfat by the use of tinned or enamelled containers, or by V2A steel containers.—S. G.

*Corrosion in Cooling Brines. H. Osterburg (*Milchwirtschaftl. Zentr.*, 1935, **64**, 303–307; *Chem. Zentr.*, 1936, **107**, (I), 170).—Investigations with solutions of chemically-pure salts showed that alkali salt brines have least effect on iron, while magnesium chloride solutions have the greatest. Potassium and sodium chlorides are preferred for use with zinc. Alkali brines have the greatest corroding effect on tin and aluminium. The quantity of metal dissolved was remarkably small.—L. A. O.

Principles for the Simplification of the Testing Conditions in Corrosion Tests. DIN 1703. —— (*Z. Metallkunde*, 1936, **28**, (1), 20–21; and (abridged) *Light Metals Research*, 1936, **4**, (22), 384–385).—Standard conditions are laid down for the selection of the test-piece, the preparation of the surface, and the dimensions. In reporting results the nature and concentration of the corroding medium, the temperature, and the presence or absence of air and agitation should be specified. The results should be reported as change in weight and change in mechanical properties; information should also be given on the change in surface appearance, any change in structure, the nature and type of corrosion products, and the change in the composition of the corroding medium.—A. R. P.

Cleaning Copper Strips Used in the Determination of the Corrosive Action of Petroleum Products. E. G. Ivanova (*Neft (Petroleum)*, 1936, **7**, (6), 21–22; *C. Abs.*, 1936, **30**, 6178).—[In Russian.] Satisfactory results were obtained by treating copper strips with 5% ammonia and neutralizing with oxalic acid.—S. G.

V.—PROTECTION

*Modern Plated Aluminium–Copper–Magnesium Alloys and Their Properties. Paul Brenner (*Z. Metallkunde*, 1936, **28**, (9), 276–280; discussion, 280).—A thin coating of pure aluminium (1% of the total thickness) on sheet of the Duralumin type of alloys considerably increases the resistance to corrosion without appreciably affecting the strength; with a 5% coating the strength is reduced by 5–7%, but the resistance to corrosion is practically equal to that of pure aluminium and the metal will withstand more prolonged heat-treatment without depreciation of the protective value of the coating by diffusion. A very high resistance to corrosion without reduction in strength is obtained by plating with the Hydronalium alloy BSS, which has a high surface hardness and resists diffusion of the copper from the base-metal during heat-treatment.
—A. R. P.

Protection of Aluminium Alloys from Corrosion. D. N. Shevzov (*Sudostroenie (Shipbuilding)*), 1936, (5), 329–334).—[In Russian.] A review.—N. A.

Measures Against Corrosion in Aviation. V. O. Kroenig (*Aviopromishlenost (Air Industry)*), 1936, (4), 23–26).—[In Russian.] A review.—N. A.

Aluminium Plating for the Protection of Metals from High-Temperature Oxidation. V. F. Negreev and S. G. Znaichenko (*Neft (Petroleum)*), 1936, **7**, (5), 24–25; *C. Abs.*, 1936, **30**, 5924).—[In Russian.] The advantages of aluminium plating various parts of equipment exposed to high temperatures are discussed.—S. G.

*****Porosity Tests for Zinc-Coated Iron and Steel.** W. A. Koehler and R. O. Burford (*Electrochem. Soc. Preprint*, 1936, Oct., 241–244).—It has been found practical to apply the Walker test for pin-holes, when iron or steel is coated with zinc, using an external e.m.f. to produce ferrous ions at the points where the iron is exposed. Paper impregnated with a test solution can also be used for the test with or without an external e.m.f., depending on the nature of the metal coating on the iron.—S. G.

*****Some Studies in Microstructure of Zinc Coatings.** (Buck.) See p. 458.

*****Influence of Hot-Dip Galvanizing on the Endurance Bending Strength and the Regularity of the Tensile Properties of Drawn Steel Wire.** Franz Greis and Herbert Ruppik (*Arch. Eisenhüttenwesen*, 1936–1937, **10**, (2), 69–71).—Hot-dip galvanizing of steel wire reduces the endurance limit (alternate bending test) owing to the formation of the hard zinc–iron intermediate layer and the roughening of the surface in the pickling bath. These effects are enhanced by irregular quenching as the wire leaves the zinc bath, but may be mitigated to a considerable extent by annealing followed by a careful quenching.—A. R. P.

Longer Life for Galvanizing Furnaces. Wallace G. Imhoff (*Machinist (Eur. Edn.)*), 1936, **80**, (1), 18E–20E).—The destructive forces acting on the pot in hot-galvanizing are briefly considered, with particular reference to the action of galvanizers' dross and of sal ammoniac.—J. H. W.

A New Galvanizing Furnace. W. H. Spowers, Jr. (*Heat-Treat. and Forging*, 1936, **22**, (7), 356–358; and *Indust. Heating*, 1936, **3**, (6), 375–378).—Heating of a large galvanizing pot by radiation from electrical elements showed many advantages, but cost of electric power in many districts in U.S.A. prevented its wider adoption. The principle has been extended to other fuels, and an installation is described in which the galvanizing kettle is heated by vertical tubes of chrome–nickel alloy, heated from the inside by gas, and applying to the side walls of the galvanizing kettle heat given off by the glowing tubes. Perfect heat control, long life for the kettle, fuel economy, very low dross formation, and low heat losses are among the advantages claimed.—J. E. N.

To Exhibit New Zinc Plating Process at Metals Exposition. —— (*Amer. Metal Market*, 1936, **43**, (200), 3).—A brief note of a new process using a new brightening agent, which is claimed to be particularly adaptable for use in barrel plating of building hardware, radio parts, electrical fixtures, and other metal equipment where attractive appearance is important. The new brightening agent is a liquid which is easy to handle and control. It is non-corrosive, non-inflammable, and non-toxic.—L. A. O.

The Protection of Zinc by Phosphate and Chromate Processes. Hugo Krause (*Illust. Zeit. Blechindustrie*, 1936, **65**, (35), 1037–1038).—An account is given of the " Granodizing " process as applied to zinc and its alloys, plain or cadmium-plated, and of a dichromate immersion process for the treatment of zinc, cadmium, and the zinc–cadmium alloys. References to the relevant patents are given.—P. M. C. R.

*****On the Chemical Polarization of the Hydrogen Electrode by Oxygen and the Problem of Electrolytic Corrosion Protection.** Arthur F. Lorch (*Electrochem. Soc. Preprint*, 1936, Oct., 173–178).—The chemical polarization of the hydrogen electrode by oxygen was investigated and found to bear a simple relation to its

electrical polarization. The current equivalent of a given concentration of oxygen remains constant over a wide range of potentials except that at sufficiently positive potentials oxygen ceases to react at the cathode. From the results obtained it is possible to explain the failure of electrolytic corrosion protection in some cases.—S. G.

The Adhesion of Rubber to Metals. V. Evstratov and N. Trankovskaya (*J. Rubber Ind. (U.S.S.R.)*, **1936**, 578–582).—[In Russian.] A description, with 50 references.—S. G.

The Corrosion Problem. Paints and Anti-Corrosive Coatings. Georges Genin (*Indust. chimique*, 1935, **22**, 802–806; 1936, **23**, 10–15, 322–325, 402–405; *C. Abs.*, 1936, **30**, 6217).—A general discussion of various types of metallic coatings, aluminium paints, and anti-rust coatings resistant to high temperatures.—S. G.

VI.—ELECTRODEPOSITION

(Continued from pp. 404–407.)

Cadmium-Plating in Precision Industry. A. M. Sokov (*Tochnaja Industria (Präzisions Ind.)*, 1936, (8–9), 19–20).—[In Russian.] The Westbrook bath is recommended and a description of the process given.—N. A.

*The **Theory of Electrolytic Chromium Plating.—II.** Robert Weiner (*Z. Elektrochem.*, 1936, **48**, (8), 585–598).—See *Met. Abs.*, this vol., p. 366. Further theoretical explanations on the process of electrolytic chromium plating are given. The difference in behaviour of gold, platinum, and carbon from that of base metals was thoroughly, if not exhaustively, investigated, and the important metals in chromium plating practice, namely iron, nickel, and copper, were examined. Owing to the extraordinarily varying, and at first completely contradictory, results, a rigorous explanation was put forward, bringing other base metals into consideration; although this led to further complications, a satisfactory theory to account for the many and varied phenomena was evolved.—J. H. W.

The Nickel and Chromium Plating of Aluminium and Aluminium Alloys. E. Raub (*Mitt. Forschungsinst. Edelmetalle*, 1936, **9**, (11/12), 111–121; and *Metallwaren-Ind. u. Galvanotech.*, 1936, **34**, (8), 150–154).—When aluminium sheet is nickel- or chromium-plated by any of the standard methods the first step in which involves an etching operation to remove the surface oxide film, the resulting plated metal does not withstand corrosive conditions well since the plate is invariably porous due to the roughness of the surface of the aluminium. Examples of this are shown after exposure to salt-spray (which produces intense pitting) and steam (which causes the plate to flake off). It is stated that there is now available a method of treating the aluminium surface, which removes the oxide film without spoiling the polish of the metal and provides a smooth surface on to which first nickel and then chromium can be plated in such a way that the coatings do not flake even when the plated sheet is bent; such coatings are claimed to be absolutely non-porous, but no details are given of the method.—A. R. P.

Special Appliances for Chromium-Plating of Round Calibration Instruments. P. E. Fomin (*Tochnaja Industria (Präzisions Ind.)*, **1936**, (6), 11–13).—[In Russian.] The workshop plant and the process of chromium-plating adopted at the works are described.—N. A.

Electrolytic Lead Coating (from Fluosilicate Solutions). P. P. Beljaev and J. B. Gurevich (*Zhurnal Khimicheskoy Promishlenosti (J. Chem. Ind.)*, 1936, **13**, (10), 602–605).—[In Russian.] The method and apparatus used at the " Dorkhim " works are described.—N. A.

Nickel Anodes. Tentative Standards DIN 1702. —— (*Z. Metallkunde*, 1936, **28**, (6), 182).—The following specification is suggested : composition—

nickel not less than 99, copper not more than 0·25, iron less than 0·05, manganese less than 0·01, zinc less than 0·01, and magnesium less than 0·05%; the anodes must be tough and free from brittleness, have a homogeneous structure free from segregations along the grain boundaries, and be free from a casting or rolling skin.—A. R. P.

Nickel Anodes. E. Raub (*Mitt. Forschungsinst. Edelmetalle*, 1936, **10**, (4), 37–43).—Various types of nickel anodes are described and their relative merits discussed. The effect of small amounts of impurities in the anode on its rate of corrosion in the bath and on the plating process is briefly described.
—A. R. P.

*Electroplating of Aluminium and Its Alloys with Zinc, Cadmium, Copper, Nickel, and Chromium. V. I. Lainer and S. I. Orlov (*Legkie Metalli* (*Light Metals*), 1936, (2), 22–33).—[In Russian.] A common method of preparing an aluminium surface for electroplating is to immerse it for 1–3 minutes in sodium zincate solution d 1·25–1·4, then to degrease in an alkaline cyanide bath. Plating with zinc is best carried out at 1–1·5 amp./dm.² in a bath containing zinc oxide 45 and sodium cyanide 100 grm./litre without addition of colloids, but for cadmium plating an acid bath containing cadmium sulphate crystals 100, ammonium sulphate 65, and peptone 1·5–2 grm./litre at p_H 3–4 with 0·7 amp./dm.² is the most satisfactory. A copper undercoat should be used only when the article is to be subsequently plated with nickel or cadmium; this is preferably obtained by flashing in a cyanide bath, then building up the deposit in the ordinary acid sulphate bath. Nickel or chromium plating over the copper layer is sufficiently good in ordinary baths.—D. N. S.

