# METALLURGICAL ABSTRACTS

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# METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

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## I.—PROPERTIES OF METALS

***Negative Resistance-Temperature Coefficient of Thin Evaporated Films of Bismuth.** T. J. Tulley (*Nature*, 1946, **157**, (3986), 372).—Thin films of bismuth were evaporated on to microscope slides (which were washed and wiped, but not otherwise cleaned) at a pressure of $10^{-3}$ mm. in a chamber to which mercury vapour from a diffusion pump had access. In all cases the film showed a negative temp. coeff. of resistance, which decreased with increasing film thickness. Numerical results are given.—G. V. R.

***The Thermal Conductivity of Bismuth at Low Temperatures.** S. Shalyt (*Zhur. Eksper. Teoret. Fiziki*, 1945, **15**, (6), 250–252).—[In Russian] See *Met. Abs.*, 1945, **12**, 205.—N. A.

***On the Thermal Conductivity of Bismuth.** A. I. Akhieser and I. Ya. Pomeranchuk (*Zhur. Eksper. Teoret. Fiziki*, 1945, **15**, (10), 387–392).—[In Russian] See *Met. Abs.*, this vol., p. 41.—N. A.

***Magnetic Self-Recovery in Cold-Worked Copper.** J. Reekie and T. S. Hutchison (*Nature*, 1946, **157**, (3998), 807–808).—Rods of high-purity copper were cold worked by drawing through hardened steel dies, giving a 20–35% reduction in area. Specimens were then maintained at various constant temp. and the magnetic susceptibility measured at regular intervals. Results, which are given graphically, show that at −180° C. no measurable change in susceptibility occurs, while at room temp. a change of 5% occurs in 100 hr. At 90° C. a change of 8% occurs in 25 hr. It is concluded that the magnetic susceptibility is strain sensitive and that the results obtained are connected with the self-recovery of the metal. No evidence of ferromagnetic impurity was obtained.—G. V. R.

**Calculation of the Elastic Constants of a Single Crystal of Copper.** I. Sal'nikov (*Zhur. Eksper. Teoret. Fiziki*, 1945, **15**, (6), 301–311).—[In Russian] A simple method is given for computing that part of the elastic const. $c_{11}$–$c_{12}$ and $c_{44}$ which is dependent on the so-called energy of overlapping. Using this method the elastic const. of a single crystal of copper are calculated. —N. A.

***Resistivity of Thin Nickel Films at Low Temperatures.** A. van Itterbeek and L. De Greve (*Nature*, 1946, **158**, (4003), 100–101).—Continuing work on the electrical resistance of thin nickel films (*Nature*, 1945, **156**, 634; *Met. Abs.*, this vol., p. 153), the resistance of such films as a function of temp. was measured down to liquid helium temp. On cooling films thicker than 40 $\mu$, the resistance passes through a reversible minimum and the temp. coeff. changes from positive to negative. The nearer the thickness approaches to 40 $\mu$, the more the minimum in the resistance curve is displaced towards higher temp. —G. V. R.

***Investigation of the Thomson–Nernst Thermomagnetic Effect in a Nickel Crystal.** R. Aniaev (*Zhur. Eksper. Teoret. Fiziki*, 1945, **15**, (11), 629–642).—[In Russian] See *Met. Abs.*, this vol., p. 242.—N. A.

***The Electrolytic Growth of a Single Crystal of Silver.** A. T. Vagramyan (*Zhur. Fiz. Khim.*, 1945, **19**, (6), 305–313).—[In Russian] In the electro-

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* Denotes a paper describing the results of original research.

† Denotes a first-class critical review.

crystallization of silver on an unpoisoned, growing portion of the cathode, the rate of the reaction is limited by the addition of material to that growing portion, while the rate of passivation is governed by the addition of passivators. —N. A.

**On the Displacement of the Critical Temperature of Supraconducting Tin by Extension.** N. Alexeevsky (*Zhur. Eksper. Teoret. Fiziki*, 1945, **15**, (6), 244–245).—[In Russian] See also *Met. Abs.*, this vol., p. 42. The relation between temp. and the change of induction and electrical conductivity of a single crystal of tin is demonstrated. On increasing the stress producing extension of the crystal, the critical temp. is also increased.—N. A.

***Dilatometric Study of Pure Zinc.** A. A. Bochvar and Z. A. Sviderskaya (*Izvest. Akad. Nauk S.S.S.R.*, **1945**, [Tekhn.], (3), 209–211).—[In Russian] An experimental study was made of the direction taken by dilatometric curves obtained during the heating of deformed single-crystal specimens of zinc. —N. A.

**Creep of Metals.** N. P. Allen (*Nature*, 1946, **157**, (3989), 469–471; see also *Engineering*, 1946, **161**, (4182), 233–235; (4183), 258–259; *Engineer*, 1946, **181**, (4701), 148–149; (4702), 170–171; and *Chem. and Ind.*, 1946, (**10**), 109).—A summary report of a conference held at the Royal Society in Feb. 1946. Papers were presented by several authors and there was a general discussion. *E. N. da C. Andrade* reviewed the general characteristics of deformation and creep of single crystals of metals, directing attention to need for working at constant stress rather than constant load. *H. J. Tapsell* referred to engineering problems necessitating long-time tests and outlined an extrapolation technique which enables use to be made of data from short-time tests. *E. Orowan* dealt with a new theoretical approach to the problem of creep and *A. McCance* proposed a mathematical approach enabling predictions to be made from short-time tests. *N. P. Allen* reviewed the influence of metallurgical structure, and the metallurgical control of creep.—G. V. R.

**Strength and Ductility.** Maxwell Gensamer (*Metal Progress*, 1946, **49**, (4), 731–734).—Twentieth Campbell Memorial Lecture. The measured mechanical properties of metals are reviewed in relation to their behaviour in service and their dependence on chemical composition and structure. Attention is primarily directed to the effect of alloying elements, present either in solid solution or as undissolved compounds, on the mechanical properties of steel, but the principles involved are of general interest. The main conclusions are: *Strength* is not sensitive to local variations in composition and structure. It is closely related to composition in solid solutions, but depends in aggregate structures on the average spacing between particles, the shape of the latter being important only in so far as it influences the mean spacing. Fine dispersions influence strength to a much greater extent than do dissolved elements. *Ductility* is much influenced by local conditions, but unless local ductility is exceptionally low, local deformation has a much greater effect on energy absorption. The distribution of deformation can most advantageously be improved by modifying the plastic properties of materials, except at high strengths where the intrinsic ductility is sufficiently low to be an important factor in failure.—P. R.

**The " Degree of Loosening " of Solids.** K. Lichtenecker (*Z. Elektrochem.*, 1942, **48**, 669–671; *C. Abs.*, 1943, **37**, 5897).—Cf. *Z. Elektrochem.*, 1943, **49**, 174; *Met. Abs.*, 1945, **12**, 242. The " degree of loosening," $\lambda$, is defined as $(Q - (E/2))/E$, where $Q$ is the integral of the heat capacity from abs. zero to the melting point and $E$ is the sum of $Q$ and the energy of fusion. For many solids, $\lambda$ is positive and is relatively large for the softer metals. The " mobility " and coeff. of self-diffusion are related qualitatively to $\lambda$.

**Analysis of the Process of Absorption of Gases by Metals. I.—Characteristics of Gas–Metal Systems.** A. D'yakonov and A. Samarin (*Izvest. Akad. Nauk S.S.S.R.*, 1945, [Tekhn.], (9), 813–820).—[In Russian] A general account.—N. A.

***On the Structure of Thin Solid Films.** Nicolas Cabrera (*Compt. rend.*, 1946, **222**, (16), 950–952).—Observations with an electron microscope revealed a discontinuous structure in thin solid metal films at room temp. For thicknesses of less than about 15 mμ, the film contained holes; thinner films consisted of independent grains. These discontinuities are due to surface tension. If $v_0$ is the volume of material per c.c. of support and this material is distended uniformly, a continuous film of thickness $h_0 = v_0$ results. The stable structure is that for which the free energy is a minimum. The expression for the free energy for the volume $v_0$ contains a term proportional to $v_0$ and always the same, and another proportional to the surface and differing from one structure to another. The equation for the energy, $E$, of the film is worked out mathematically. The determination of the surface entropy is more difficult and rests on an assumption to be discussed later. The free surface energy, $F = E - TS$, where $T$ is the temp. and $S$ the surface. There are two critical temp.: the first, $T_1$, from which the hole structure will be the more stable, the second, $T_2$, from which the grain structure will always replace the hole structure. At a certain temp., $T_0$, there will be critical thicknesses, $h_{01}$ and $h_{02}$, for which $T_0$ is equal to $T_1$ and $T_2$. Hence, for the intermediate case, $h_0 > h_{01}$, there is a continuous film; for $h_{01} > h_0 > h_{02}$, there is the hole structure; and for $h_{02} > h_0$, there is the grain structure.—J. H. W.

***Infra-Red Emissivity of Metals at High Temperatures.** D. J. Price (*Nature*, 1946, **157**, (3997), 765).—By measurement of the intensity of radiation from the inside and outside of a hollow cylindrical specimen, the emissivity of various metals was measured at 1000°–1500° C. and wave-lengths of 1·0–4·5 μ. Results show that at wave-lengths less than 0·93 μ for platinum or 1·0–1·5 μ for iron the temp. coeff. of emissivity is zero. In the far infra-red region the coeff. is equal to half the temp. coeff. of resistivity. Over a range of intermediate wave-lengths the relation between wave-length and temp. coeff. of emissivity is linear.—G. V. R.

**An Extension of the London Theory of Supraconductivity.** M. v. Laue (*Ann. Physik*, 1942, **42**, 65–83; *C. Abs.*, 1943, **37**, 5633).—Two independent mechanisms of conductivity assumed in London's theory are harmonized relativistically; certain difficulties are thus removed.

**On the Measurement of the Depth of Generation of Secondary Electrons in a Metal.** A. Kadyshevich (*Zhur. Eksper. Teoret. Fiziki*, 1945, **15**, (11), 651–654).—[In Russian] See *Met. Abs.*, this vol., p. 244.—N. A.

**Theory of Metals.** P. Gombás (*Nature*, 1946, **157**, (3994), 668–669).—Theoretical. An expression is derived for the lattice energy of a metal, which is considered statistically as a lattice of positive metal ions and a uniformly distributed electron-gas consisting of the valency electrons. From this expression the fundamental const. of the alkali metals are deduced and are in fair agreement with experiment.—G. V. R.