*The Electrolysis of Aqueous Solutions of Sodium and Zirconyl Sulphates. I.—A Preliminary Report. W. E. Bradt and Henry B. Linford (*Electrochem. Soc. Preprint*, 1936, Oct., 363–371).—Aqueous solutions of sodium and zirconyl sulphates were electrolyzed under controlled conditions. Difficulties due to the hydrolysis of zirconyl sulphate were partially avoided by the addition of sodium sulphate. Factors investigated were: concentration of zirconyl sulphate, concentration of sodium sulphate, hydrogen ion concentration, current density and temperature of electrolyte. Electrodeposited metallic zirconium was obtained in 2 forms. One is a silver-white, compact, adherent metal similar to nickel electroplate in appearance. This slowly changes to the other modification which appears to be a non-adherent aggregation composed of a black powder which may be zirconium or some oxidation product of zirconium. Conditions are described for obtaining thin deposits of compact, bright metal.—S. G.

*The Formation and Growth of Pits in Electrodeposited Metals. Michel Cymboliste (*Electrochem. Soc. Preprint*, 1936, Oct., 347–362).—Pits in electroplating, notably nickel deposition, are attributed to bubbles, either of hydrogen or other gases. The origin of these gas bubbles is discussed at length, and different types of pits are illustrated with the aid of numerous photomicrographs. Furthermore, it is emphasized that most bubbles are non-adherent. The adherence of bubbles to the basis metal, or to the surface of the electrodeposited metal, is attributed to a wide variety of possible irregularities in this surface, such as scratches, nodules, foreign particles which have anchored themselves to the surface, &c. Gas bubbles may continue to adhere without increasing in volume, or they may grow in size and either remain at the surface or detach themselves and escape from the solution. The interposition of a thin coat of copper between 2 coats of nickel is suggested as a practical means for the elimination of pits.—S. G.

*The Co-deposition of Metals of the Same Valence in Acid Solutions. W. George Parks and I. Milton LeBaron (*Electrochem. Soc. Preprint*, 1936, Oct., 235–239).—The co-deposition of 2 metals of the same valence was investigated. The following systems were included: zinc–cadmium, copper–cadmium,

nickel–copper, zinc–copper, and silver–thallium. The cathode potential method previously described (*Met. Abs.*, this vol., pp. 163, 406) was employed at different current densities, at room temperature, in solutions of p_H 5. The variation of co-deposition with difference in electrode potential has been determined, and the equation derived for co-deposition of monovalent and bivalent metals of the same valence.—S. G.

Overpotentials in the Electrodeposition of Metals on Indifferent Cathodes. A. G. Samartzev and K. S. Eustropiev (*Izvestia Akademii Nauk S.S.S.R. (Bull. Acad. Sci. U.R.S.S.*), **1934**, [vii], 603–613; *Brit. Chem. Abs.*, **1934**, [A], 1178).—[In Russian.] The deposition of metals (cadmium, silver) begins at a higher potential than that attained after a few minutes; this phenomenon is not due to growth of the crystals but to the passage of the metal through a state intermediate between the ionic and the metallic.—S. G.

*Some Peculiarities of Electrodeposited Metals.** Ladislav Jenicek (*Rev. Mét.*, 1936, **33**, (6), 371–378).—Electrodeposited chromium and iron contract on heating, much more than nickel, and the softening that occurs follows a curve of the same form as that for contraction. No contraction was observed with copper, and there was very little reduction in hardness on heating. Change of structure also results from heating, and recrystallization occurs on heating to temperatures higher than those required to reduce the hardness.
—H. S.

The Development of Electroplating. D. J. Macnaughtan (*Met. Ind. (Lond.*), 1936, **49**, (13), 323–324).—A paper forming the introduction to a discussion on electroplating at the 1936 meeting of the British Association.—J. E. N.

The Future of Electrodeposition. H. J. T. Ellingham (*Met. Ind. (Lond.*), 1936, **49**, (13), 324–325).—The concluding contribution to the discussion on electroplating at the 1936 meeting of the British Association.—J. E. N.

VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY
(Other than Electrodeposition.)

*The Mechanism of Electrolytic Separation of Hydrogen by Palladium and Platinum.** L. Kandler and C. A. Knorr (*Z. Elektrochem.*, 1936, **42**, (9), 669).— Experiments on the cathodic polarization of pure palladium and platinum electrodes in $2N$-sulphuric acid solution showed that quite different current–e.m.f. curves are obtained according as to whether : (1) no gas, (2) hydrogen, or (3) nitrogen is introduced into the cathode vessel during the measurement. The curves of the e.m.f. against the logarithm of the current density in (1) and (3) are straight lines ; that in (2) is a curve lying between (1) and (3). According to Tafel, in case (2) with the highly active palladium and platinum electrodes, the reaction $2H \longrightarrow H_2$ occurs, together with the determining back-reaction, $H_2 \longrightarrow 2H$. In case (1), in the absence of the gas phase, the migration of the molecular hydrogen from the electrode to the solution is, according to Nernst, a slow process, and the hydrogen concentration on the electrode, and hence the velocity of the back reaction $H_2 \longrightarrow 2H$, increases linearly with the current density. Thus it appears possible that with pure palladium and platinum electrodes and under suitable conditions, the mechanism of the electrolytic separation of hydrogen according to both Nernst and Tafel can be realized.—J. H. W.

*The Potential Differences at Metal–Vapour, Vapour–Liquid, and Liquid–Metal Interfaces of Partially Immersed Electrodes.** Colin G. Fink and Richard C. Dehmel (*Electrochem. Soc. Preprint*, 1936, Oct., 245–284).—A method was devised and special apparatus has been designed and constructed for verifying the existence and measuring the magnitude of the potential difference existing across the vapour between the exposed portion of a partially immersed electrode

and the surface of the solution into which it is dipping. A shielded oscillating electrode has been developed which makes possible the measurement of rapidly changing contact potential differences. The oscillating electrode system permits the use of an a.c. amplifier and an audible detector, thereby providing high sensitivity with excellent electrical stability. Quantitative determinations of the potential across the vapour were made with copper, gold, and platinum, each dipping into aqueous molar solutions of their salts. The change resulting from oxygen admission which occurred in the potential drop across the vapour was studied quantitatively. The effects of dissolved oxygen on the solution potentials were also determined. The effect of the potential difference existing across the vapour at a partially immersed electrode on its corrosion is discussed.—S. G.

Electrolytic Separation of Light Metals from Non-Aqueous Solutions. I.—Preliminary Experiments of Electrolysis of Alkali Metal Salt Solutions. M. A. Klochko (*Zhurnal Prikladnoĭ Khimii* (*J. Applied Chem.*), 1936, **9**, (3), 420–433).—[In Russian.] Electrolysis of solutions of double alkali–aluminium halides (formed by fusing the two salts together) in nitrobenzene affords cathodic deposits of the alkali metal in current yields of 35–70%. Li, Na, K, and Rb have been obtained from the double bromides and Li and Na from the double chlorides.—N. A.

*Studies of Overvoltage : The Effect of Fusion of the Cathode and the Effect of Temperature on Gas Polarization.** Allison Butts and W. A. Johnson (*Electrochem. Soc. Preprint*, 1936, Oct., 205–220).—Cell voltages were measured and gas polarization voltages determined in cells with Wood's alloy cathode and with a gallium cathode, while the temperature of the cell varied so as to cause the cathode to melt and to freeze. Voltage–temperature curves and voltage–time curves were obtained at constant current densities. No change of polarization was found during melting or freezing except in the case of Wood's alloy when the alloy had not reached equilibrium. Sharp increases of voltage were observed with the liquid gallium cathode (not during freezing), and also sudden pronounced flattening of the liquid gallium. Overvoltages of hydrogen were measured on solid and liquid Wood's alloy and gallium.—S. G.

*On the Problem of Hydrogen Overvoltage.** P. P. Porfirov (*Zhurnal Obstchei Khimii* (*J. General Chem.*), 1934, **4**, 1311–1321 (in Russian); and *Dokladi Akademii Nauk S.S.S.R.* (*Compt. rend. Acad. Sci. U.R.S.S.*), 1935, [N.S.], **1**, 386–390 (in Russian), 390–392 (in English)).—Experiments are described which were carried out in an attempt to settle the controversy regarding the existence of the so-called contact (or transfer) resistance on the cathode during the evolution of hydrogen.—S. G.

*Electrolysis of Alumina with Incombustible (Metal) Electrodes.** A. I. Beliaev and J. E. Studentsov (*Legkie Metalli* (*Light Metals*), 1936, (3), 15–24).—[In Russian.] The possibilities of alumina electrolysis with copper, nickel, chromium, and silver anodes were investigated. The use of an equimolecular mixture of potassium and sodium cryolites as electrolyte allows of a minimum working temperature of 936° C. The solubility of aluminium oxide in this bath is 13% at 830° C. In all cases rapid destruction of the anodes by oxidation occurred.—D. N. S.

IX.—ANALYSIS

Researches on Spectrographic Analysis. W. Gerlach and W. Rollwagen (*Metallwirtschaft*, 1936, **15**, (36), 837–840).—In most cases it is much easier to detect impurities with the flaming arc than with the spark method of exciting the spectrum. The sensitivity is improved if the arc is electrically interrupted.
                                                                          —v. G.

Fractional Reaction for Antimony. N. A. Tananaev and L. M. Rabinovich (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1936, **9**, (2), 369–371).—[In Russian.] As little as 0·1 mg. of Sb per c.c. may be detected as $HSbO_3$ or by reaction of $HgCl_2$ with tervalent Sb.—N. A.

*Quantitative Separation and Determination of Aluminium and Zinc. F. H. Fish and J. M. Smith, Jr. (*Indust. and Eng. Chem.* (*Analyt. Edn.*), 1936, **8**, (5), 349–350).—The neutral solution of the two metals is treated with LiCl, 5 grm. of $CH_3 \cdot CO_2NH_4$, and NH_4OH until the liquid is faint pink with phenolphthalein. The precipitate is washed with a 2% solution of $CH_3 \cdot CO_2NH_4$, dissolved in dilute HNO_3, and reprecipitated as before; the second precipitate is ignited and weighed as $2Li_2O,5Al_2O_3$ (47·40% Al). Zn in the filtrate is precipitated as $ZnNH_4PO_4$, which is ignited to $Zn_2P_2O_7$ for weighing.—A. R. P.

Volumetric Determination of Arsenic in the Presence of Iron Salts. Wilhelm Daubner (*Angew. Chem.*, 1936, **49**, (7), 137–138).—The solution is neutralized with NH_4OH, made feebly acid with $CH_3 \cdot CO_2H$, and treated hot with $(NH_4)_3AsO_4$ to precipitate a mixture of $AlAsO_4$ and $FeHAsO_4$. The washed precipitate is dissolved in acid and the As determined volumetrically. Fe is determined in the usual way in another portion of the solution and the Al calculated by difference.—A. R. P.

*Determination of Bismuth as Phosphate. W. C. Blasdale and W. C. Parle (*Indust. and Eng. Chem.* (*Analyt. Edn.*), 1936, **8**, (5), 352–353).—A critical study of the conditions under which Bi can be precipitated quantitatively as phosphate showed that in the absence of Cl' and SO_4'' complete precipitation is obtained from solutions $0·2M$ with respect to HNO_3 if the excess of $(NH_4)_2HPO_4$ added is sufficient to give a $0·065M$ solution. K, Mg, Zn, Cu, and Ca do not interfere, Cd causes the results to be slightly high, and Pb renders the method inaccurate. The chief source of error is the co-precipitation of basic salts; this difficulty is overcome by precipitating from a hot solution with a hot dilute phosphate solution and digesting for 1 hr. at 80° C. Too great an excess of precipitant should be avoided to prevent contamination of the precipitate with excess of PO_4'''. The precipitate is finally ignited at 800° C. and weighed as $BiPO_4$.—A. R. P.

Microchemical Determination of Bismuth by Quinoline-Thiocyanate. M. V. Gapchenko and O. G. Sheintsis (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1936, **9**, (3), 544–566).—[In Russian.] A saturated aqueous solution of quinoline containing NH_4CNS gives with acid Bi solutions a characteristic golden-yellow crystalline precipitate; Zn'', Sn'', Sb''', Hg', and Ag' interfere, but Cu is without effect if the solution contains 10% of citric acid.—N. A.

*Separation and Determination of Bismuth with Gallic Acid. L. Kieff and G. C. Chandlee (*Indust. and Eng. Chem.* (*Analyt. Edn.*), 1936, **8**, (5), 392).—Bi is quantitatively precipitated by addition of gallic acid to the hot (70° C.) nitrate solution containing 3% of HNO_3. The precipitate is washed with 2% gallic acid containing 3% of NH_4NO_3, dissolved in 20 c.c. of HNO_3, and precipitated as basic carbonate by addition of $CH_3 \cdot CO_2NH_4$. Pb, Cd, Cu, Zn, Al, Cr, Fe, Ni, Ba, Ca, K, and Na do not interfere although reprecipitation of the gallate is advisable if much of these metals is present. Sb, Hg, Sn, and Ag interfere.—A. R. P.

*Quantitative Determination of Cadmium and Lead in Zinc Using a Grating Spectrograph with a Sector Disc. Harris M. Sullivan (*Indust. and Eng. Chem.* (*Analyt. Edn.*), 1936, **8**, (5), 382–383).—The sample is placed in the lower (positive) graphite electrode and an arc of 5 amp. at 220 v. passed between the electrodes (1 cm. gap). The arc is placed at the focal centre of a convex lens so that a parallel beam of light is thrown on the slit of the spectrograph. The logarithmic sector disc rotates at 300 r.p.m. and is adjusted, as close to the slit as possible, so that about 3 mm. length of the 16 mm. slit is left open at all times, the remainder of the slit opening varying during the time of exposure

as the sector disc rotates in front of it to cause the lengths of the lines on the film to vary according to their intensity. The lengths of the lines Cd 3261 and Pb 2833 and 2663 A. are a measure of the proportion of these elements present although the relation is not exactly linear. The method gives results accurate to 10–15% for quantities of Pb or Cd in Zn of the order of 10 p.p.m.—A. R. P.

*Determination of Gold in Dental Alloys. J. Lewis Maynard (*Indust. and Eng. Chem. (Analyt. Edn.*), 1936, 8, (5), 368–369).—The chief constituents of dental alloys are Au, Ag, Pt, Pd, and Cu with sometimes minor amounts of Ir, Ni, Zn, Sn, and In. The alloy is dissolved in *aqua regia* and the Ag, Ir, and Sn removed by Swanger's method (*J. Inst. Metals*, 1926, 36, 519). The Au is then precipitated with SO_2, washed with hot 1% HCl, and redissolved in *aqua regia*. After removal of the HNO_3 by boiling with HCl and evaporating to 3 c.c.; 20 c.c. of H_2O are added followed by 4 c.c. of 15% $N(C_2H_5)_4Cl$ for every 0·1 grm. of Au present. After 15 minutes the precipitate of $N(C_2H_4)AuCl_4$ is collected, washed 4 times with 5 c.c. of the precipitant, and boiled with 35 c.c. of 20% glucose solution containing 2 grm. of NaOH. The precipitated Au is collected, washed with water, then with hot HCl, and finally with hot water, dried, ignited, and weighed. The filtrate from the second Au precipitation is treated with H_2S to recover any Pt or Pd co-precipitated in the SO_2 process.—A. R. P.

†Determination of the Fineness of Gold Alloys by the Streak Test. K. Bihlmaier (*Mitt. Forschungsinst. Edelmetalle*, 1936, 10, (2/3), 27–34).—Full details are given of standard tests for ascertaining the carat of gold alloys, including white golds, by the streak test.—A. R. P.

*Investigation of the Microreactions of Lead. I. I. Korenman and Sh. Sh. Mesongenik (*Zavodskaia Laboratoria* (*Works' Lab.*), 1936, 5, (2), 168–169).—[In Russian.] The best conditions were investigated for the microdetermination of Pb as $PbCl_2$, PbI_2, $PbSO_4$, and $K_2CuPb(NO_2)_6$. Precipitation of $PbCl_2$ is best effected in 0·1N-HCl, precipitation of PbI_2 in 0·3N-KI solution, and precipitation of $PbSO_4$ in 1N-H_2SO_4. Sn interferes in the $PbCl_2$ and $K_2CuPb(NO_2)_6$ methods.—D. N. S.

*The Qualitative and Quantitative Determination of Lithium, Rubidium, and Cæsium by the Spectrum Method. U. M. Tolmachev (*Izvestia Akademii Nauk S.S.S.R.* (*Bull. Acad. Sci. U.R.S.S.*), 1934, [vii], 904–920).—[In Russian.] See *Met. Abs.*, 1935, 2, 244.—S. G.

Microchemical Determination of Magnesium with 8-Hydroxyquinoline. M. V. Gapchenko and O. G. Sheintsis (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1936, 9, (3), 541–543).—[In Russian.] Mg can be determined by Hahn's method (*Z. anorg. Chem.*, 1926, 139, 1198) in the presence of $NH_4^{\cdot}$, Na, K, Li, Cs, Rb, Ba, Sr, and Ca.—N. A.

*Determination of Manganese in Tungsten and Ferrotungsten. G. Frederick Smith, J. A. McHard, and K. L. Olson (*Indust. and Eng. Chem. (Analyt. Edn.*), 1936, 8, (5), 350–351).—The finely-powdered material (1 grm.) is heated with 30 c.c. of a 1 : 2 mixture of 72% $HClO_4$ and 85% H_3PO_4 at 200°–215° C. until solution is complete. The cold solution is boiled with 20 c.c. of HNO_3 until Cl_2 and HCl are expelled, cooled, treated with a few drops of $FeSO_4$ solution, then with 15 c.c. of H_2SO_4, and boiled with 1 grm. of Na bismuthate. The bismuthate is removed by filtration through a Gooch crucible, an excess of standard $FeSO_4$ solution is added, and the excess titrated with $Ce(SO_4)_2$ using diphenylaminesulphonic acid as indicator. The Mn may also be oxidized to $HMnO_4$ by boiling the solution of the metal obtained as above with 200 c.c. of water and 0·3 grm. of KIO_4; the excess of oxidizer is removed by addition of 4–5 grm. of $Hg(NO_3)_2$, and the filtered solution treated with an excess of $FeSO_4$ and titrated with $KMnO_4$.—A. R. P.

Fractional Reaction for Zirconium. N. A. Tananaev and A. V. Tananaeva (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1936, 9, (3), 526–531).—[In

Russian.] Zr can be detected and determined approximately, in the presence of all elements except Si, by precipitation as phosphate from a 25–30% H_2SO_4 or 20% HCl solution.—N. A.

Electrometric Titration Processes : Potentiometric Analysis. Fritz Lieneweg (*Arch. tech. Messen*, 1935, 5, (54), T163–T164).—The method described depends on the accurate comparison of the potential of a given system with that of a standard. The conditions of comparison are discussed, and an illustrated description is given of an automatically recording titration apparatus. The method is applicable to a wide variety of mineralogical and metallurgical analyses, and permits the estimation of several metallic ions in presence of each other (*e.g.* of Ag, Cu, Cd, and Zn in certain solders). A list of applications and a *bibliography* are appended.—P. M. C. R.

X.—LABORATORY APPARATUS, INSTRUMENTS, &c.
(See also " Testing " and " Temperature Measurement and Control.")

On the History of the Metallurgical Microscope. H. Freund (*Giesserei*, 1936, 23, (19), 491–502).—An account is given of the developments in the metallurgical microscope between 1891 and 1934.—A. R. P.

Some Improvements in the Field of Material Testing Methods and Their Importance in Foundry Practice. A. Karsten (*Giesserei*, 1936, 23, (11), 265–268).—The Busch " Metaphot " is described and its use in the examination of the macro- and microstructure of castings is discussed.—A. R. P.

Advances in the Investigation of Microstructure, and Their Value in Testing Materials in the Motor Industry. A. Karsten (*Automobiltech. Z.*, 1936, 39, (15), 393–394).—The characteristics and applications of a small portable apparatus for the X-ray examination of microstructures are considered, and such an apparatus, intended primarily for use on light alloy parts, is described and illustrated.—P. M. C. R.

Spectrograph for Rapid Industrial Application. M. F. Hasler and R. W. Lindhurst (*Metal Progress*, 1936, 30, (3), 59–63, 90).—The exceptional resolving power of the equipment described is due to the substitution of a diffraction grating for the usual prism. The construction and mounting of the arc-chamber facilitates rapid work, whilst rapid comparison with a reference spectrograph is permitted by a special projector. The use of the apparatus in typical works' analyses is described.—P. M. C. R.

Thermostat of the Ural Physico-Technical Institute. P. G. Strolkov (*Zhurnal Tehnicheskoy Fiziki* (*J. Tech. Physics*), 1935, 5, (8), 1502–1510).—[In Russian.] The thermostat, which will maintain a temperature of 600° C. within $\pm$ 0·1° C. for at least 40 hrs. is described in detail.—N. A.

The Rotap Testing-Sieve Shaker. —— (*Engineering*, 1936, 142, (3685), 237).—The determination of the percentages of different-sized particles by passing the material through a series of sieves, which are shaken by hand, results in appreciably different values being obtained. A machine is described and illustrated which performs the operation mechanically—the sample being passed successively through the series of different openings at one operation.

—R. Gr.

A Sachs Camera. A. P. Kamar and V. S. Averkiev (*Zhurnal Tehnicheskoy Fiziki* (*J. Tech. Physics*), 1935, 5, (9), 1653–1655).—[In Russian.] A new type of Sachs camera for X-ray examinations at high temperature and *in vacuo* is described.—N. A.

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

†**The Significance of the Numerical Values of Mechanical Tests of Metals.** L. Delville (*Métaux*, 1936, **11**, (131), 140–147).—The nature of the physical and mechanical properties of metals is considered, and their definitions and dimensions are tabulated. From these considerations, the relation of the various properties one to another are discussed. All testing comprises measurement, interpretation, and comparison. Measurement depends on the magnitude of the properties and the accuracy required, and on the cost; interpretation must take into account all the fundamental variables concerned; comparison can only properly be made between properties of the same dimensions, unless not purely numerical parameters are introduced to make up for the missing dimensions.—J. H. W.

New Application of a Three-Point Amplifier for Recording Results of Mechanical Tests. Pierre Chevenard (*Rev. Mét.*, 1936, **33**, (4), 280–287).—A new machine constructed by the Imphy laboratories employs very small test-pieces for tensile, bend, and shear tests. Stress–strain diagrams are recorded autographically by a pen attached to a three-point amplifier, stress being measured by deflection of a spring.—H. S.