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## II.—PROPERTIES OF ALLOYS

***Micro-Hardness Study of the Structure of Cast Aluminium–Copper and Aluminium–Silicon Alloys.** A. A. Bochvar and O. S. Zhadaeva (*Izvest. Akad. Nauk S.S.S.R.*, 1945, [Tekhn.], (10/11), 1089–1092).—[In Russian] It is shown that the hardness of the crystals of primary solid solution in the region of the eutectic is not uniform, but depends on composition. The variation is reduced by homogenization but is not entirely eradicated.—N. A.

***On the Mechanical Properties and Corrosion-Resistance of Cold and Warm Age-Hardened Aluminium–Zinc–Magnesium–Copper Forging Alloys.** K. L. Dreyer and H. J. Seeman (*Aluminium*, 1944, **26**, (5/6), 76–82).—The mechanical properties and corrosion-resistance of six alloys of aluminium containing 0·7% manganese with : (1) zinc 3·7, magnesium 2·5, and copper 1·5, 2·0, and 2·5% ; and (2) zinc 4·5, magnesium 1·5, and copper 1·5, 2·0, and 2·5%, together with the effects thereon of various solution temp., ageing temp., and times, are shown in tables and graphs. It was established that as the values for the variable factors increase, the values for 0·2% proof stress and tensile strength increase, the max. values being obtained by solution-treatment at 500° C. for 30 min., followed by water-quenching and ageing at 50°–100° C. for 10–90 days, when the 0·2% proof stress becomes 25–30 kg./sq. mm. and the tensile strength becomes 45–50 kg./sq. mm., the corresponding figures for the quenched alloys being 12–15 kg./sq. mm. and 30–35 kg./sq. mm., respectively. When unpolished and polished sheets of the alloys were exposed to a 3% salt solution for 0–120 days (*a*) polished sheets corroded less than unpolished sheets; (*b*) both series of alloys had almost equal layer-corrosion-resistance ; and (*c*) the second series of alloys had superior stress-corrosion-resistance, although the resistance decreased with increase of copper content, solution temp., ageing temp., and time. The best alloy is that with zinc 4·5, magnesium 1·5, copper 1·5, and manganese 0·7%.—E. N.

***The Relationship Between the Working Properties and Final Rolling Reduction Before Annealing of Sheets of Duralumin-Type Alloys Containing 3% and 4% of Copper, Made from Chill- and Continuously Cast Billets.** Hans Hartmann (*Aluminium*, 1944, **26**, (5/6), 84–88).—Chill-cast and continuously cast billets of Duralumin-type alloys containing 3 and 4% copper were cold rolled, annealed, subjected to further rolling reductions of 10–70%, and re-annealed, after which their grain structure and deep-drawing and stretching properties were studied. Heavy rolling reductions produced coarse grains on annealing, causing a decrease in the working properties of the alloy and this tendency was more pronounced (*a*) with the chill-cast metal, and (*b*) with the alloy containing 4% of copper. To obtain the best material the final rolling reduction should be in the region of 30%.—E. N.

***Metallurgical Requirements for the Production of Corrosion-Resisting High-Strength Sheets of Aluminium–Zinc–Magnesium Alloys.** W. Patterson (*Metallwirtschaft*, 1944, **23**, (18/21), 161–173).—An extensive study was made of the influence of the degree of cold work, heat-treatment, and additions of up to 0·3% of beryllium, cerium, chromium, thorium, titanium, vanadium, and zirconium ("stabilizers") on the mechanical, recrystallization, and corrosion-resistance properties of aluminium alloys with up to 0·5% of manganese and $<$ 8% of zinc plus magnesium. The stabilizers broaden the recrystallization range and displace it to higher temp. ; diffusion takes place more slowly and precipitation at the grain boundaries is hindered. These are factors which increase the resistance of the alloys to layer- and stress-corrosion, the optimum conditions being obtained with additions of 0·3% chromium or 0·1% vanadium, a final rolling reduction of 50–75%, and a solution-treatment at 470°–530° C. for 20–30 min., followed by quenching and warm ageing at 110°–120° C. for 4 hr. The additions, however, produce alloys of inferior working qualities; such alloys are sensitive to the presence of iron, are subject to cracking when continuously cast, are liable to burst when hot rolled, and have a tendency to coarse-grain formation on annealing after heavy rolling reductions. The mechanical properties of the resulting alloys are inferior to those of the straight aluminium–magnesium–zinc series ; the tensile strength and 0·2% proof strength are reduced, the elongation increased, and, unless recrystallization is fully completed, the resulting heterogeneous structure has not only variable mechanical properties but is more susceptible to stress-corrosion. It is concluded that in alloys of this type a combination of high mechanical and corrosion-resistance properties is not fully compatible.—E. N.

**Aluminium Alloys 2S, 3S, and 52S (Wrought, Non-Heat-Treatable Types).** —— (*Machine Design*, 1944, **16**, (7), 149–153).—A comprehensive review of the properties of three commercial aluminium alloys giving tables showing mechanical and physical properties of the material in various degrees of hardness, nominal compositions, high-temperature properties, effect of drawing on mechanical properties, commercial tolerances for sheet, plate, wire, rod, and bar, official designations, accounts of welding properties, corrodibility, and recommendations for piercing and riveting.—P. R.

***Control of Shrinkage Porosity and Mechanical Properties in Chill-Cast Phosphor-Bronzes, Leaded Bronzes, and Gun-Metals.** W. T. Pell-Walpole (*Metallurgia*, 1946, **34**, (200), 85–90; (201), 155–161).—The variables in the chill-casting process which affect the extension and distribution of shrinkage porosity were examined for phosphor-bronzes, gun-metals, and leaded bronzes. The rate of pouring is the most important factor and freedom from the most harmful types of shrinkage porosity is obtained when the rate is the lowest at which the mould will fill without cold shuts. This critical rate is related to the shape and size of the ingot by the formula $R = KP$, where $R$ is the pouring rate, $P$ is the periphery of the ingot cross-section (or, in the case of cored sticks, the sum of the peripheries of mould and core), and $K$ is a const. which, for constant mould conditions and pouring temp., depends on the alloy composition. Values of $K$ were determined for all standard bronze compositions. The mechanical properties of these bronzes vary, in general, with casting conditions in the same manner as density—*i.e.* optimum values are obtained uniformly across the section when the pouring rate is the minimum which will fill the mould without cold shuts. Slight variations in properties are also produced by the effect of pouring and mould temp. on the distribution of the brittle compound phases.—J. W. D.

***Welded Magnesium Alloys and Their Alternating Tension–Compression Fatigue Strength.** A. Thum and R. Zoege von Manteuffel (*Metallwirtschaft*, 1944, **23**, (22/26), 215–220).—A study was made of the static tensile properties and alternating tension–compression fatigue strength of unwelded and welded test-pieces of alloys of magnesium with (*a*) aluminium 3·18, manganese 0·40, and zinc 0·90%; (*b*) aluminium 6·70, manganese 0·19, and zinc 0·70%; and (*c*) manganese 1·93%. After welding, the static and fatigue properties of alloy (*a*) were slightly superior to those of (*b*), while both (*a*) and (*b*) had properties greatly superior to those of (*c*). For example, the fatigue strength of alloy (*a*) after $50 \times 10^6$ cycles was ±4·2 kg./sq. mm. (unwelded ±7·6 kg./sq. mm.), while that of (*c*) was ±2·6 kg./sq. mm. (unwelded ±4·6 kg./sq. mm.). Examination of the weld structure showed that (i) microporosity was present in all cases; (ii) the failure of alloy (*c*) was explained by the coarse, dendritic crystal formation which had taken place in the weld seam. It is concluded that steel is not replaceable by light alloys when alternating tension–compression fatigue stresses have to be endured.—E. N.

**The Structure of Nickel–Aluminium Magnet Alloys and the Control of Brittleness.** Alan Torry (*Metallurgia*, 1946, **34**, (201), 147–153).—After an historical survey of the progress in explaining the cause of high coercivity in the ternary alloys of nickel, iron, and aluminium, an attempt is made to show how the factors responsible for coercivity are also associated with a weak intergranular structure. It is suggested that excessive brittleness in these alloys may be directly attributed to the differences in the rates of contraction or expansion of the phases already present or being precipitated. A study of the thermal dilatation of Alni, Alnico, and Alcomax alloys of varying compositions revealed the magnitude of the influence of such elements as aluminium, copper, and titanium in causing departure from uniform expansion or contraction, both after casting and in subsequent heat-treatments. By controlling the relative proportions of all the elements present, with improved knowledge of their separate effects on the magnetic characteristics, heat-treatment, and dilatation behaviour, economic production has been improved and mechanical stability obtained without sacrifice of magnetic performance.—J. W. D.

**Inconel, Wrought and Cast.** —— (*Machine Design*, 1944, **16**, (8), 113–116).—The mechanical properties of Inconel in various conditions of work and heat-treatment are tabulated, together with information on creep strength of hot-rolled rod, high-temperature and low-temperature properties, physical const., fabrication (machinability, drilling, reaming, tapping, perforating, &c.), corrosion-resistance, annealing, tolerances for cold-rolled sheet and for hot-rolled rods and flats, and designations.—P. R.

***The System Platinum–Mercury.** I. N. Plaksin and N. A. Suvorovskaya (*Izvest. Sekt. Platiny*, 1945, **18**, 67–76).—[In Russian] Cf. *Met. Abs.*, 1941, **8**, 225, 298. Thermal, X-ray, and micrographic analyses were carried out and the solubility of mercury in platinum studied up to 200° C. The results reveal the existence of a solid solution of mercury in platinum up to 23 at.-% and three intermetallic compounds : β (73–76 at.-% platinum), γ (60–70 at.-% platinum), and δ (45–55 at.-% platinum). These compounds melt congruently at 485·1°, 236°, and 159·1° C. They correspond to $Pt_3Hg$, $Pt_2Hg$, and PtHg. —N. A.