Microchemical Analysis of Welds. Pierre Chevenard and Albert Portevin (*15me. Congrès chim. indust. (Bruxelles 1935)*, 1936, 223–241; *C. Abs.*, 1936, **30**, 5925).—After reviewing the causes of mechanical heterogeneity of welds resulting from chemical and physico-chemical reactions, from fusion effects, from hardening and from tempering, C. and P. discuss their consequences as regards : (1) mechanical tests of welds, the interpretation and analysis of which imply the use of micro test-pieces ; (2) the definition of weldability, the characterization of which necessitates a complete and accurate exploration of the weld. The problem has been solved by the use of the micro-machine based on the principle of the optical lever with photographic record, after large amplification, of the deformations of the tensile, shearing and bending micro test-pieces, as a function of the loads measured by the elastic deformation of the frame of the machine. A series of examples of selected welds is presented in the form of micro tensile and micro shearing diagrams, which give the variations of strength, elastic limit and elongation determined at a number of closely situated points. The examples comprise both gas and electric welds of ferrous materials ; they reveal clearly the complex influence on the mechanical properties of fusion in the welded zone, and the hardening and tempering effects on the heated zone as a whole. Unlike tests carried out on large test-pieces, micro-mechanical testing makes it possible to ascertain both the position and the value of the maxima and minima of the various mechanical properties, and this in turn makes it possible to find their causes and to reduce them as much as possible so as to improve the homogeneity.—S. G.

On Anti-Friction Properties of a Material. N. N. Serafimovich (*Metallurg (Metallurgist)*, 1936, (6), 102–108).—[In Russian.] Deals with the method of determining anti-friction properties on a Mohr–Federhof machine, and gives examples of the determination of friction moments of bronzes.—N. A.

On the Question of the Upper and Lower Yield-Point and the Breaking Load. G. Welter (*Metallwirtschaft*, 1936, **15**, (38), 885–889 ; (40), 936–938).—W. repeats and amplifies the false conclusions reached (see *Met. Abs.*, this vol., p. 50) on the influence of the construction of the tensile machine on the contour of the load–elongation curves.—v. G.

Contribution to the Question of the Tensile Test with Simple Gravity Loading. E. O. Bernhardt (*Metallwirtschaft*, 1936, **15**, (38), 889–892).—Polemical against Welter (preceding abstract).—v. G.

Contribution to the Question of the Tensile Test with Simple Gravity Loading.
G. Welter (*Metallwirtschaft*, 1936, **15**, (41), 960–964).—See preceding abstracts.
—v. G.

Vibration Tests (Simultaneous Series) of Flat Metal Specimens for Fatigue.
I. I. Mihailovskiy (*Vestnick Ingenerov i Tehnikov* (*Messenger Engineers and Technologists*), **1936**, (5), 309–311).—[In Russian.] A review.—N. A.

Criticism of the Short Time Methods of Determining the Alternate Bending Endurance Limit. W. Spåth (*Metallwirtschaft*, 1936, **15**, (31), 726–729 ; (32), 750–752).—The various accelerated methods of determining the endurance limit of metals are described. S. considers that the test-piece should be subjected to a preliminary 10^5 alternations at not too high frequency prior to making the test proper.—v. G.

A Bend Test for Tinplate. C. C. Willis (*Metal Progress*, 1936, **30**, (3), 50–55).—An illustrated description is given of a recording apparatus the purpose of which is to expose the sheet to stresses similar to those encountered during manufacture (*i.e.* of the bending–tensile type). Records of alternate bending and unbending tests on common varieties of tinplate are reproduced and correlated with the results of Olsen cup tests and with the respective microstructures, and the interpretation of the curves is discussed.—P. M. C. R.

German Machines and Apparatus for Determining Hardness. G. Richter (*Germanskaja Tehnika* (*Z. deut. Technik*), 1936, **15**, (4), 68–74).—[In Russian.] Description of Brinell, Rockwell, Shore, and other special apparatus for determining hardness, manufactured by German firms.—N. A.

Manufacture of Experimental Apparatus and Machinery at the " Rukhimovitch " Works. A. J. Rostovih (*Tochnaja Industria* (*Präzisions Ind.*), **1936**, (5), 1–4).—[In Russian.] Description of apparatus for mechanical tests on metals (hardness, resistance to impact, extension, &c.).—N. A.

RADIOLOGY.

The Application of X-Rays to Metallurgy.—III. C. Hubert Plant (*Metallurgia*, 1936, **14**, (83), 121–122).—See also *Met. Abs.*, this vol., pp. 373, 412. In this, the final article, on the application of X-rays to metallurgy, the practical side of the subject is dealt with. Particular attention is given to the X-ray apparatus so far as the type of tube, transformer, general arrangement, radiation dangers, and manipulation are concerned. The results obtained from X-ray photographs in analyzing and identifying metals and alloys by means of spectrographs are considered, and reference is made to photographs of the Laue type and the information obtained from them regarding the structure of materials. A brief account is also given of the application of the X-rays to the examination of metals for defects.—J. W. D.

The Influence of Stresses Normal to the Surface on the Deformation as Measured by X-Rays. G. Kurdjumow and M. Scheldak (*Metallwirtschaft*, 1936, **15**, (39), 907–908).—In measuring stresses by the X-ray method it must be remembered that the thickness of the surface film is not negligible and that, therefore, the magnitude of the stresses perpendicular to this must also be taken into account in the calculations.—v. G.

On the Relation Between the X-Ray Photograph and the Strength of Cast and Extruded Piston Alloys. E. Schiedt (*Metallwirtschaft*, 1936, **15**, (37), 857–862).—A series of X-ray photographs of pistons is shown which indicate that it is not possible to draw conclusions about the mechanical properties directly from such photographs.—v. G.

Radiographic Use of Radium. V. E. Pullin (*J. Roy. Soc. Arts*, 1934, **82**, 307–322 ; discussion, 323–326 ; *Sci. Abs.*, 1934, [B], **37**, 133).—After referring in general terms to the production and important properties of γ-rays, their use is described in detecting flaws in materials, and the advantages of γ-rays over X-rays in certain circumstances are pointed out. Examples are given of

the practical application of the γ-ray method, together with reproductions of radiographs. The process of estimating the position and size of flaws is referred to.—S. G.

XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from p. 413.)

Electric Recorder and Controller. —— (*J. Sci. Instruments*, 1936, **13**, (9), 306–307).—A note describing the " Multelec " recorder. The instrument works on the potentiometer principle, and automatically standardizes its own circuit voltage every 54 minutes. It is stated that $\frac{1}{1000}$ in. deflection of the galvanometer needle is shown on the chart, and that any change in conditions is recorded within 2 seconds of its occurrence. A wide range of industrial uses is claimed.—W. H.-R.

Methods for Measuring and Regulating Temperature, and Apparatus Used. R. Boye (*Germanskaja Tehnika* (*Z. deut. Technik*), 1936, (6–7), 101–106).— [In Russian.] A review.—N. A.

Recent Revisions of High Temperatures. H. T. Wensel (*J. Amer. Ceram. Soc.*, 1936, **19**, (3), 81–86).—W. points out that to convert temperature values recorded in the literature to the present International Temperature Scale, a correction must be applied which is calculated from the constants that define the particular scale in which recorded values are expressed. Applying the same corrections to all previous scales leads, in many cases, to values which depart from the present scale more than the values actually recorded. Examples are given showing the correct method of converting temperature values based on Wien's Law to the International Scale.—S. G.

XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 413–415.)

Correction of Porosity in Non-Ferrous Casting by Impregnation with Bakelite Varnish. Z. I. Shnaiderman (*Liteinoe Delo* (*Foundry Practice*), 1936, (4), 25–26).—[In Russian.] A description of the thermal treatment of Bakelite varnish, and the process of impregnation of bronze and aluminium sections.

—N. A.

On Light Metal Ingot Castings. H. Röhrig (*Z. Metallkunde*, 1936, **28**, (2), 43–45; and (abridged) *Light Metals Research*, 1936, **4**, (22), 386–387).— Practical hints are given on the correct methods of casting aluminium and its alloys to prevent segregation and undue piping, and the causes of faulty castings are discussed.—A. R. P.

Casting a Trough 5300 mm. Long of Aluminium Alloy. K. P. Lebedev (*Liteinoe Delo* (*Foundry Practice*), 1936, (4), 26–27).—[In Russian.] A description of the method of moulding.—N. A.

Causes of Rejects in Aluminium Castings and Methods for Their Elimination. A. M. Brezgunov (*Aviopromishlenost* (*Air Industry*), 1936, (3), 17–25; (4), 27–31).—[In Russian.] Deals with the classification and nomenclature of rejects in the casting of aluminium alloys.—N. A.

Casting of a Bronze Manipulator Subjected to a Hydraulic Test of 30 Atmospheres. Z. S. Lavut (*Liteinoe Delo* (*Foundry Practice*), 1936, (5), 36–37).— [In Russian.] A technical description of the casting process.—N. A.

The Bronze Casting Technique of Our German Ancestors. Erich Becker (*Giesserei-Praxis*, 1936, **57**, (37/38), 409–413; (39/40), 440–442).—Read at the International Foundry Congress at Düsseldorf. Discusses the composition, shape, and probable method of casting of old bronzes in Germany.—J. H. W.

K K

Magnesium Alloys in Aero Engine Construction. A. S. Lugaskov (*Avio-promishlenost* (*Air Industry*), 1936, (4), 31–40).—[In Russian.] A review, describing the composition of the alloys, their preparation, moulds, testing, and the treatment of castings and rectification of their defects.—N. A.

Measures Against Rejects and Improvement of the Quality of Magnesium Alloy Castings. A. S. Lugaskov (*Aviopromishlenost* (*Air Industry*), 1936, (5) 27–35).—[In Russian.] A review.—N. A.

* **On the Deoxidation of Technical Silver Alloys.** E. Raub, H. Klaiber, and H. Roters (*Metallwirtschaft*, 1936, 15, (33), 765–770 ; (34), 785–788).—The efficiency of numerous deoxidizers for the silver alloy with 16·5% copper has been examined ; only phosphorus and lithium were found satisfactory in all respects. Phosphorus removes the oxygen as cuprous metaphosphate which separates relatively slowly from the molten metal, but is harmless if not completely eliminated. Small amounts of retained lithium are also without effect on the mechanical properties, but reduce slightly the resistance to corrosion by acetic acid and increase considerably the resistance to corrosion by nitric acid ; lithium does not affect sulphide tarnishing.—v. G.

Preheating Bearings for Tinning with Babbitt. John E. Hyler (*Machinist* (*Eur. Edn.*), 1936, 79, (51), 915E).—The advantages of heating bearings before tinning them with Babbitt are counteracted if the heating is excessive. If the bearings are damp, they should be heated relatively hot, but allowed to cool until comfortably warm to the hand before pouring in the Babbitt.—J. H. W.

The Problem of Porosity of Aluminium Alloys in Die-Casting. P. E. Liamin (*Liteinoe Delo* (*Foundry Practice*), 1936, (4), 22–25).—[In Russian.] Different types of porosity and their causes are examined.—N. A.

Changeable Cores for a Die-Casting Die. E. Stevan (*Machinist* (*Eur. Edn.*), 1936, 80, (3), 46E–47E).—The use of interchangeable pads in a die-casting die for, say, a zinc-base alloy, enables drill stands for fractional, metric, and wire gauge sizes to be made with one set of tools.—J. H. W.

Die-Casting Problems in the U.S.S.R. B. A. Jungmaister (*Liteinoe Delo* (*Foundry Practice*), 1935, (10), 3–4).—[In Russian.] General views on the desirability of developing this branch of casting.—N. A.

What Points Must be Observed in the Construction of Moulding Boxes ? Gustav Krebs (*Giesserei-Praxis*, 1936, 57, (35/36), 365–368).—Discusses the wall thickness, cooling, strength, and general construction of moulding boxes, and describes the production of large moulds for special castings.—J. H. W.

Material for the Production of Pattern Plates. Joh. Mehrtens (*Giesserei-Praxis*, 1936, 57, (37/38), 418–426).—Read before the International Foundry Congress at Düsseldorf. Describes the economics of moulding materials and the construction of a large variety of moulds. The use of wood, cast iron, non-ferrous metals (alloys of copper, lead, aluminium, and magnesium), and non-metallic materials for this purpose is discussed, and alternative materials of domestic origin for various applications are suggested.—J. H. W.

On the Use of Cements as Binders for Foundry Sands. Max Paschke, Carl Weyman, and Eugen Schneider (*Giesserei*, 1936, 23, (16), 381–386).—Good foundry sands can be made from sharp silica sand with cement as a binder ; the permeability to gases and the refractoriness of moulds made from the mixture are sufficiently good for most foundry purposes. Fused alumina cement is better than Portland cement as it gives better permeability and a higher tensile strength. The sand used should be as pure as possible as even iron oxide reduces the refractoriness owing to the lime present in the cement.
　　　　　　　　　　　　　　　　　　　　　　　　　　　　—A. R. P.

On the Practical Applications of Moulding Sand Testing in Foundries. ——— Aulich (*Giesserei*, 1936, 23, (18), 431–437).—Methods and apparatus for determining the sand, clay, and moisture contents of moulding sands, the apparent volume, the permeability and the compression, tensile, and shear strengths are described.—A. R. P.

Driers for Foundries. —— Schmidt (*Giesserei*, 1936, **23**, (14), 341–342).—Types of ovens for drying moulds and cores are described and illustrated.
—A. R. P.

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

(Continued from p. 415.)

Basic Principles of the Refining of Simple Copper Alloys while Molten in the Foundry. Willi Claus (*Metallwirtschaft*, 1936, **15**, (37), 862–865).—The treatment of copper alloys containing, as impurities, aluminium, iron, antimony, oxides, sulphides, or hydrogen is broadly discussed.—v. G.

On the Principles of Converting Old into New Metal. E. J. Kohlmeyer (*Metallwirtschaft*, 1936, **15**, (29), 677–683).—The effects of oxidizing salts and salt fluxes on the treatment of scrap copper, aluminium, lead, zinc, and their alloys are discussed.—v. G.

XV.—FURNACES AND FUELS

(Continued from pp. 415–416.)

Tempering Furnace with Mechanically-Controlled Convection Currents. —— (*Engineering*, 1936, **142**, (3682), 158–159).—Describes and illustrates a gas-heated furnace. The heating chamber is situated within an insulated combustion chamber, and the ascending products of combustion are deflected downwards into it by means of a fan. Automatic temperature control is employed.—R. Gr.

What the Electric Furnace Has Done for Civilization. P. H. Brace (*Electrochem. Soc. Preprint*, 1936, Oct., 115–122).—The early beginnings of the electric furnace are briefly described. The effects of metallurgical electric furnace technique on present ways of living are set forth with special reference to the part played by the electric furnace in the production and uses of aluminium, magnesium, beryllium, chromium, tungsten, calcium carbide, phosphoric acid, silicon, manganese, and tantalum. Its use as a processing tool in shaping metals and in " copper brazing," &c., is mentioned.—S. G.

*Progress Report on Tests of Various Electric Heating Elements for Furnace Temperatures Between 1100° and 1500° C.—I. M. G. Toole and R. E. Gould (*Electrochem. Soc. Preprint*, 1936, Oct., 139–159).—The results of tests on silicon carbide resistors for electric heating for temperatures between 1100° and 1500° C. showed relatively high power loss, a material decrease in mechanical strength of bars with use, and failure when the resistance had increased 500%. No difference in resistance increase was noted for steady load as compared with on-and-off control. A more rapid resistance increase on bringing up to temperature after a shutdown and also a daily increase when operated at maximum temperature were noted. A rapid current increase just prior to failure was also noted. An average life of 1700 hrs. was observed. Tests on graphite resistors showed successful operation when protected from oxidation by propane gas, using a silicon carbide protection tube. The outside terminal block is the weakest part of the resistor assembly. A self-control terminal greatly improved the over-all thermal efficiency. Further tests are described using high-frequency induction heating. The general conclusion reached is that non-metallic heating units can be developed to operate at comparatively small cost per unit of material to be heated.—S. G.

Small Electric Furnaces. —— (*J. Sci. Instruments*, 1936, **13**, (9), 305).—A brief note describing small resistance furnaces suitable for heating soldering irons, tempering small tools, &c.—W. H.-R.

Electro Refractories. (Paoloni.) See p. 475.

A Graphical Method of Calculating Heat Loss Through Furnace Walls. Clarence E. Weinland (*J. Amer. Ceram. Soc.*, 1936, **19**, (3), 74–80).—Cf. *Met.*

Abs., 1935, **3**, 720. The expression of thermal conductivity data in the form of " true " conductivity is discussed, and a graphical method for the solution of problems in steady state heat-flow is developed. No account is taken of certain disturbing factors in furnace-wall calculations, such as joint resistances and conductances, air infiltration, and lack of temperature equilibrium. W. believes that the theory will serve as a basis for future developments along this line, and that the method of calculation described is reliable, workable, and also results in a saving of time.—S. G.

XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from p. 416.)

Properties of Insulating Refractories. S. M. Phelps (*Heat-Treat. and Forging*, 1936, **22**, (5), 251–253).—Insulating fire-bricks are being used as exposed linings for certain types of industrial furnaces on account of their low heat-flow, small heat capacity, lightness in weight, and satisfactory refractoriness. It is pointed out that the usual methods applied to the testing of refractories under load at high temperatures should not be used for these materials as they depart widely from furnace conditions. It is stated that a load test in which the bricks are heated on one face only indicates satisfactory mechanical strength at the maximum temperature which they are intended to stand in service and more closely simulates working conditions.—J. E. N.

*Contribution to the Study of the Action of Carbon Monoxide on Refractories. Léon Scheepers (*15me. Congrès chim. indust. (Bruxelles 1935)*, 1936, 1003–1011 ; *C. Abs.*, 1936, **30**, 6151).—The dissociation of carbon monoxide produces deterioration of refractories, particularly in the internal region of blast furnaces, where the average temperature is 400°–900° C. Various catalysts such as the oxides of iron promote the action. The catalytic action of silica, porcelain, kaolin, alundum, graphite, Fe_3O_4, iron silicate, bauxite, and iron filings was studied by a method (described in detail) based on the automatic measurement of the carbon dioxide formed on passing a given amount of carbon monoxide over the catalyst in a given time, at a given temperature, in a specially designed vertical electric furnace. Bauxite and natural magnetite are particularly active.—S. G.

*Testing Silico–Aluminous Refractory Materials at High Temperatures. B. Long (*Céramique*, 1935, **38**, (571), 219–224 ; *Ceram. Abs.*, 1936, 15, (6), 182).—A small thermostatically controlled electric furnace is used for measuring the load-bearing properties of refractory materials at high temperatures. It is found that the failing curve under pressure at 1500° C. : (1) gives evidence of the total porosity, and (2) furnishes under the name of coefficient of apparent viscosity, a measure of its value in practice.—S. G.

*Influence of the Addition of Fluxes on the Softening and Melting Points of Silico-Aluminous Refractories. Marcel Lepingle (*15me. Congrès chim. indust. (Bruxelles 1935)*, 1936, 300–318).—The results confirm previous work.—S. G.

Developments of Refractories Containing Magnesia. L. Litinsky (*Ber. deut. keram. Ges.*, 1935, **16**, (11), 565–596 ; also *Iron Steel Ind.*, 1936, **9**, (12), 462–466 ; (13), 495–499 ; 1936, **10**, (2), 101–105 ; and *Ceram. Abs.*, 1936, **15**, (9), 276).—A comprehensive review of recent developments in the industry and of the manner in which new ideas have been put into practice. The problems encountered and methods whereby they were overcome are discussed at length.—S. G.

*The Use of Penetrating Radiations in the Measurement of the Porosity of Refractory Brick. J. B. Austin (*J. Amer. Ceram. Soc.*, 1936, **19**, (2), 29–36).—A method of determining the porosity of a refractory brick by measuring the absorption of some penetrating radiation has been tested on silica brick of known porosity, using both X-rays and γ-rays, and has been found to be

entirely feasible. The test is simple, quickly and easily made, non-destructive, and can be made continuous. The apparatus must be calibrated for each composition, but once standardized can be used for different thicknesses of the same material. The ionization method of determining the intensity of the beam after passing through the sample is much superior to the photographic method.—S. G.

Refractory Products for Metal Melting Furnaces. Karl Lentzen (*Giesserei-Praxis*, 1936, **57**, (37/38), 404–407).—Read before the International Foundry Congress at Düsseldorf. The nature and use of the refractories available for the construction of metal melting furnaces are discussed.—J. H. W.

The Destruction of Refractory Smelting Furnace Bricks by Softening and Melting. E. T. Richards (*Feuerungstechnik*, 1936, **24**, (5), 73–77).—The softening and melting of refractory materials used in smelting furnaces by mechanical forces, gases, metallic vapours, and dust are referred to, and means of preventing such destruction are briefly mentioned. These comprise: (1) suitably supporting the materials, particularly the furnace arch, and (2) protecting the materials against impurities which can lower their melting points, by reducing their surface porosity.—J. S. G. T.

Electro Refractories. A. Paoloni (*Corriere ceram.*, 1935, **16**, (7), 279–284; *Ceram. Abs.*, 1936, **15**, (2), 63).—The electrothermal treatment of raw materials for the production of refractory and ultra-refractory synthetic materials (silicon carbide products and artificial graphite) and a description of an electric furnace devised by P. for temperatures of 1400°–1800° C. are given.

—S. G.

XVIII.—WORKING

(Continued from pp. 417–418.)

*Contribution to the Knowledge of Material Flow in the Rolling Process. Hermann Unckel (*Arch. Eisenhüttenwesen*, 1936–1937, **10**, (1), 13–18).— An ingot of pure aluminium was drilled at regular intervals and channels cut in the surface, all being filled with a 0·5% copper–aluminium alloy; the composite material was then rolled to various degrees of reduction, sectioned, and etched to produce blackening of the alloy inclusions. In this way a complete picture was obtained of the relative flow in the various parts of the ingot. Broadening of the ingot takes place uniformly over the whole surface, but the rate of flow in the core of the ingot is less than that at the upper and lower surfaces, *i.e.* the normal to the rolling plane is bent against the direction of rolling. The effect of stresses produced transversely to the direction of rolling may be seen by making short longitudinal slits in the ingot prior to rolling; when a lead ingot so cut is rolled both ends are splayed outwards and the slit becomes triangular in shape showing the presence of stresses directed from the centre outwards to the edges.—A. R. P.

Multiple-Stage Rolling Mills. Wilhelm Rohn (*Z. Metallkunde*, 1936, **28**, (6), 139–142; and (abridged) *Met. Ind.* (*Lond.*), 1936, **49**, (11), 259–260).—A description of modern types of 20-high rolling mills and their performance.

—A. R. P.

On Spreading in Rolling. W. Trinks (*Blast Fur. and Steel Plant*, 1936, **24**, (9), 785–788).—Discusses the factors which influence the spreading of metal in rolling and reviews the formulæ suggested for its estimation. Written from the ferrous point of view.—R. Gr.

Preparation of Silver Sheet. The Tensile Properties of Sheet of Commercial Silver Alloys in Relation to the Method of Manufacture. (Moser and Raub.) See p. 444.

Modern Extrusion for Tube Manufacture. Gilbert Evans (*Metallurgia*, 1936, **14**, (83), 142–144).—The adaptation of hydraulics to the piercing and

extrusion of non-ferrous metals for finishing into tubes is discussed in relation
to improvements of design for the hydraulic operation, the adaption of the
tools to the conditions regulated by the material to be extruded, and improve-
ments in design, which aim at greater manufacturing accuracy, and consistent
dimensions in extensive production. Vertical and horizontal types of presses
are compared, and a description is given of a modern 3500-ton horizontal
hydraulic extrusion press for non-ferrous metal sections and tubes, which is the
outcome of prolonged research and experiment.—J. W. D.