***The Phenomenon of Super-Plasticity in Zinc–Aluminium Alloys.** A. A. Bochvar and Z. A. Sviderskaya (*Izvest. Akad. Nauk S.S.S.R.*, 1945, [Tekhn.], (9), 821–824).—[In Russian] On heating above 100° C., alloys of zinc with 20% aluminium show an unusual reduction in hardness and increase in plasticity. The hardness of pure zinc and aluminium at 300° C. is approx. 10 kg./sq. mm., whereas the hardness of the alloy of zinc with 20% aluminium is only 0·6–1·0 kg./sq. mm. at that temperature.—N. A.

***Contribution to the Question of Changes in Materials Under Fatigue Stress. [Brass, Aluminium, Duralumin, Nickel–Chromium–Iron Alloy, Steels.]** A. Karius (*Metallwirtschaft*, 1944, **23**, (48/52), 419–434).—Experiments were carried out on specimens of brass, aluminium, Duralumin, iron–19% nickel–25% chromium alloy, and various steels to determine the influence of fatigue stress on the elastic modulus and damping capacity. Plain and notched test-pieces were subjected to alternating-bend tests in a Schenck fatigue-testing machine and, after various numbers of cycles, the alterations in damping capacity and elastic modulus were determined in a Förster machine. It was shown that with all polycrystalline materials changes due to fatigue are of a similar nature and follow a similar course throughout the test. Initially there is a sharp increase in damping capacity and a corresponding decrease in elastic modulus due to cold working ; these effects almost vanish with a slight increase in stress and duration of test but recur, as a result of the formation of macroscopic cracks, shortly before the onset of fracture. The initial changes are dependent on the volume of stressed material in the specimen and are not limited to the points at which subsequent failure takes place ; changes in properties just before fracture are independent of the volume. Notched specimens exhibit only slight changes in properties ; no volume effect occurs as cracks are formed in the region of the notch. Preliminary static or dynamic stressing causes a reduction in damping and modulus changes by fatigue testing, but high preliminary stressing brings about a reversal of this effect. The initial changes occurring in fatigue testing are partly eliminated by resting at room temp. and are completely removed by heat-treatment at 150° C., showing that such changes are the result of lattice displacement and not plastic deformation, the low-temp. annealing relieving the internal stresses set up. In the case of individual crystals, submicroscopic cracks are only eliminated by heating above the recrystallization point.—E. N.

***On the Temperature Curve of the Commencement of Linear Contraction in Binary Alloys.** A. A. Bochvar and V. I. Dobatkin (*Izvest. Akad. Nauk S.S.S.R.*, 1945, [Tekhn.], (1/2), 3–6).—[In Russian] The curve denoting the commencement of linear contraction in a series of alloys divides the two-phase region between the liquidus and the solidus into two parts: (i) the upper, consisting of liquid with traces of the solid phase, and (ii) the lower, consisting of solid with isolated inclusions of the liquid phase. An apparatus is described with which this curve can be determined and with which experiments were carried out on alloys of the magnesium–aluminium and aluminium–silicon systems. The results are correlated with the microstructures.—N. A.

## III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

[For all abstracts on the constitution of alloy systems, including X-ray studies, see II.—Properties of Alloys.]

**Distinguishing the Common Aluminium Alloys.** Vernon H. Patterson (*Metal Progress*, 1946, **49**, (2), 346–347).—Brief note. Common wrought aluminium alloys are classified into three groups, which contain (i) copper 4% or more; (ii) neither copper nor chromium; and (iii) chromium 0·25%. The groups may be distinguished by the blackening of (i) in warm NaOH solution (removable by nitric acid) and the golden colour produced in (iii) by anodizing. Methods of separation within the groups are briefly described.—P. R.

**Fractography.** J. E. Hurst and R. V. Riley (*Metal Progress*, 1946, **49**, (1), 96–97).—It has been claimed by Zapffe and Clogg (*Trans. Amer. Soc. Metals*, 1945, **34**, 108–141; *Met. Abs.*, 1945, **12**, 80) that the study of cleavage facets on fractured metals ("fractography") reveals unusual structures which may throw light on molecular structure, internal stresses, &c. It is pointed out that certain alloys with a tendency to form surface films, *e.g.* the high-silicon-iron alloys, may show misleading structures which should not be accepted as confirming the results of "fractographic" examination. The method is considered most suitable for the examination of hard, brittle alloys.—P. R.

**Estimation of Spatial Grain-Size.** William A. Johnson (*Metal Progress*, 1946, **49**, (1), 87–92).—A plea is made for the estimation of grain-size in terms of spatial size instead of by observations on plane surfaces. J. points out that even if the spatial grain-size is nearly constant not more than half the grains cut by such planes will come within the range covered by a single grain-size number (A.S.T.M. specification). An account is given of a method developed by E. Scheil for correlating "planar" with "spatial" grain-sizes. The relative area of each size of the grains shown on a micrograph is estimated and from this the relative (statistical) distribution of spatial grains is calculated by means of an expression based on the A.S.T.M. definition of grain-size numbers. The average size of "spatial" grains is then computed from the percentage by volume of the different sizes and the standard deviation is determined in order to give a measure of size uniformity. The procedure is described in detail.—P. R.

**Rapid Estimation of Grain-Size in Magnesium Castings.** J. P. Ogilvie (*Metal Progress*, 1946, **49**, (2), 349).—Brief note. A simplified method of preparing magnesium castings for grain-size determination consists in polishing on emery, wax lap, and "gamal" lap, and etching with 10% tartaric acid solution. This obviates the usual need for solution heat-treatment.—P. R.

**Preparation of Micro-Specimens [of Magnesium Alloys] by Strong Etchants.** E. M. Savitsky (*Zavod. Lab.*, 1945, **11**, (2/3), 192–194).—[In Russian] Micro-specimens of magnesium and its alloys are prepared by grinding on coarse grades of emery paper and then immersing in two etchants, the first of which removes loose particles and the deformed surface layer while the second reveals the grain boundaries. The compositions of the etching reagents are given. —N. A.

**Electropolish-Attack: a New Metallographic Technique.** L. Ya. Popilov (*Zavod. Lab.*, 1945, 11, (1), 60–71).—[In Russian] A review of the method and of P.'s experiments.—N. A.

***X-Ray Examination of Self-Recovery in Metals.** L. L. van Reijen (*Nature*, 1946, **157**, (3986), 371).—The recovery of copper filings has been demonstrated by comparison of X-ray photographs obtained at an interval of some months. Only two low-angle rings were recorded on a film placed behind the specimen. The second photograph, however, showed many distinct spots on the reflection rings, indicating the occurrence of a number of relatively large crystallites. Several aspects of the X-ray study of self-recovery are discussed.—G. V. R.

**Electron Microscopy.** V. N. Vertsner (*Zavod. Lab.*, 1945, **11**, (6), 543–554).—[In Russian] A review.—N. A.

**X-Ray Methods for the Determination of the Lattice Type and Dimensions of Sub-Microscopic Crystals.** G. S. Zhdanov (*Zavod. Lab.*, 1940, 9, (5/6), 566–571; (7), 732–740).—[In Russian] A review.—N. A.

**Electron Microscopy in Metallography.** B. A. Ostroumov (*Zavod. Lab.*, 1945, **11**, (6), 554–561).—[In Russian] A review.—N. A.

**Methods for the Precision Determination of the Lattice Dimensions of Polycrystalline Specimens.** A. Kh. Breger (*Zavod. Lab.*, 1940, 9, (1), 55–63).—[In Russian] A review.—N. A.

## V.—POWDER METALLURGY

**Powder, Pressure, and Heat.** —— (*Fortune*, 1942, **25**, (1), 44–47, 120).—A review of powder metallurgy.

***Appraisal of Aluminium Powder for Paint Pigments.** H. C. J. de Decker (*Verfkroniek*, 1942, **15**, 24–29, 39–42; *Chem. Zentr.*, 1942, **113**, (II), 1407; *C. Abs.*, 1943, 37, 6143).—Six different samples of aluminium powder were tested for quality and dispersibility (reflecting power). For a normal spatula sample, a mixture of 80 g. of linseed oil stand oil (viscosity 60 centipoises at 20° C., $d = 0{\cdot}976$, $n = 1{\cdot}4912$, acid no. = 12·2) and 95 g. of benzine lacquer is placed in a Pyrex glass cylinder (1·8 × 19 cm.) so that it contains 25 c.c. of this mixture per 10 cm. fluid height. To this is added 2 g. of aluminium powder; the Pyrex cylinder is closed with a cork and shaken for 5 min. at 4 turns per second. A spatula is immersed in the colour so that it is covered up to a height of 10 cm. The time of withdrawal and shaking off of free material adhering to the spatula up to periods of 2 min. is determined with a stop watch. After 2 min. both sides of the spatula are observed, and reflection intensity and total colour intensity are read in mm. upon a line. The dispersibility or reflecting power of aluminium powder corresponds to the average reflection intensity in % of the total colour intensity. The spatula test can be used for determination of the dispersibility of aluminium bronzes.

**The Leafing Properties of Aluminium Bronze Powders.** H. Th. Mayer (*Farben-Chem.*, 1942, **13**, (5), 83–85).

**Sintered Powders for Electrical Contacts.** Heinz H. Hauser (*Bull. Assoc. Suisse Elect.*, 1942, **33**, 29–34; and (translation) *Engineering*, 1946, **161**, (4180), 188–190).—Theoretical aspects of arcing are discussed and the properties required of materials able satisfactorily to withstand this phenomenon are considered with reference to sintered materials such as molybdenum–silver, tungsten–silver, and tungsten–copper.—R. Gr.

## VI.—CORROSION AND RELATED PHENOMENA

***On the Corrosion-Resistance After Cold and Warm Age-Hardening of Sheets of Aluminium-Copper-Magnesium Alloys with Various Clad Coatings.** W. Bungardt (*Metallwirtschaft*, 1944, **23**, (22/26), 221–227).—A study was made of the corrosion-resistance of Duralumin after cladding with pure aluminium, aluminium–manganese, and aluminium–magnesium–silicon–manganese alloys. The specimens were solution-treated at 500° C., cold and warm (160° C.) aged for varying periods, immersed in a stirred aqueous solution of 3% sodium chloride and 0·1% hydrogen peroxide, and the coatings compared by measurements of tensile strength, elongation, and rate of diffusion of copper into the coating. Solution-treatment at 500° C. for 30 min. followed by cold ageing for 3 hr. gives materials which have the best corrosion-resistance. After artificial ageing, coatings of pure aluminium, which allow copper to diffuse rapidly into them, give the least protection. The two alloy coatings are of approx. equal value. Although the aluminium–magnesium–silicon–manganese alloy is liable to intercrystalline corrosion, this has no deleterious effect on the resistance of the clad sheet.—E. N.

***Metallurgical Requirements for the Production of Corrosion-Resisting High-Strength Sheets of Aluminium–Zinc–Magnesium Alloys.** (Patterson). See p. 316.

***On the Mechanical Properties and Corrosion-Resistance of Cold and Warm Age-Hardened Aluminium–Zinc–Magnesium–Copper Forging Alloys.** (Dreyer and Seeman). See p. 316.

***Attack of Various Superheated Steam Atmospheres Upon Aluminium-Bronze Alloys.** A. P. C. Hallowes and E. Voce (*Metallurgia*, 1946, **34**, (201), 119–122).—Based on part of a report to the British Non-Ferrous Metals Research Association. The action of superheated steam on complex aluminium-brasses was studied as a result of some failures of these alloys when used industrially in certain superheated-steam atmospheres under service conditions involving stress. Pure steam was found to be harmless. Prolonged exposure to an atmosphere of steam contaminated with a small amount of sulphur dioxide produced attack in the surface layers of aluminium bronzes at elevated temp. Preferential oxidation of aluminium to alumina occurred and the oxide remained embedded in a copper-rich matrix. A volume increase of more than 9%, leading to rupture of the surface layers, accompanied the reaction. The attack was more severe at higher temp. and with higher concentrations of the contaminating agent in steam, also when the aluminium content of the alloy was increased. Attack of the same nature was obtained by using chlorine as the contaminating agent in steam. Specimens of 60 : 40 brass in the as-cast condition were not attacked after similar treatment but, in certain conditions, cast tin bronze was subjected to localized attack, after which stannic oxide was found to be embedded in a copper-coloured matrix.—J. W. D.

***Electrochemical Investigation of the Corrosion of Metals [Iron, Lead] in Acid Media in the Presence of Oxidizing Agents.** I. Oknin (*Zhur. Priklad. Khim.*, 1945, **13**, (9/10), 494–504).—[In Russian] An electrochemical study was made of the corrosion of iron and lead in acid media containing oxidizing agents. Factors studied were the rate of corrosion, the potential of the corroding metal, the potential of a platinum cathode as a function of cathode c.d., the electrical conductivity of the systems platinum–medium–platinum and corroding metal–medium–corroding metal, and the hydrogen-ion concentration. It is shown that the rate of corrosion of the metal is determined by the magnitude of its potential during corrosion. A theoretical survey of the problem is made.—N. A.

***Study of A.C. Sheath Currents and Their Effect on Lead Cable Sheath Corrosion.** C. M. Sherer and K. J. Granbois (*Elect. Eng.*, 1945, 64, (5), 264–268).—Two cases of A.C. electrolysis are discussed, in which the lead sheaths on single-conductor power cables were corroded through. Field observations and laboratory tests are described which show that at first the corrosive action was accelerated by rectified alternating currents which were induced in the sheaths by the load current. Several corrosion-prevention methods are given. —E. V. W.

**Further Data on Corrosion-Test Equipment. [Corrosion of Galvanized Pipe by Water.]** Wm. B. Schworm (*J. Missouri Water Sewerage Conf.*, 1943, 14, (3), 26; *C. Abs.*, 1943, 37, 6780).—Water having carbonate alkalinity corrodes galvanized pipe, to give a basic zinc carbonate.

**Selecting Materials for Corrosion-Resistance.** L. G. van de Bogart (*Machine Design*, 1945, 17, (3), 165–168).—A chart is given comparing the resistance of iron and steel, Ni-resist, 18-8 stainless steel, Monel metal, nickel, red brass, acid-resisting bronze, and aluminium to corrosive attack by a large number of materials, the concentration and approx. degree of purity being indicated in each case. Special precautions to be taken and recommendations regarding use are appended in some instances.—P. R.

**On the Stress-Corrosion of Metals.** A. Beerwald (*Metallwirtschaft*, 1944, 23, (18/21), 174–187).—Methods of determining the stress-corrosion properties of materials are illustrated, and their application to the testing of steels, non-ferrous alloys of aluminium, copper, magnesium, nickel, zinc, and the precious metals are described. Existing knowledge of the nature and incidence of stress-corrosion is reviewed, together with its relationship to (1) other mechanical properties, especially hardness; and (2) the crystal state. Trans- and intercrystalline stress-corrosion are referred to and illustrated by photomicrographs.—E. N.

***Galvanic Corrosiveness of Soil Waters.** Howard S. Phelps and Frank Kahn (*Elect. Eng.*, 1945, **64**, (4), 156–159).—Describes a study of the relation of $p$H of soil waters to galvanic action between couples of lead, copper, iron, and carbon.—E. V. W.

***Crack-Heal Mechanism of the Growth of Invisible Films on Metals.** U. R. Evans (*Nature*, 1946, **157**, (3996), 732).—The invisible films formed on unheated iron exposed to air were studied by using a sodium-carbonate–bicarbonate buffer solution to reveal major discontinuities as rust spots. Specimens were exposed alternately in air and in this solution and records of the discontinuities taken between each exposure. Records were taken by placing filter paper moistened with the buffer solution in contact with the specimens and developing by conversion of the rust spots to Prussian Blue. Results obtained show that the primary effect of air-exposure is to heal existing pores and the secondary effect is to introduce new ones, owing to strains introduced on oxidation. In addition to chemical blockage, produced by oxidation at the base of an already existing pore, mechanical blockage may occur anywhere in a pore. The chance of mechanical blockage increases with film thickness, leading to a decrease in the rate of oxidation. The logarithmic film-thickening law may be explained by these considerations.—G. V. R.

**Hydrogen Overvoltage as a Factor in the Corrosion of Metallic Couples.** T. P. Hoar (*Nature*, 1946, **157**, (3987), 408–409).—The results reported by Le Brocq and Cocks (*Nature*, 1945, **156**, 536; *Met. Abs.*, this vol., p. 172) are interpreted in terms of potential/current diagrams. The usefulness of such constructions is pointed out.—G. V. R.

**Apparatus for the Determination of Corrosion Losses by the Method of Hydrogen Evolution.** E. I. Gurovich (*Zavod. Lab.*, 1940, 9, (4), 484).—[In Russian] Descriptive.—N. A.

## VII.—PROTECTION

(Other than by Electrodeposition.)

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**Anodizing Aluminium (Theory and Application).** Gilbert C. Close (*Indust. Finishing*, 1945, **21**, (4), 42, 44, 46, 48, 52, 53).—C. briefly reviews the nature of the anodizing process and gives a short account of the coating produced. A tabulated summary is given of the usual electrolytes, concentrations, c.d., duration of treatment, solution temp., rinsing required, thickness and continuity of film, and suitable materials for the equipment required in the Alumilite and chromic acid processes. Many of these data are also considered in detail. —P. R.

***On the Corrosion-Resistance After Cold and Warm Age-Hardening of Sheets of Aluminium–Copper–Magnesium Alloys with Various Clad Coatings.** (Bungardt). See p. 321.

**Finishing Aluminium with Paint Coatings [—II].** Robert I. Wray (*Indust. Finishing*, 1945, **21**, (3), 66, 69, 70, 72, 74, 76).—See also *Met. Abs.*, this vol., p. 173. The choice of primers depends on the purpose of the part and on its conditions of use: synthetic resin coatings are suitable for decorative work, pigmented alkyd-base primers for domestic equipment, alkali-resistant phenolic-base primers for washing machinery, and zinc chromate-synthetic resin mixtures for parts likely to be exposed to industrial atmospheres. Other pigments used in primers include strontium and calcium chromates, zinc tetroxychromate, ammonium ferrous phosphate, and a mixture of zinc dust and aluminium powder (in linseed oil). Primers are recommended for different classes of work, with special reference to aluminium and its alloys. Coatings for high corrosion-resistance should preferably be non-pigmented. Special precautions are indicated to obviate corrosion at joints between dissimilar metals.—P. R.

**Chromium Plating by Diffusion—a New Process.** Walter Eckardt (*Z. Metall- u. Schmuckwaren-Fabrik. Verchrom.*, 1942, **23**, 152; *Chem. Zentr.*, 1942, **113**, (II), 456; *C. Abs.*, 1943, **37**, 6630).—$CrCl_3$ is precipitated on ceramic material and the articles to be plated are packed in the ceramic material and heated to 950° C. The $CrCl_3$ is decomposed and chromium diffuses into the metal. High carbon content of iron hinders the diffusion of chromium.

***One-Sided Tinning of Sheet Iron.** I. S. Vylegzhanin (*Vestn. Inzhen. Tekhn.*, **1941**, 45–46; *Chem. Zentr.*, 1942, **113**, (I), 924–925; *C. Abs.*, 1943, **37**, 6631).—In order to conserve tin, tests were made of a bilateral, electrolytic method of tinning sheet iron by the use of alkaline baths and cloth-covered tin anodes. Non-porous, matte tin coats (0·18 g./100 sq. cm.) were obtained that were spotty and unsatisfactory. In one-sided hot tinning (the other side being covered with synthetic-resin lacquer), the flux adheres to the lacquered side of the sheet. Diminished roll velocities cause greater burning of the tin, so that there is no saving of tin in spite of the thinner coats. Velocities of 10–14 r.p.m. for a bilateral hot tinning gave good results (0·3–0·45 and as little as 0·2 g. of tin/100 sq. cm. of sheet iron). When two iron sheets, welded together at the edges, were hot tinned, the enclosed air expanded on heating and caused the sheets to bulge. A special welding machine is described. The product, however, is well suited for the manufacture of tin cans for food. Coatings of lacquer are also helpful. Soldering tests with tin–lead solder and alcoholic rosin solutions were unsuccessful; this alloy can be used successfully only with $ZnCl_2$. Experiments made to replace HCl by AcOH likewise gave unsatisfactory results; however, AcOH can be used in alcoholic solution for soldering.