Henley Lead Extrusion Machine. —— (*Machinist (Eur. Edn.*), 1936, **80**,
(11), 187E–188E).—Describes the construction and operation of a machine for
extruding lead pipes and sheathing cables. It is claimed that a fine tolerance
in the thickness of the sheathing throughout the entire length of the pipe or
cable is obtained. Non-circular sections can be satisfactorily extruded. The
heat radiation is low and the temperature is controlled by a series of thermo-
couples.—J. H. W.

Four-Unit Wire-Drawing Machine. —— (*Engineering*, 1936, **142**, (3684),
195–196).—A wet drawing rod machine is illustrated and described, which is
specially suitable for the drawing of bronze wire. Hard phosphor–bronze may
be drawn from 5-gauge rod in 4 drafts to approximately 12-gauge at an
approximate rate of 600 ft./minute.—R. Gr.

Theoretical Premises for Designing a Process of Wire-Drawing. S. N.
Jakovlev (*Zvetnye Metally (Non-Ferrous Metals*), 1936, (1), 120–127).—[In
Russian.] General views.—N. A.

Power Used in Drawing-Rolls of Multiple Mills. S. N. Jakovlev (*Zvetnye
Metally (Non-Ferrous Metals*), 1936, (2), 107–119; (3), 90–101).—[In
Russian.] The distribution of forces on the rolls, back tractive effort, and
coefficient of friction of wire-drawing rolls are studied. Coefficients of friction
in relation to drawing rates are shown graphically for copper, brass, and
bronze wire, and the wire pressure on the rolls is estimated. Nomograms are
constructed for practical use.—N. A.

***Formation of Ears in the Deep-Drawing of Silver Sheet.** E. Raub (*Mitt.
Forschungsinst. Edelmetalle*, 1936, **10**, (5/6), 53–67).—In the cold-rolling of
copper–silver alloys the copper and silver crystallites tend to become oriented
in the direction of rolling, and hence directionality of the tensile properties is
developed, the tensile strength being at a maximum at right angles to the
direction of rolling and a minimum at an angle of 45° thereto. Preliminary
forging of the casting, change in the copper content of the alloy, precipitation
heat-treatment, and the addition of 0·3% phosphorus or 0·94% cadmium to the
metal have no effect on this directionality. Even annealing has little effect on
the directionality of the tensile strength and elongation, and may, under
certain conditions, intensify it by reducing still further the strength and
increasing the ductility at 45° to the direction of rolling. After high-tempera-
ture anneals the strength in the direction of rolling becomes equal to that at
right angles thereto except when the alloy contains phosphorus. Cross-rolling
prevents the formation of the usual fibre structure but does not prevent the
development of anisotropy ; in the hard-rolled state the strength is at a mini-
mum at 45° to the rolling direction but on annealing this slowly disappears.
From these results it appears that ear formation in deep-drawing can be
prevented by cross-rolling, frequent annealing at not too high a temperature
and avoiding too high a degree of reduction at any stage. The development of
a regular crystal structure takes place only at 800° C. and this temperature is
too high for annealing the relatively low-grade Continental standard silver
alloys since they contain a high proportion of eutectic.—A. R. P.

The Production of Metallic Films. R. V. Jones (*J. Sci. Instruments*,
1936, **13**, (9), 282–288).—The methods for producing thin metallic films by
deposition (sputtering, evaporation, and electrodeposition) and by the reduc-

tion of bulk metal (beating, planishing, and rolling) are summarized with references to original papers, and some electrical properties are described. Foil produced by rolling is in general much superior. If the foil is rolled from sheet metal, it is necessary to reduce the diameter of the rolls as the foil becomes thinner, and a suitable machine is suggested. If strips of foil are rolled from wire, the diameter of the rolls has little influence since the distortion of the metal is at right angles to the direction of feed (*i.e.* parallel to the rolls), whereas when sheet is rolled the distortion is longitudinal. Practical details of the production of films of the order 0.1μ in thickness are described, and also methods for cutting and manipulating thin films.

—W. H.-R.

The Press Forging of Brass. —— (*Heat-Treat. and Forging*, 1936, **22**, (7), 327–328).—A brief account of the advantages of die-pressings of brass and related alloys over sand-castings.—J. E. N.

Comparator Gauge for Drop Forgings. Frank Hartley (*Machinist (Eur. Edn.*), 1936, **80**, (14), 276E–277E).—Describes a gauge for gauging the entire outline of the contour of a drop forging having off-set surfaces that cannot be measured by ordinary means.—J. H. W.

Investigation of Piston Forgings from AC-11 Alloy. V. A. Livanov (*Zvetnye Metally (Non-Ferrous Metals*), 1936, (1), 127–137).—[In Russian.] From examination of the macro- and micro-structure and tensile and impact tests, it is concluded that the best material for pistons is that produced from rolled and pressed rods.—N. A.

Methods of Employing Perforation Boring of Hard Strata by Means of Hard Alloys. V. P. Banul and M. M. Kravtsov (*Redkie Metalli (Rare Metals*), 1936, (1), 16–26).—[In Russian.] Hard sintered alloys of the " Pobedit " type are unsatisfactory for drilling hard strata, sharpened strips 8–10 mm. thick inserted in the drill-heads breaking at the first impact. With a special tougher alloy (" Pobedit 13 ") it is possible to drill up to 2 metres at one effort at one quarter the cost with a steel drill.—D. N. S.

XIX.—CLEANING AND FINISHING

*The Cleaning of Tinned Equipment in the Dairy. G. Genin (*Lait*, 1936, **16**, 612–615; *C. Abs.*, 1936, **30**, 6838).—The corrosion of tin and tinned copper by sodium carbonate and sodium hydroxide solutions depends essentially on the quantity of oxygen dissolved in the solution and very little on the temperature and concentration of the alkali. The presence of a reducing agent permits a marked reduction in the corrosion. For this purpose sodium sulphite was found very effective. Thus, pure tin on treatment with 0.5% solutions of sodium carbonate lost 6.6 mg./dm.^{2} while when the carbonate solution contained sodium sulphite the loss was reduced to 0.8 mg./dm.^{2}. Sodium sulphite has the advantages of low cost, relative stability in a solid state, and ready solubility in water and alkaline solution; moreover, its product of oxidation, sodium sulphate, exerts no deleterious effect. By the addition of sodium sulphite it is possible to reduce to about $\frac{1}{10}$ the attack of alkaline solutions on tin. It is suggested that proper proportions of mixing sodium sulphite and carbonate or hydroxide are 1 part sodium sulphite to 10 parts of crystallized sodium carbonate or 1 part sodium sulphite to 4 parts of sodium carbonate or sodium hydroxide. The protective action of the sodium sulphite on tin is exerted until all of it has been oxidized to the sulphate.—S. G.

*Methods of Caring for Cream Separators and Their Influence Upon the Quality of Cream [Cleaning of Separator Parts]. C. K. Johns (*Sci. Agric.*, 1936, **16**, 373–390; *C. Abs.*, 1936, **30**, 6072).—A rinse of sodium hypo-

chlorite containing 50 p.p.m. was very effective in reducing contamination in separator bowls. Metso, a commercial sodium metasilicate detergent, proved to be very corrosive to metal separator parts.—S. G.

Colouring of Metals. IV.—Zinc and Die-Castings. Herbert R. Simonds and C. B. Young (*Iron Age*, 1936, **138**, (10), 30–35, 110).—Describes the few commercial methods available for colouring zinc and outlines the chief research now in progress. The Cronah method involves simple immersion in acidified sodium bichromate, which causes an insoluble film to be deposited on the surface of the metal. The possibilities for electrodeposited coatings on zinc are the same as for other metals previously described (*Met. Abs.*, this vol., p. 324), but the procedure sometimes requires specific adaptation. The compositions of both inorganic and organic baths for nickel plating are given, and the method of alloying for colour (nickel–brasses) and the use of nickel for producing colour effects are described.—J. H. W.

The Use of Steel Wool for Grinding and Polishing Aluminium and Other Metals. R. Böing (*M.S.v.Z. für Metall- u. Schmuckwaren Fabrikation Sowie Verchromung*, 1936, **17**, (7), 11 ; *Neuhausen Wochenbericht*, 1936, (**28**), 299).—The steel wool used for polishing should be soft rather than brittle, should consist of long threads, and should be degreased to avoid smearing. Owing to the sharp edges of the separate strands it has been found suitable for fine grinding. Irregularly shaped articles can be treated with steel wool as the latter readily follows all the irregularities of the surface and does not leave dirt or dust on the surface of the metal.—L. A. O.

Applying the Grinding Wheel to New Production Operations. Fred Horner (*Canad. Mach.*, 1936, **47**, (8), 20–22, 46).—Complex grinding operations have been considerably developed and extended as a result of the demand for standardized metal parts and of the introduction of artificial abrasives. Examples of plunge-cut work, centreless grinding, tapering, and recessing are described and illustrated.—P. M. C. R.

Sand-Blasting from the Point of View of Economy. R. Engelhart (*Werkstatt u. Betrieb*, 1936, **69**, (17/18), 233–235).—Sand-blasting installations are classified according to the method of introduction of the abrasive. In plant for light work (*e.g.* production of a matt surface), the sand is sucked in by the air stream ; a gravity feed is used in heavier ornamental work, whilst in the cleaning of foundry pieces, &c., the abrasive is introduced under pressure. Modern plant is described and illustrated, with an estimate of costs.—P. M. C. R.

Pickling Tank Tie-Rods. —— (*Engineer*, 1936, **162**, (4210), 299).—Considers the defects of tanks constructed of wood and outlines the mechanism of tie-rod corrosion. Suggests and illustrates methods of minimizing corrosion.—R. Gr.

XX.—JOINING

*Contribution to the Testing of Tin–Lead Soldered Joints.** Willi Tonn and Heinrich Günther (*Z. Metallkunde*, 1936, **28**, (8), 237–239).—The strength of butt and lap joints in tinplate and zinc sheet soldered with pure lead–tin solders of various compositions has been determined. For joints in sheet zinc the strength increases with the tin content of the solder, but for joints in tinplate no further increase in strength takes place above a tin content of 30% in the solder. In both cases lap joints are about twice as strong as butt joints. Using an electric soldering iron the time taken to solder a joint and the amount of solder used decrease with increasing tin content of the solder so that the apparent saving in tin in using a low-tin solder is offset by the necessity of using much more solder.—A. R. P.

*Physical Properties of Soft Solders and the Strength of Soldered Joints. (Gonser and Heath.) See p. 454.

Properties of Metals and Alloys and Their Importance in Welding and Soldering. Erich Lüder and Karl Heinemann (*Z. Metallkunde*, 1936, 28, (7), 188–192).—The effect on the soldering and welding properties of metals and alloys of the following factors is discussed ; the heat transfer properties of the metals to be joined, the freezing range of alloys used as solders, the reducibility of the various oxides by the torch flame, the solubility of the oxides in the fluxes used, and the solubility of gases in the welded metal.—A. R. P.

Low-Temperature Brazing with Silver Alloys. Philip Kriegel (*Welding Eng.*, 1936, 21, (8), 32–36).—The advantages of silver solders are enumerated and advice on their use is given. Oxy-acetylene is recommended for heating the seam to be jointed, the solder being applied to the preheated seam after removal of the flame. Lap joints are preferred to butt joints or fillets, and a close fit is desirable. Applications to copper, bronze, stainless steel, and nickel alloys are illustrated and described.—H. W. G. H.