**On the Tendency for Spangle Formation in Galvanizing.** —— (*Chem.-Zeit.*, 1944, **68**, (6), 108–109).—Lead and iron are both detrimental to the working of the bath. Tin, up to about 1·5%, produces white, feathery crystals, but quantities in excess of this give large spangles; it tends to counteract the effects of lead and iron, but reduces the corrosion-resistance of the coating. 0·1–0·5% cadmium improves ductility. Antimony gives small crystals with a bluish sheen and reduces the corrosion-resistance and adherence of the coating, which can be overcome, to some extent, by the addition of <0·001% aluminium. These facts hold good for bath temp. of 450°–475° C., but as the temp. increases the crystal size decreases until at 510°–520° C. no spangle formation occurs. The spangle size and adherence of the coating are also influenced by (1) initial temp. and surface cleanliness of the material being coated; (2) time of immersion; (3) the interval between galvanizing and quenching; and (4) rate of quenching.—E. N.

***The Formation of Dross in Hot-Dip Galvanizing.** Phillip M. Fisk and F. F. Pollak (*Sheet Metal Ind.*, 1946, **23**, (227), 490–492, 494).—Results are given of a study of the effect of the pickling operation, using hot sulphuric and hydrochloric acids, on the formation of dross in galvanizing. Variables considered included metal surface condition, type of acid, quantity of iron in the pickling solution, and variables in the washing tank.—R. Gr.

***The Magnitude of the Protection from Corrosion Afforded Zinc by Amalgamation.** C. Drotschmann (*Batterien*, 1940, **9**, 36–37; *Chem. Zentr.*, 1941, **112**, (I), 2007; *C. Abs.*, 1943, **37**, 5359).—Samples of a standard commercial sheet zinc 0·33 mm. thick, and of zinc strip 0·25 mm. thick, were amalgamated in a boiling solution of 100 g. $NH_4Cl$, 10 c.c. 3·5% HCl, and 0·17 g. $HgCl_2$ in 1000 c.c. water. These specimens and untreated specimens were exposed to the action of 3·5% HCl. The decrease in thickness of the amalgamated sheet zinc was 0·03 mm. after 24 hr. in the acid; that of the untreated sheet zinc was 0·23 mm. for 3 hr. treatment in the acid. Neither the amalgamated nor the untreated zinc strip showed any reduction in thickness.

**Protection by Zinc and Surface Coatings.** K. Voss (*Werkstatt u. Betrieb*, 1942, **75**, 112–116; *Chem. Zentr.*, 1942, **113**, (II), 1174; *C. Abs.*, 1943, **37**, 5359).—A review of established uses of varnishing, galvanizing, dipping, and electrolytic oxidation.

**Metallizing as a Method of Waterworks Maintenance.** C. E. Palmer (*Water and Sewage*, 1943, **80**, (12), 20, 45; **81**, (1), 16–18, 36–37; *C. Abs.*, 1943, **37**, 6780).—A description of the plant at Erie, Pa., U.S.A. All steelwork is now metallized with zinc for protection against corrosion.

**Protective and Decorative Coatings for Metals.** A. F. Brockington (*Sheet Metal Ind.*, 1946, **23**, (231), 1355–1362).—After a brief historical review, a general review is given of the use of paint, enamel, metals, and other substances to protect and decorate articles. Reference is made to the many various methods. Electrodeposition of metals is dealt with in more detail.—R. Gr.

## VIII.—ELECTRODEPOSITION

**Practical Experiences with Hard Chromium-Plated Cutting Tools.** N. N. Sawin (*Maschinenbau*, 1942, **21**, 11–14; *Chem. Zentr.*, 1942, **113**, (II), 1174; *C. Abs.*, 1943, **37**, 5659).—Hard chromium plate increased tool life three- to eight-fold; the use of chromium on cutting tools is limited to a tool operating temperature of 600° C. and is governed by chip pressure. The life of high-speed steel twist drills, 10–24-mm. dia., in cutting steel having a tensile strength of 57,000–85,000 lb./sq. in., was increased four-fold. Improvements with reaming and lathe tools were limited to certain applications. Tool life increases with chromium thickness up to 15 μ, and decreases with thicker deposits.

**Chromium-Plating Practice in the Facing of Press Dies.** E. A. Ollard and E. B. Smith (*Sheet Metal Ind.*, 1946, **23**, (230), 1129–1141, 1159).—The advantages of chromium plating press dies and the technical difficulties of carrying out the operation satisfactorily are given. The dies should be within certain limits of hardness, pickled and demagnetized if necessary before plating. Practical details of the plating operation applied to materials of various compositions and shapes are described.—R. Gr.

**On a Method for the Study of the Mechanical Properties of Chromium Coatings.** F. F. Vitman and N. N. Davidenkov (*Zavod. Lab.*, 1945, **11**, (9), 844–852).—[In Russian] Describes a method for the determination of the normal elastic modulus of chromium in coatings, the elastic limit in tension, the adhesion of the coatings to the basis metal, and their resistance to cutting action.—N. A.

**Developments in Brass Plating.** A. Pollack (*Chem.-Zeit.*, 1944, **68**, (10), 191–192).—A review of developments in brass plating during the past 10 years. The composition of typical rapid-plating baths and their operating conditions are described. White brass deposits of high zinc content may be obtained by increasing the zinc cyanide content and *p*H value of the bath. By suitable additions of polyvinyl alcohol, piperonal, and molybdic oxide, polished surfaces are produced which are hard, free from porosity, tarnish-resisting, and which will protect iron from rusting. The use of brass as an intermediate deposit between chromium and nickel, as well as between chromium and steel, is discussed.—E. N.

**Porosity Formation in Nickel Plating and Its Removal.** Edmund R. Thews (*Chem.-Zeit.*, 1944, **68**, (9), 159–162).—Pits and dimples in nickel plating are due to the formation of hydrogen bubbles at the cathode and the presence of foreign matter in the solution. As the working period of the bath increases, the density and surface tension of the solution increase while the viscosity decreases, these being factors which favour the adherence and prevent the dispersal of the gas bubbles. They can be overcome by making the following adjustments to the electrolyte: (1) keeping it agitated; (2) adding water at intervals, so that the density is kept constant; (3) increasing the temp., and working at 20°–65° C.; (4) decreasing the c.d.; (5) increasing the acid content, so that the *p*H value is 2·6–3·5; and (6) decreasing the surface tension. Foreign matter can be excluded from the bath by making additions of oxidizing agents and removing organic chemicals, sulphur, iron, &c., by continuous filtration or treatment with charcoal; the colloids can be stabilized by introducing sodium or potassium salts. In these conditions porosity and dimpling practically vanish.—E. N.

**The Uses of Palladium and Platinum for Electrodeposits.** M. A. Klochko and Z. S. Medvedeva (*Izvest. Sekt. Platiny*, 1943, **19**, 103–118).—[In Russian] A review.—N. A.

***Thickness Measurement of Thin Coatings by X-Ray Absorption.** H. Friedman and L. S. Birks (*Rev. Sci. Instruments*, 1946, **17**, (3), 99–101).—The thickness of metal or pigment films ($10^{-5}$–$10^{-2}$ cm. thick) on a fine-grained polycrystalline metallic base may be determined by measuring, with a Geiger counter, the intensity of an X-ray beam reflected at a Bragg diffraction angle from the base and observing the absorption due to the double transmission through the coating. When the grain-size of the base is large, it may be necessary to oscillate the specimen, thereby increasing the number of crystallites irradiated. The application of the method to the determination of the thickness of silver electrodeposits on brass is outlined. The accuracy of the method may be checked by measuring the thickness of metal foils mounted in contact with a copper backing.—J. C. C.

**Chemical Control of the Thickness of Tin Coatings.** M. I. Zibel'farb and L. M. Shteinberg (*Zavod. Lab.*, 1945, **11**, (11/12), 1042–1046).—[In Russian]

Five methods were examined. The most convenient for coatings on copper and brass appears to be removal with HCl (1·16). Solutions are suggested for use in the drop and jet methods.—N. A.

**Production Plating of Zinc Die-Castings.** Herbert Chase (*Iron Age*, 1946, 157, (22), 34–38).—The bright copper–nickel–chromium plating of zinc die-castings on a high production basis is outlined, the types of solution, current densities, and conveying arrangements being described in detail.—J. H. W.

**Choice of Plated Coatings.** H. L. Farber (*Metal Progress*, 1946, 49, (4), 754).—Factors in the cost of plated coatings include, in addition to the price of the coating material, the need for preliminary treatment of the basis metal, labour and chemicals used in plating, nature of basis metal as it affects plating costs, and range of equipment required to produce a given finish.—P. R.

**Methods for the Removal and Recovery of Electrodeposited Coatings.** Edmund R. Thews (*Chem.-Zeit.*, 1944, 68, (11), 205–210).—A survey of the chemical and electrolytic methods in use for the removal of deposits of chromium, nickel, copper, zinc, cadmium, tin, silver, and gold from commonly occurring basis metals. The composition and working details of baths are given, attention being directed to the necessity or otherwise for reclamation of the article being stripped.—E. N.

## IX.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

**The Potential $Cu/Cu^{\cdot\cdot}$ in Concentrated Copper Sulphate Solutions at Different Temperatures.—II.** Friedrich Müller and Hellmut Reuther (*Z. Elektrochem.*, 1942, 48, 682–686; *C. Abs.*, 1943, 37, 5662).—Cf. *Z. Elektrochem.*, 1941, 47, 640–644; *Met. Abs.*, 1942, 9, 360. If a copper electrode is immersed in a $Hg_2SO_4$ solution, it is covered with a thin film of mercury, which apparently does not amalgamate and has no influence on the electrode potential. With such an electrode, potential measurements can be carried out in air. Results obtained in $CuSO_4$ solutions of different concentrations and at different temperatures are presented graphically and in tabular form. The most probable value of the $N$ potential of $Cu/Cu^{\cdot\cdot}$ is $E_{25^\circ} = 0{\cdot}3400 \pm 0{\cdot}0003$ V.

**Importance of Metal—Metal Contact Potential and the Electromotive Force of Primary Cells.** W. G. Burgers (*Chem. Weekblad*, 1942, 39, 198–205, 215–220).—A review.

**The Action of Solid and Liquid Metallic Particles in Solutions of Electrolytes.** A. Frumkin and V. Levich (*Zhur. Fiz. Khim.*, 1945, 19, (12), 573–599).—[In Russian] A quantitative theory is developed of the action of an external electrical field in the case of an isolated particle, ideally polarized and not fully polarized.—N. A.

**Electrolytic Etching of Electrotypes.** A. I. Nevsorov (*Poligraf. Proizvodstvo*, 1940, (12), 20–22; *Chem. Zentr.*, 1942, 113, (I), 1435; *C. Abs.*, 1943, 37, 6559).—The etching of zinc electrotypes in a bath containing $ZnSO_4$ 250, $Na_2SO_4$ 50, and $K_2Cr_2O_7$ 25 g./litre was not satisfactory. Better results were obtained with a bath containing $ZnCl_2$ (200 g.) and $CrO_3$ 10 g./litre, a c.d. of 30 amp./sq. dm., and an electrode spacing 5 cm. The areas not to be etched are coated with a cold enamel obtained by fixing a layer of shellac to the plate with a tanning solution ($H_2CrO_4$ + Cr alum).

## XI.—ANALYSIS

***Quantitative Spectrographic Analysis of Aluminium Alloys with the Application of Objective Photometry.—I.** A. R. Striganov (*Zavod. Lab.*, 1940, 9, (2), 170–178).—[In Russian] S. indicates the optimum working conditions (as revealed by his own experiments) for the determination of Cu, Mg, Mn, Fe, Si, and Ni in Al alloys. (For abstract of Part II, see *Met. Abs.*, this vol., p. 223.) —N. A.

**Spectral Lines for the Analysis of Aluminium Alloys by the Photographic Method Using the Microphotometer.** A. R. Striganov (*Zavod. Lab.*, 1945, **11**, (4), 311–314).—[In Russian] Recommends line pairs for use in analysis. —N. A.

**Very Rapid Spectrographic Analysis of Aluminium Alloys.** A. R. Striganov (*Zavod. Lab.*, 1945, **11**, (5), 415–419).—[In Russian] The method is described. —N. A.

**Very Rapid Spectrographic Analysis of Aluminium Alloys.** N. N. Semenov and I. S. Fishman (*Zavod. Lab.*, 1945, **11**, (5), 419–424).—[In Russian] A description of the method.—N. A.

**Spectrum Analysis of Aluminium Alloys.** A. R. Striganov and K. A. Sukhenko (*Izvest. Akad. Nauk S.S.S.R.*, 1945, **9**, (6), 593–606).—[In Russian] Reviews methods used for the routine analysis of alloys in many aluminium works, in which approx. 300,000 quantitative determinations per month are being carried out in about 30 factories. For high-speed analysis, spectra taken through a stepped wedge may be estimated by visual interpolation, and tables of the lines used for this are given for Mg, Mn, Cu, Si, Fe, Ti, Co, Sn, Ni, and Be. For more precise work, microphotometric comparison with standard samples is preferred. Standard sparking conditions are given for the Feussner spark generator and for a simpler circuit and the methods of casting standard samples are described. Visual estimation with a polarizing spectrometer may also be used in some cases.—E. van S.

**The Spectrographic Analysis of Aluminium Alloys.** A. R. Striganov and K. A. Sukhenko (*Zavod. Lab.*, 1945, **11**, (7/8), 685–694).—[In Russian] A review. (See also abstract above).—N. A.

**Preparation and Investigation of Aluminium and Magnesium Alloy Standards for Spectrographic Analysis.** K. A. Sukhenko and B. S. Krasil'shikov (*Zavod. Lab.*, 1945, **11**, (11/12), 1125–1131).—[In Russian] The question of casting the standards is surveyed.—N. A.

**The Influence of Third Elements on the Results of Spectrographic Analysis of Aluminium and Magnesium Alloys.** K. A. Sukhenko and O. I. Mladentseva (*Zavod. Lab.*, 1945, **11**, (11/12), 1132–1136).—[In Russian] The calibration curves of the standards of a number of alloys were compared among themselves, with the object of rationalizing the standards of alloys similar in chemical composition.—N. A.

**The Spectrographic Determination of Copper in Aluminium Alloys.** L. E. Vvedensky (*Zavod. Lab.*, 1945, **11**, (2/3), 221–222).—[In Russian] Some directions based on V.'s own work.—N. A.

**On the Application of the Method of Internal Electrolysis to the Determination of Small Quantities of Copper in Metallic Aluminium.** N. A. Suvorovskaya (*Zavod. Lab.*, 1945, **11**, (5), 474).—[In Russian] The proposed method is described.—N. A.

***Determination of Iron in Light Alloys by Means of Sulphosalicylic Acid.** E. I. Nikitina (*Zavod. Lab.*, 1940, **9**, (5/6), 629–630).—[In Russian] N. recommends the introduction of $NH_4Cl$ to prevent precipitation of $Mg(OH)_2$. —N. A.

**The Determination of Silicon and Copper in Aluminium Alloys by the Lange Photocolorimeter.** A. A. Tikhonova (*Zavod. Lab.*, 1945, **11**, (6), 616–617).—[In Russian] Describes the method.—N. A.

***Contribution to Rapid Polarographic Analysis. III.—An Investigation of the Possible Errors in the Estimation of Zinc and Nickel in Aluminium and Secondary Aluminium Alloys.** F. Jablonski and H. Moritz (*Aluminium*, 1944, **26**, (5/6), 97–99).—A study was made of the possible errors (mainly due to high Si content) in the estimation of Zn in Al alloys, using the method previously described. Any residue left after the sample had been dissolved had a negligible volume effect on the determination, and there was no loss of Zn by precipitation as silicate or by adsorption in any undissolved $SiO_2$. The solution was stable over a period of days, no precipitation of dissolved $SiO_2$ taking place. It is concluded that the errors due to analytical procedure are somewhat less than the subjective errors involved in the evaluation of the polarogram.—E. N.

***The Determination of Oxygen in Metallic Antimony.** A. S. Shakhov (*Zavod. Lab.*, 1945, **11**, (9), 807–809).—[In Russian] Reduction by means of dry $H_2$ at 700° C. for 1½ hr. is recommended. The accuracy is to 0·06%.—N. A.

**The Quantitative Spectrographic Analysis of Bronze and Cast Iron in the Ultra-Violet Region of the Spectrum.** N. N. Semenov (*Zavod. Lab.*, 1945, **11**, (2/3), 215–218).—[In Russian] Describes experience in a works laboratory. —N. A.

***Polarographic Determination of Lead in Lead Bronzes.** V. F. Toropova (*Zhur. Priklad. Khim.*, 1945, **18**, (3), 177–180).—[In Russian] T. points out the possibility of determining Pb in bronze in alkaline solution. The accuracy is about 2%, and the time required 8 min.—N. A.

**Analysis of Cable-Sheathing Alloys.** G. M. Hamilton (*Nature*, 1946, **157**, (4000), 875).—The use of a new solvent for Pb alloy cable sheathing preparatory to wet analysis is described. The alloy contains approx. Sn 2·0, Sb 0·8, and Cd 0·25% and samples weighing 2·5 g. may be disintegrated in a few minutes in a mixture of 20 c.c. of 30% $H_2O_2$ and 5 c.c. glacial acetic acid. Sb is not attacked, but is later taken into solution with HCl, which also decomposes most of the peroxide and converts the other metals into chlorides. From this point the analysis follows conventional methods. Alloys rich in Sn are only slowly attacked by the recommended reagent.—G. V. R.

***Determination of Sodium in Calcium–Sodium Babbitts.** V. I. Kolosov and M. D. Trykov (*Zavod. Lab.*, 1940, **9**, (5/6), 518–519).—[In Russian] 2–4 g. of Babbitt turnings in a porcelain boat are heated for 10–15 min. at 400°–450° C. in a Mars furnace in a current of air. The oxidized product is then lixiviated with boiling water and a stream of $CO_2$. The residue of $CaCO_3$ and PbO is filtered off, and Na is determined in the filtrate by titration with HCl.—N. A.

**The Application of the Polarographic Method in the Analysis of Bearing Metals.** S. I. Kaplansky, A. B. Gurevich, and I. A. Korshunov (*Zavod. Lab.*, 1945, **11**, (10), 916–920).—[In Russian] Deals with the construction of directly calibrated apparatus for determining Cu, Cd, and Ni; the analysis of artificial mixtures; the analysis of works samples (for Cu, Ni, and Cd); and the determination of Sb and Sn.—N. A.

**Colorimetric Determination of Zinc and Aluminium in Tin and Lead–Tin Solders.** S. Yu. Fainberg and T. V. Zaglodina (*Zavod. Lab.*, 1945, **11**, (11/12), 1109–1112).—[In Russian] A scheme of analysis is given.—N. A.

**The Preparation of Standard Alloys for the Spectrographic Analysis of Zinc, Cadmium, Lead, and Tin.** A. K. Rusanov (*Zavod. Lab.*, 1945, **11**, (4), 349–350).—[In Russian] In the preparation of alloys of predetermined composition, R. recommends melting in a stream of hydrogen.—N. A.

***Spectrographic Estimation of Traces of Impurities in Zinc Alloys by Means of the Condensed Spark.** Paul Croissant (*5me Congrès du Groupement pour l'Avancement des Méthodes d'Analyse Spectrographique des Produits Métalliques*, **1946**, 65–67; discussion, 68).—Various spark-circuit conditions were tried on cylindrical samples of die-casting alloys to estimate traces of Mg, Fe, and Pb. By the use of unusually large capacity and self-inductance and 2-min. exposures, Pb and Cd can be estimated down to 0·003% and Sn down to 0·001%.

For Pb in the range 0·01–0·03% the coeff. of variation of the duplicate spectra was less than 2·5%. The precision for other elements is under investigation. —E. van S.

**The Analysis of Zinc Alloys.** R. B. Golubtsova (*Zavod. Lab.*, 1945, **11**, (11/12), 1112–1113).—[In Russian] A method is outlined for determining Al (5–20%), Cu (1–5%), and Fe (0·2–1·5%) in Zn alloys.—N. A.

***The Polarographic Determination of Cobalt in the Presence of Nickel. The Catalytic Evolution of Hydrogen in the Presence of Complexes of Cobalt with Dimethylglyoxime.** A. G. Stromberg and A. I. Zelyanskaya (*Zhur. Obshch. Khim.*, 1945, **15**, (4/5), 303–317).—[In Russian] A new method has been worked out for the polarographic determination of Co in the presence of Ni. It depends on the fact that dimethylglyoxime gives an insoluble complex with Ni, while forming a complex compound with Co, which remains in solution and can be determined polarographically. The necessary conditions for the determination of Co in the presence of Ni, Cu, Zn, and Fe have been examined. —N. A.