New Brazing Alloy Increases Applications [Phos–Copper]. —— (*Amer. Metal Market*, 1936, 43, (159), 6). Westinghouse " Phos–Copper " Brazing Alloy. —— (*Machinist* (*Eur. Edn.*), 1936, 80, (38), 779–780).—A brief note. Phos–copper, an alloy of phosphorus and copper, has been developed to replace expensive silver solders. Its properties, uses, and the forms in which it is available are described.—L. A. O.

*Does Loss of Alloying Constituents Occur in Light Metal Welding ? M. Maier (*Aluminium*, 1936, 18, (8), 373–374).—In the oxy-acetylene welding of good grades of technical aluminium the loss of iron and silicon is practically negligible, but with Hydronalium there is a loss of about 4% of the magnesium content but no reduction in the manganese content. In gas-welding Silumin very little silicon is lost under a good flux but about 3% is lost without a flux ; no loss of copper occurs in welding " German alloy," but about 2–3% of the zinc may be lost. In welding the American 8% copper alloy, however, the copper content of the weld may be as much as 0.5% less than that of the surrounding metal, a loss of over 7% of the total copper.—A. R. P.

Electrical Spot Welding of Light Alloys. I. M. Brailovskiy (*Aviopromish-lenost* (*Air Industry*), 1936, (4), 41–43).—[In Russian.] The advantages of spot welding over riveting in aircraft construction are indicated.—N. A.

Technical Standardization and Costs of Gas Welding of Copper and Aluminium Sections. J. S. Smirnow (*Avtogennoe Delo* (*Autogenous Practice*), 1935, (12), 24–25).—[In Russian.] A study of causes, with numerical data, affecting expenditure of time and materials.—N. A.

The Sheathed Electrode for the Welding of Copper. A. Matting and W. Lessel (*Elektroschweissung*, 1936, 7, (9), 161–170).—The new electrode has four coatings : the first, immediately surrounding the core of substantially pure copper, forms a slag of approximately the same melting point as the latter ; the second forms, under the heat of the arc, large quantities of a gas which is not absorbed by copper ; the third and fourth form the sheath, being fused away less readily than the core, so as to form a tube which directs the stream of gas on to the seam. This tubular stream of gas enables a long arc to be held without difficulty and without risk of oxidation of the molten metal. Lengthening the arc reduces the melting speed of the electrode and allows high voltages to be used, so that sufficient heat is given to the work to compensate for the high thermal conductivity, without the need for auxiliary blowpipe flames. The weld metal passes steadily through the " tubular arc " instead of falling in large drops. The electrode is connected to the $+$ pole ; the voltage used varies from 40 v., for 8 mm., to 100 v. for 30 mm. length of arc, and the current is between 220 and 120 amp. for a 4-mm. diam. electrode. Preheating to $200°$ C. is necessary at the beginning of a seam and may be carried out by

carbon arc. The welding speed is about 3·3 m. per hr. for 10 mm. thick material. Tensile tests on the welds give 90% of the strength of the parent metal and 18–22% elongation. The electrodes can be used for vertical welding.—H. W. G. H.

Welding in Repairs of Bronze Articles. B. I. Belov (*Avtogennoe Delo* (*Autogenous Practice*), **1936**, (5), 21–22).—[In Russian.] A description of the welding process.—N. A.

Methods of Lead Welding Differ Widely from Practices with Other Metals. F. E. Rogers and W. H. Carter (*Welding Eng.*, 1936, **21**, (8), 24–27).—For tank linings, lap seams are normally used, butt joints being made only in thick material. The technique to be adopted is described for both types of joint, great emphasis being laid on the need for scrupulous cleanliness. Various types of joint for pipe work are also discussed. Hydrogen is recommended for welding.—H. W. G. H.

Hints on Maintenance of Resistance Welding Machines. A. M. Macfarland (*Welding Eng.*, 1936, **21**, (8), 19–20).—Attention is particularly directed to the need for keeping constant the area of the electrode tips, cleaning switch and contactor contacts, and preserving the close fit of dies and clamp for butt- or flash-welding.—H. W. G. H.

High-Power Machinery for Spot Electrical Welding of the AGA-175 Type. G. V. Nedzevezkiy (*Vestnik Elektropromishlennosti* (*Messenger Elect. Ind.*), **1936**, (8), 10–13).—[In Russian.] Descriptive.—N. A.

Phenomena Determining the Process of Spot Welding. A. S. Orlev (*Avio-promishlenost* (*Air Industry*), **1936**, (4), 44–48).—[In Russian.] The thermal, electrical, power, and geometrical phenomena in spot welding are examined and conditions for attaining good results laid down.—N. A.

The Atomic Physics Basis of the Welding Capacity of Metals. A. S. Ogie-vezkiy (*Avtogennoe Delo* (*Autogenous Practice*), 1935, (12), 14–17).—[In Russian.] A survey of general principles.—N. A.

Oxy-Acetylene Welding. L. C. Percival (*Indust. Gases*, 1936, **17**, (1), 24–33 ; (2), 69–73, 79–83).—See *Met. Abs.*, this vol., p. 177.—H. W. G. H.

Novel Constructions of Welding Torches. A. S. Falkevich (*Avtogennoe Delo* (*Autogenous Practice*), **1935**, (11), 25–26).—[In Russian.] The new lighter type of welding torches made of aluminium and its alloys, as constructed at the First Autogenous Works, and other types are described.—N. A.

XXI.—INDUSTRIAL USES AND APPLICATIONS

Shaping and Constructing in Light Metals. Walther Zarges (*Aluminium*, 1936, **18**, (8), 353–360).—A lecture dealing with the industrial applications of aluminium and its alloys in the form of sheet and castings. Among the uses discussed are the construction of coach-work, deck superstructures in steamboats, non-magnetic metal parts of magnetic separators, ventilating apparatus for railway trains, railway and omnibus doors, sign plates, stands for scientific instruments, and parts of electrical apparatus.—A. R. P.

Light Articulated Unit of Welded Construction in Aluminium Alloys. Maurice Leroy (*Allégement dans les Transports*, 1936, **5**, (3/4), 30–36).—An account of the 3-car rail units adopted on the French Chemin de Fer du Nord. The annealing of the welded body-work is obviated by the use of M.G.7, a light alloy containing 7% of magnesium ; the properties of this material when fully annealed are given.—P. M. C. R.

New Light Metal Car for the Milan Tramways. R. Ferrari (*Allégement dans les Transports*, 1936, **5**, (9/10), 114–121).—[In French and German.] An

experimental tramcar constructed for the Milan city authorities has a super-structure mainly of Avional, whilst Duralite castings and forgings are used in bogey construction.   An 18% reduction in weight has been effected in the complete unit, the reduction in the case of the superstructure being estimated at 40%.   Details of design and construction are illustrated.—P. M. C. R.

Light Metal Speed-Boat. Ad.-M. Hug (*Allégement dans les Transports,* 1936, **5,** (1/2), 14–17).—[In French and German.] Peraluman, an easily welded light alloy of high resistance to corrosion, has been used in the construction of the hull and most of the stressed members of a 300-h.p. speed-boat recently launched at Vitznau.   Other light alloys employed are Aluman A (petrol tank), Anticorodal B (seats), Silumin-Gamma (steering-levers), and Peraluman 2 (bearing-boxes).   The properties of these materials are tabulated, the treatment being indicated in each case.—P. M. C. R.

Autothermic Piston Controls Clearance. P. M. Heldt (*Automotive Ind.,* 1936, **75,** (12), 376–378).—Undesirable expansion effects in aluminium–silicon alloy pistons are eliminated by the inclusion of light steel inserts and by oval grinding of the skirt.   The design is fully described and illustrated.

—P. M. C. R.

Non-Vibrating Cables for Aerial Conductors. M. Preiswerk (*Bull. Assoc. Suisse Elect.,* 1936, **27,** (9), 543).—A short note on the satisfactory service and freedom from vibration of a composite aerial cable of Aldrey with a core of galvanized steel wire.—P. M. C. R.

†**The Manifold Uses of Aluminium Powder.** E. Herrmann (*Aluminium,* 1936, **18,** (8), 376–381).—A review of the patent literature showing the many useful applications of aluminium powder.—A. R. P.

Aluminium Powder Paints. —— Freitag (*Oberflächentechnik,* 1935, **12,** 152–153; *C. Abs.,* 1935, **29,** 5286).—A much better and denser coat of aluminium paint is obtained if the aluminium powder and the binder are mixed just shortly before the coat is applied than when the paint stands ready mixed for some time.   Aluminium paints are particularly advantageous where the materials to be protected are exposed to strong sunshine (tropics) or where vessels, rooms, &c., must be protected from heat radiation (airships, railroad cars, storage tanks for inflammable liquids).—S. G.

Use of Electrolytic Cadmium in the Manufacture of Syphons for Carbonated Beverages [Toxicity of Cadmium]. —— Bordas (*Ann. Falsif.,* 1936, **29,** 233–234; *C. Abs.,* 1936, **30,** 4935).—As cadmium offers considerable analogy with zinc and seems to be more toxic, it is recommended that its use be prohibited for articles that come into contact with foodstuffs.—S. G.

Substitution of Tin–Bronzes by Special Bronzes, Special Brasses, and Other Metals, DIN 1705. —— (*Z. Metallkunde,* 1936, **28,** (8), 243).—Suitable substitutes for phosphor–bronzes containing 6, 10, 14, and 20% tin are indicated for various purposes, also alloys free from tin which can be used in place of standard German red brasses.—A. R. P.

On the Use of Calcium Babbitts in Shipbuilding. I. T. Kolenov (*Sudostroenie (Shipbuilding),* 1936, (8), 575–577).—[In Russian.] A review.—N. A.

Filling of Bearings with Calcium–Sodium Babbitt and Bronze Turnings. —— Frankfurt (*Uralskaja metallurgia (Metallurgy of Ural),* 1936, (5), 38).—[In Russian.] The inclusion of bronze turnings in calcium–sodium Babbitts has made their use in heavy plant possible.—N. A.

Some Troubles with Plumbers' Materials. F. L. Brady (*J. Inc. Clerks Works Assoc. Gt. Britain,* 1935, **52,** (627), 75–78; *Building Sci. Abs.,* 1936, **9,** 11).—Considering lead as a plumber's material, B. points to the proved durability of lead when correctly used.   Cases of failure would appear to be due but rarely to the lead itself.   The marked resistance of lead to weathering results from the protective film of corrosion products which is quickly formed. Instances are described of the corrosion of lead by water containing lime in

solution from Portland cement mortar. In that case the protective film is not formed. The corrosion product is a red oxide which appears to be formed in annual layers, which indicate the number of years during which corrosion has proceeded. The corrosion of lead in contact with timber, especially hard woods such as oak or teak, is thought to be due to acid substances in the wood, particularly if unseasoned. In flat-roof construction where sheet lead is laid over timber it is advisable to insert a layer of protective material, such as bituminized felt, between the two materials. Good workmanship is essential to prevent the penetration of moisture between the wood and the lead. Attention is directed to the need for further investigation of the behaviour of lead pipes in different types of soil. Failure of lead pipes under pressure may be due to a weak weld. Failure of lead results also from fatigue due to alternating stresses. Brief reference is made to the ternary alloys of lead with cadmium, antimony, or tin.—S. G.

Lead Poisoning Caused by Drinking Water. A. Pellé and —— Artus (*Bull. acad. méd.*, 1935, **113**, 54–57; *C. Abs.*, 1936, **30**, 6861).—Lead is frequently found in drinking water of low mineral content. Covering the interior of tubes with tin gives little protection because the coating usually has rather a high lead content itself. Numerous cases of poisoning have been reported.
—S. G.

Nickel Alloys as Working Materials in Rotary Deep-Drilling Technique. K. Kallos (*Oel, Kohle, Erdoel, Teer*, 1936, **12**, 389–394).—S. G.