***The Fractional Detection of Copper Ions.** N. A. Tananaev and V. N. Podchainova (*Zavod. Lab.*, 1940, **9**, (2), 168–169).—[In Russian] CdS can be used for the fractional detection of Cu down to 10 mg./litre in the presence of Bi, Ag, and Hg, and down to 0·5 mg./litre in their absence.—N. A.

**The Use of $Na_2SO_3$ for Volumetric Determination of Lead.** T. Ya. Shevtsova (*Trudy Inst. Khim. Khar'kov. Gosudarst. Univ.*, 1940, **5**, 283–291; *Khim. Referat. Zhur.*, 1941, **4**, (7/8), 69; *C. Abs.*, 1943, **37**, 6586).—[In Russian] For analysis of metallic Pb or of Pb alloys, dissolve the sample in $HNO_3$ (1 : 2), evaporate to dryness, moisten with $N$-$HNO_3$, dissolve in water and filter; neutralize with $NH_4OH$ in the presence of methyl red and titrate with $Na_2SO_3$ solution to a yellow colour. Cu and Cd interfere with the determination; less than 1% Fe does not interfere. The $Na_2SO_3$ must contain no sulphates; they can be removed by repeated crystallization from water.

**Conductometric Titration of Lead with Iodate.** C. Dragulescu and E. Latiu (*Z. anal. Chem.*, 1943, **126**, 63–66; *C. Abs.*, 1943, **37**, 6585).—The conductometric titration of $Pb^{++}$ with $IO_3^-$ can be carried out satisfactorily according to the reaction $Pb^{++} + 2IO_3^- = Pb(IO_3)_2$, but it is necessary to wait until the conductivity value is const. after each addition of reagent, particularly in the neighbourhood of the end point. The reason for this is the fact that $Pb(OH)IO_3$ is formed at first and this basic iodate changes very slowly into the normal salt.

**Potentiometric Titration of Lead with Iodate.** C. Dragulescu and E. Latiu (*Z. anal. Chem.*, 1943, **126**, 67–72; *C. Abs.*, 1943, **37**, 6585).—To the neutral $Pb(NO_3)_2$ solution add an excess of $KIO_3$ solution and titrate the excess with standard $Pb(NO_3)_2$ solution. Use Ag wire as indicator electrode against a $N$-calomel electrode in the usual compensation apparatus. The excess $KIO_3$ can also be titrated with standard $AgNO_3$ solution. The results obtained by direct titration with $KIO_3$ were unsatisfactory, although some freshly precipitated $AgIO_3$ was added at the start and in some cases EtOH was added to decrease the solubility.

***A Simple Colorimetric Method for the Works Determination of Nickel.** J. Kinnunen (*Metall u. Erz*, 1944, **41**, (13/14), 158).—Ni may be estimated colorimetrically as $NiSO_4$ using a Lange photoelectric colorimeter with a red filter. The light adsorption is independent of time, temp., $H_2SO_4$, $H_3PO_4$, thiourea, and $CuSO_4$ concentration. When Cu is present, it may be decolorized with a solution containing 50 g. thiourea, 500 c.c. $H_2SO_4$ (1 : 1), and 1000 c.c. $H_2O$, 15 c.c. of which will decolorize 200 mg. Cu. Fe is decolorized with $H_3PO_4$. The method may be applied to Ni and Cu electrolytes, $NiSO_4$, NiO, nickel matte, nickel silvers, &c. The results obtained are in very good agreement with those from electrolytic estimations.—E. N.

***Direct Titration of Nickel with Dimethylglyoxime Solution.** A. K. Babko and M. V. Korotun (*Zavod. Lab.*, 1945, **11**, (10), 896–899).—[In Russian] The chemical conditions of titration were studied and a method established for the determination of Ni in the presence of Fe and Cu.—N. A.

***On the Determination of Very Small Quantities of Platinum.** N. S. Poluektov and F. T. Spivak (*Zavod. Lab.*, 1945, **11**, (5), 398–403).—[In Russian] A method has been evolved for the determination of small amounts of Pt in metallic Sb. It is based on the reaction with Sn chloride and ethyl acetate and enables 0·03 g. of Pt in 10 g. of specimen to be determined.—N. A.

***Gravimetric Method for the Determination of Potassium, Rubidium, and Cæsium.** O. G. Sheïntsis (*Zavod. Lab.*, 1940, **9**, (2), 162–163).—[In Russian] K, Rb, and Cs are precipitated as hexanitrodiphenylamines, and the precipitate washed with dry ether and dried at 80°–90° C.—N. A.

***The Use of Anthraquinone-α-Arsonic Acid in the Determination of Small Quantities of Tin.** V. I. Kuznetsov (*Zavod. Lab.*, 1945, **11**, (4), 263–266).—[In Russian] Sn is converted into the β-compound of $Sn^{IV}$ by heating the alkaline solution acidified with $HNO_3$. For precipitation from very dilute solutions, K. proposes a new reagent—anthraquinone-α-arsonic acid. The method is suitable for use in the presence of large quantities of W, Sb, Cu, Cr, Mo, V, and Nb.—N. A.

***Separation of Iron, Aluminium, and Chromium from Zinc by Means of Pyridine.** E. A. Ostroumov and R. I. Bomshtein (*Zavod. Lab.*, 1945, **11**, (2/3), 146–149).—[In Russian] 200 ml. of an HCl solution, containing approx. 0·3 g. of the sesquioxides of the metals, are neutralized with $NH_4OH$ until turbidity appears; this is cleared by addition of 3 or 4 drops of dil. HCl. Then 20–40 g. of $NH_4Cl$ are added and the solution heated to boiling; after removal from the flame, Fe, Al, and Cr are precipitated by means of a 20% solution of pyridine.—N. A.

***The Reaction Range of Organic Reagents in Metal Analyses.** Hellmut Fischer (*Wiss. Veröff. Siemens-Werken*, **1940**, 217–229; and *Mikrochem. ver. Mikrochim. Acta*, 1942, **30**, 38–56; *Chem. Zentr.*, 1941, **112**, (I), 2975; *C. Abs.*, 1943, **37**, 6582).—A study was made of the way in which the reactivity of diphenylthiocarbazone (dithizone) varies with different groups of cations with the same electron configuration. The *p*H range of stability of the metal complexes formed was determined. Corresponding experiments were carried out with diphenylcarbazone dissolved in both $CCl_4$ and $CHCl_3$. The reactions of α-nitroso-β-naphthol and β-nitroso-α-naphthol with heavy metal cations can be carried out in the same manner as the reactions of dithizone. The stability range was determined for these compounds also. A definite relationship was found to exist between the reactivity of the cations and the stability of the complexes formed on the one hand and the electron configuration of the reacting cations on the other. The tendency to form stable complexes is most pronounced in the case of the cations of the transition metals with incomplete electron shells; next to these are the group of cations with 18 external electrons. The reactivity of cations with 18 + 2 electrons is essentially more limited, as is also the *p*H range within which they react.

**The Sorting of Metals and Alloys by Means of Spot-Tests.** E. I. Nikitina (*Zavod. Lab.*, 1945, **11**, (2/3), 231–234).—[In Russian] Methods are indicated for Al alloys, Mg alloys, brasses, and steels.—N. A.

**Quantitative Analysis by the Variation of the Specific Activity of an Added Radioactive Isotope.** Pierre Sue (*Nature*, 1946, **157**, (3993), 622).—The method of using radioactive isotopes in quantitative analysis is illustrated by reference to a new method of analysis for K in the presence of Li and Na. To the solution is added a radioactive potassium preparation of known activity. From the new mixture the K is precipitated as $KClO_4$. From the measured activity of a weighed sample of the precipitate, the quantity of inactive K in the original mixture is deduced. The precipitation need not be quantitative. —G. V. R.

**Metallurgical Analysis. Review of the Commonly Used Drying Agents.** James Sanders (*Iron and Steel*, 1946, 19, (8), 423–425).—A review of drying agents commonly used in metallurgical analysis, dealing with $CaCl_2$, $B_2O_3$, conc. $H_2SO_4$, $P_2O_5$, $Mg(ClO_4)_2$, and silica gel. The properties of each substance are discussed and their method of use and rate of desiccation considered. Some examples of their use are also given.—J. W. D.

†**Modern Light Sources for Spectrographic Analysis.** N. S. Sventitsky (*Izvest. Akad. Nauk S.S.S.R.*, 1945, [Phys.], 9, (6), 677–690).—[In Russian] A critical review of light sources for spectrographic analysis, comparing the D.C. arc, different types of spark, and A.C. arcs of the usual types described in German and American papers. The A.C. arc with H.-F. ignition, favoured in the U.S.S.R., is supplied with an additional interrupter in the primary of the transformer, which enables an intermittent discharge to be used for samples of low melting point. The trend in the development of controlled sources is discussed and it is pointed out that there is only a limited value to theoretical calculations based on the assumption that thermal equilibrium is attained in the arc column. In seeking reproducibility of spectra, it may not be enough to aim at uniform electrical conditions which would restrict the scope of the light source; a more useful circuit would produce regular variations of potential gradient, so as to ionize the more difficult elements as well as those with lower excitation potentials.—E. van S.

**The Impulse Source of Light and Its Application to the Spectral Analysis of Metalloids in Solids.** I. I. Levintov (*Izvest. Akad. Nauk S.S.S.R.*, 1945, [Phys.], 9, (6), 699–702).—[In Russian] To estimate non-metallic elements in refractory solids which may be insulators, such as are used as catalysts, no existing spark- or arc source is suitable. To an ordinary arc circuit (A.C. or D.C.) a secondary circuit is added in which a condenser of 1μF charged to 6000 V. by a transformer is discharged periodically by a rotary interrupter. The disc of the interrupter also carries an aperture which uncovers the spectrograph slit only at the time of the discharge impulse. This results in an arc of extremely high c.d. and can be used to excite non-metallic samples packed in a carbon crater. The resultant spectra give lines for the halogens and S, but have fewer air lines than a high-intensity spark; highly ionized lines abound. Very sensitive plates must be used as the sample is rapidly volatilized and if the plates are too slow spectra must be superimposed. Very short arc gaps (0·5–1 mm.) are essential, as an ordinary arc is often extinguished by the impulse discharge. An alternative circuit is given which is of simpler type but requires a 300 kW. transformer. Little quantitative work has been done with this light source but traces of halogens in copper oxide can be estimated (above 0·05%) by an internal-standard comparison method.—E. van S.