The Sputtering of [Silver for] Large-Aperture Fabry–Perot Interferometer Mirrors. S. Tolansky and E. Lee (*J. Sci. Instruments*, 1936, **13**, (8), 261–263).— A method of producing large-aperture Fabry–Perot interferometer mirrors by sputtering silver in argon is described.—W. H.-R.

Strontium. E. G. Erick and Gordon H. Chambers (*Foote Prints*, 1936, **9**, (1), 11–19).—The occurrence and uses of strontium and its compounds are reviewed.—S. G.

Ways to Use Domestic Materials as Substitutes for Bearing Metals and Methods of Fashioning Them. R. Kühnel (*Giesserei*, 1936, **23**, (15), 357–363).— Aluminium- or zinc-base bearing metals containing copper have been used satisfactorily as substitutes for imported tin-base alloys in Germany. Lead–bronzes, special brasses, aluminium, bronze, cast iron, and some light metals can be used instead of high tin–bronzes. The various applications of these substitutes are discussed and standard bearing constructions are described.
—A. R. P.

How to Select Electric Heating Alloys. F. P. Peters (*Machinist (Eur. Edn.)*, 1936, **80**, (15), 245E–247E).—The composition and properties of 12 of the most useful resistance materials are tabulated. For operation in air above 2400° F. (1315° C.), platinum or platinum–rhodium alloy is used; these are expensive and have inconvenient electrical properties. For temperatures between 2100° and 2400° F. (1150°–1315° C.), iron–chromium–aluminium or iron–chromium–aluminium–cobalt alloys are very satisfactory. Down to 1000° F. (540° C.), nickel–chromium alloys with or without iron are used. (Tophet alloys), and below 1000° F. (540° C.), Cupron, nickel–steel, or nickel silver can be used.—J. H. W.

Uses of Metal in Electrical Machinery Construction. P. N. Ivanov (*Vestnik Elektropromishlennosti (Messenger Elect. Ind.)*, 1936, (6), 27–31).—[In Russian.] The problem of metal scrap in electrical plant manufacture and of metal reserves in electrical machine construction are examined.—N. A.

Substitution and Economy of Non-Ferrous Metals in the Electrical Industry. B. M. Tareev and A. U. Shpirt (*Vestnik Elektropromishlennosti (Messenger Elect. Ind.)*, 1936, (7), 15–18).—N. A.

Factors Responsible for Off Flavours in Milk. P. H. Tracy (*Milk Dealer*, 1936, **25**, (8), 114–117; *C. Abs.*, 1936, **30**, 4938).—Contamination of milk with

copper or iron gives flavour defects characterized as cappy, metallic, tallowy, or oily. Copper and iron catalyze oxidation processes in the milk. The use of dairy equipment which will not allow contamination with copper or iron is therefore recommended.—S. G.

*The Influence of Metals on Milk. W. Ritter (*Schweiz. Milchzeitung*, 1936, **62**, 331–332, 337–338; *C. Abs.*, 1936, **30**, 6837).—The presence of traces of copper or its alloys was found to be detrimental to the flavour of milk, and caused the development of tallowiness and similar catalytic oxidation flavours. Iron, nickel, and zinc were less harmful. Aluminium and its alloys and different types of stainless steel were without effect. The latter metals are most desirable for storing, conveying, or pasteurizing milk and milk products.
—S. G.

XXII.—MISCELLANEOUS

The Institute of Material Research of the D.V.L. P. Brenner (*Metallwirtschaft*, 1936, **15**, (32), 745–750; (33), 770–772).—The new building of the Institute of Material Research of the Deutsche Versuchsanstalt für Luftfahrt is described.—v. G.

Recent Advances in the Aluminium Industry. Francis C. Frary (*Electrochem. Soc. Preprint*, 1936, Oct., 179–189; also (abridged) *Metallurgia*, 1936, **14**, (84), 175–176; and *Met. Ind.* (*Lond.*), 1936, **49**, (17), 412–413).—Advances in fabricating technique have enabled the industry to use alloys which have superior properties but which were formerly found not to be practical because of fabricating difficulties. The aluminium-base alloys containing magnesium, first proposed many years ago but only recently commercialized, are examples of this. New equipment and knowledge have also permitted the fabrication of larger wrought articles (structural shapes, forgings, &c.), special extruded shapes and tubing. Alclad sheet, anodic oxidation, electrolytic brightening processes and fundamental studies of the design of aluminium alloy structures are enlarging the field of use of aluminium alloys.—S. G.

Care and Disinfection of Gas Masks Used to Protect Against Chronic Lead Poisoning. Otto Giesenhaus (*Gasmaske*, 1936, **8**, 50–54; *C. Abs.*, 1936, **30**, 4945).—The importance of frequent inspection of gas masks used in atmospheres containing lead smoke or vapour is stressed, and methods of inspection and care are described. The article is illustrated by photographs.—S. G.

†Safety in the Metal Industry. E. A. Bolton (*Met. Ind.* (*Lond.*), 1936, **49**, (16), 391–393).—Presidential Address to the Birmingham Metallurgical Society. Attention is directed to the hazards incurred in the manufacture of finished rod, strip, sheet, &c., from ingot metal and scrap, by careless handling and operation in the respective processes. The greatest risk lies in the fact that daily contact with machinery, melting equipment, pickling tanks, &c., removes the recognition of danger, and it is urged that every effort be made to educate the workers themselves in methods of safe working, and in the development of the right attitude towards safety.—J. E. N.

Subject Indexes to Volumes of Periodicals. S. C. Bradford (*Engineer*, 1936, **162**, (4206), 180–181).—Outlines some methods of indexing.—R. Gr.

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XXIV.—BOOK REVIEWS

Werkstoffkunde der Hochvakuumtechnik : Eigenschaften, Verarbeitung, und Verwendungstechnik der Werkstoffe für Hochvakuumröhren und gasgefüllte Entladungsgefässe. Von W. Espe und M. Knoll. Roy. 8vo. Pp. viii + 383, with 405 illustrations. 1936. Berlin : Julius Springer. (R.M. 48.)

The standard books on the subject of high vacuum technique, such as those of Dushman, Dunoyer, and Kaye, are now somewhat out of date. They were written at a time of rapid change, and developments of technique, if not of principle have gone on continually. The necessities of the lamp and radio-valve industries have given birth to most of the advances in this field, and it is refreshing to find a book of this kind treated from the strictly practical point of view. It is important to realize, however, that the book deals with the materials used in high-vacuum technique and not the apparatus. That is to say, the reader will find excellent information on particular types of glass–metal or glass–ceramic seals, but no information as to the best way of evacuating such a vessel when he has made it. In this the book differs markedly from most of its predecessors, which have tended to concentrate on high *vacua* rather than high-vacuum technique.

The book is divided into twenty-five chapters, the first six of which are concerned with the metals and alloys used in vacuum work. The reader will find here information on metals such as beryllium, platinum, and tantalum, as well as the commoner metals, copper, iron, and nickel. Physical properties are tabulated and illustrated clearly and profusely.

Other important chapters in the book are concerned with the degassing of metals, properties of glasses for vacuum work, hot and cold electrodes, gettering methods, glass-to-metal joins, &c. The technique of sealing tantalum and molybdenum foils directly into silica glass, now of great importance in extra-high pressure discharge lamps, is discussed and details are given. Those interested in cathode-ray tubes will even find several pages of information on luminescent powders. In a work of this kind, covering a wide range of applications, there are bound to be certain superficialities ; the authors have avoided any serious accusation of this kind by supplying eighteen pages of detailed references to the original literature, much of it in the form of patents.

It is safe to say that no vacuum physics laboratory could do without this book, and the authors are to be congratulated on carrying out their work so well; a special word of commendation is due to the publishers who have reproduced original photographs with great clarity.—J. T. RANDALL.

Deterioration of Structures of Timber, Metal, and Concrete Exposed to the Action of Sea-Water. (Fifteenth Report of the Committee of the Institution of Civil Engineers.) Edited by S. M. Dixon and H. J. Grose. Roy. 8vo. Pp. xvi + 138, with 135 illustrations and 51 tables. 1935. London: H.M. Stationery Office. (12s. 6d. net.)

Two sections of this volume will be found of interest to non-ferrous metallurgists who are concerned with corrosion and protection, although they refer to work on ferrous materials: namely, " Corrosion of Steel and Iron " (38 pp.) and " Protection of Steel and Iron by Means of Paints and Other Preservatives " (26 pp.). In these reports, Dr. J. Newton Friend co-ordinates data obtained as a result of experiments that have been in progress for many years in different parts of the world. Corrosion experiments on steel include the examination of effects due to additions of copper, chromium, and nickel, respectively. The work on protective coatings includes galvanizing. The results obtained are well illustrated by means of tables, graphs, and photographs.—E. S. HEDGES.

A Bibliography on the Cutting of Metals. By Orlan W. Boston. Part II. Demy 8vo. Pp. 202. 1935. Ann Arbor, Mich.: Edwards Bros., Inc. ($2.25.)

This book, a bibliography on the cutting of metals, comprises 1257 references mainly for the years 1929–1934 inclusive. The volume can be regarded as the second supplementary part of the original bibliography published in 1930, and containing some 700 references. The great majority of the references are abstracted very briefly, but in an adequately informative manner.

This survey of the literature of cutting tools is not only extraordinarily comprehensive, but has very obviously been compiled with a desire for accuracy. Whilst the reviewer makes no pretence to have verified all the references, he can say that a considerable number have been checked and found accurate in text and agreeing in substance with the abstracts. .

The references are arranged chronologically and there are subject and name indexes. The book has been published privately and is reproduced photographically from typescript. The make-up has, however, in no way suffered on this account, and in fact the book is very pleasant to handle and consult.—W. D. JONES.

Wirkung von Druckvorspannungen auf die Dauerfestigkeit metallischer Werkstoffe. Von Gerhard Seeger. (Mitteilungen aus der Materialprüfungsanstalten an der Technischen Hochschule Stuttgart. DIN AS.) Demy 8vo. Pp. vi + 56, with 39 plates. 1935. Berlin: V.D.I.-Verlag G.m.b.H. (Br., R.M. 5; V.D.I.-Mitgl., R.M. 4.50.)

The author has published in this booklet a detailed account of his researches into the effects of initial compressive stressing upon the fatigue characteristics, in torsion and bending, of the following materials :—an 1Z steel, a 50·11 steel annealed and heat-treated to 70 kg./mm.^{2}, a 60·11 steel, an annealed nickel–chrome steel, cast iron, and Lautal. The test-pieces were in the form of drilled rods, a bolt being passed through the bore to apply the initial compressive stress. The effect of interfering factors such as corrosion and notching were examined.

There are fifty-seven references in the text but no indexes. The book has apparently been printed by photographic reproduction of typescript. The illustrations and photomicrographs are not well reproduced. This booklet should form a useful adjunct to the existing publications on the subject of fatigue.—W. D. JONES.

Vorspannung und Dauerhaltbarkeit von Schraubenverbindungen. Von A. Thum und F. Debus. (Mitteilungen der Materialprüfungsanstalt an der Technischen Hochschule, Darmstadt, Heft 7.) Med. 8vo. Pp. viii + 72, with 90 illustrations. 1936. Berlin: V.D.I.-Verlag G.m.b.H. (Brosch., R.M. 6.50.)

This booklet comprises an account of the researches conducted by the joint authors on the fatigue characteristics of screwed joints, pre-stressed, as in practice. Since very little information upon this subject has hitherto been published, the booklet should prove of value to engineer designers concerned with this type of work. The illustrations are excellently reproduced, and the various photographs of apparatus assist in making clear the procedures adopted in a number of somewhat complicated investigations. The bibliography contains twenty-one items and there are subject and name indexes. The booklet is well printed on good paper, although every page required cutting.—W. D. JONES.