## XII.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

**The Upright Type of Microscope in Metallography.** J. R. Vilella (*Metal Progress*, 1946, 49, (1), 113–116).—The "inverted" microscope which permits the specimen to be placed on the stage with the polished side down, and which can be used in conjunction with a horizontal camera, is generally preferred for metallographic work. The upright microscope, however, has the advantages of superior comfort and adjustability in use, more extensive stage movement, possibility of determining the position on the specimen of the field under examination, and a permanently attached and aligned source of light. Micrographs produced with both types of instrument illustrate the high order of clarity obtainable with the " inverted " type of instrument and recommendations are made regarding lighting, choice of film and filter, and developers. —P. R.

**A New Type of Focusing X-Ray Monochromator.** W. H. Hall (*Nature*, 1946, **157**, (3999), 842).—It is pointed out that single-texture copper strip, having a <100> direction lying in the rolling direction and a {100} plane in the strip surface, may be used as the diffracting material in monochromators of the " bent crystal " type. The strip may be bent and ground more easily than the crystals usually employed and has other advantages.—G. V. R.

**X-Ray Goniometer for Use with Micro-Specimens.** L. V. Al'tshuller (*Zavod. Lab.*, 1941, **10**, (3), 271–277).—[In Russian] A. describes a camera by means of which Debye photographs can be obtained from micro-specimens, using a focusing method.—N. A.

**On Some Tests of Prism Spectrographs of High Dispersion.** A. Gatterer and J. Junkes (*Ricerche Spettroscopiche*, 1940, **1**, (3), 73–137).—[In German] A detailed examination of the resolving power and purity of the spectrum given by glass and quartz spectrographs. The instruments are considered in respect of the matching of their optical and photographic resolving power, as affected by focal length and aperture. Defects in the purity of the spectrum such as " ghosts " and broadened lines are discussed and methods of mechanical construction and adjustment are described. The paper is illustrated with actual photographs of spectra and micro-photometric traces of the photographs.—E. van S.

**Comparative Light-Transmission of the Zeiss Qu24 Spectrograph and the Zélande Spectrograph of Jobin and Yvon.** Edmond Lœuille (*5me Congrès du Groupement pour l'Avancement des Méthodes d'Analyse Spectrographique des Produits Métalliques*, **1946**, 46–64).—After a detailed comparison of the optical systems of two spectrographs, L. describes the effect on the relative intensity of two spectrum lines which results from changing from one spectrograph to another, a point which is of practical importance in the standardization of methods of analysis. The changed relative intensity is due to reciprocity-law failure of the photographic plate and disappears if the two spectrographs are similar in their light-transmissions.—E. van S.

**Some Apparatus and Devices in the Spectrographic Laboratory.** N. N. Semenov (*Zavod. Lab.*, 1945, **11**, (2/3), 218–220).—[In Russian] S. describes the drying of photographic plates in a vacuum, a chill mould for casting specimens, and devices for sharpening electrodes.—N. A.

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

***On Random Sampling in Test Statistics.** Ludwig Küttner (*Metallwirtschaft*, 1944, **23**, (22/26), 228–233).—Reports an extensive investigation of the classification, causes, and distribution of errors in experimental observations, the results being shown in tables, graphs, and error curves. K. discusses the choice of sample specimens and the probability that their properties shall be representative of the whole group. The interpretation and conclusions which can be reached from the results of small-scale sampling are dealt with.—E. N.

**Practical Hardness Testing.** K. Meyer (*Maschinenbau*, 1941, **20**, 431–436; *Chem. Zentr.*, 1942, **113**, (II), 1285; *C. Abs.*, 1943, **37**, 5680).—Static, dynamic, and special methods for hardness testing are discussed and the equipment is described.

***Elastic Constants of Isotropic Media [Steel, Brass].** S. Bhagavantam and B. Ramachandra Rao (*Nature*, 1946, **157**, (3993), 624).—A method for obtaining Young's modulus $Y$ and the rigidity modulus $n$ for very small quantities of isotropic materials is briefly referred to. The method depends upon the transmission of ultrasonic waves of continuously varying frequency through the specimen. Typical results for glass, steel, and brass are given and compared with the static values.—G. V. R.

**Verification of Tensile-Testing Machines.** W. Thompson (*Metallurgia*, 1946, **34**, (201), 145–146).—Methods adopted for verifying the accuracy of tensile-testing machines including the calibrated test bar and the steel proving ring are described and discussed and attention is directed to the comparative ease of checking by means of the latter method.—J. W. D.

**New Testing Machines of the TsNIITMASh Type.** I. V. Kudryavtsev (*Zavod. Lab.*, 1945, **11**, (2/3), 209–214).—[In Russian] New machines for the tensile testing of metals are described.—N. A.

**Rapid Method for Determining, by the Amsler Machine, the Anti-Friction Properties of Alloys During Sliding Friction.** A. I. Chipizhenko (*Zavod. Lab.*, 1945, **11**, (7/8), 727–733).—[In Russian] C. proposes a method which gives significant amounts of wear in a comparatively brief time of testing.—N. A.

**A Small-Scale Creep-Testing Unit.** G. T. Harris (*Metallurgia*, 1946, **34**, (201), 129–132).—A small-scale creep-testing machine has been developed to accelerate the development of new heat-resisting alloys for gas turbines. The machine is described, its accuracy defined, and some results are given to show the form of the strain/time curves obtained.—J. W. D.

**Improving Design Through Life Testing.** R. E. Peterson (*Machine Design*, 1945, **17**, (8), 127–130).—" Life " tests are devised to test individual parts under an approximation to working conditions. Specially designed apparatus is illustrated for testing door latches and hinges, the durability of refrigerator trays, and turbine blades. Life tests are considered in two main groups including (*a*) fatigue and creep, and (*b*) wear, corrosion, and repeated impact, (*a*) comprising quantitative, and (*b*) qualitative tests. The merits and applications of *ad hoc* life tests are compared with those of conventional testing methods.—P. R.

**The Supersonic Flaw Detector and Its Application in the Sheet-Metal Industries.** A. C. Rankin (*Sheet Metal Ind.*, 1946, **23**, (229), 893–898, 901).—A brief account is given of the apparatus and the principles on which it operates. The application of supersonic flaw detection to problems encountered in the sheet-metal industry is discussed, with some examples of its use. R. suggests that standardization and calibration for each application is necessary.—R. Gr.

## *RADIOLOGY*

**Prague Conference on the Use of X-Rays in the Metal Industries.** V. Vand (*Nature*, 1946, **157**, (3987), 415–416).—A summary report of a conference held in Nov. 1945 by the Society of Czechoslovak Mathematicians and Physicists. —G. V. R.

**Sectional Radiography.** Robert Taylor (*Metals and Alloys*, 1945, **22**, (1), 99–101).—A method is outlined by means of which the defects in any given plane through a casting may be recorded sharply on an X-ray film and all defects on other planes thrown out of focus. This is accomplished by moving the X-ray tube and film in opposite directions during the time of the exposure. Methods of securing the desired movement are indicated diagrammatically. —J. C. C.

**The Present State of X-Ray Radiology.** A. K. Trapeznikov (*Zavod. Lab.*, 1945, **11**, (4), 287–304).—[In Russian] A review.—N. A.

**Two-Million Volt X-Ray Inspection Equipment.** David Goodman (*Metal Progress*, 1946, 49, (2), 327–332).—A high-voltage installation for the non-destructive inspection of heavy ordnance permits the horizontal radiations to be used for inspecting pieces carried round the machine on a turn-table, while a beam, transmitted through the anode along the axis of the tube, is used for examining larger pieces in another part of the building, the transmitted beam being shut off by lead screening when not in use. The lay-out, safety devices, and method of operation are described.—P. R.

**X-Ray Tube with Earthed Anode.** L. P. Spassky (*Zavod. Lab.*, 1940, 9, (5/6), 655–657).—[In Russian] Describes the design of a new type of anode for X-ray tubes intended for radiology.—N. A.

## XIV.—TEMPERATURE MEASUREMENT AND CONTROL

**Anticipator Improves Temperature Control.** M. J. Manjoine (*Machine Design*, 1945, 17, (6), 116).—The " anticipator " consists of two thermocouples of different characteristics and an electrical heating element, the assembly being enclosed in a vacuum tube. The thermocouples and the control thermocouple in the furnace are connected in series in such a way that the polarity of the couple with the less thermal capacity is additive, and that of the couple with greater thermal capacity is subtractive, with respect to the furnace couple. The heating element of the anticipator is actuated by the power source connecting the control mechanism with relays operating the main power supply. Differences in temp. between the two anticipator couples cause changes in the controller voltage and prevent the furnace temp. from increasing above or decreasing below the prescribed limits. It is stated that control of heat-treating furnaces within $\pm 2\frac{1}{2}°$ F. ($\pm\ 1\frac{1}{2}°$ C.) is practicable with anticipators of this type.—P. R.

## XV.—FOUNDRY PRACTICE AND APPLIANCES

**German Aluminium Alloy Pistons.** —— (*Found. Trade J.*, 1946, 78, (1548), 414, 417).—A summary of British Intelligence Objectives Sub-Committee Report No. BIOS 238 (1946).

***Reciprocal Effects of Cuprous Oxide, Poling Gases (Hydrogen), and Deoxidizers in the Melting and Casting of Oxygen-Free and Oxygen-Containing Copper.** Paul Klare and Justus Kohlmeyer (*Metall u. Erz*, 1944, 41, (13/14), 149–155; (15/16), 174–180).—The production of high-conductivity copper was studied and the optimum conditions for poling, deoxidation, and casting ascertained. The action of the undermentioned deoxidizers on underpoled and overpoled copper was investigated: phosphorus, lithium, magnesium, calcium, strontium, barium, cerium, aluminium, and thorium. Copper of the highest conductivity is obtained by melting in a reverberatory furnace, poling at a temp. not exceeding 1200° C. until the oxygen content is reduced to 0·01%, and pouring the metal into ladles of 1800 kg. capacity which contain about 4 shovelfuls of glowing charcoal. The oxygen (0·002–0·005%) and hydrogen contents are thereby rendered so low that an addition of 0·0015% lithium effects the simultaneous removal of both elements. The molten metal, now at a temp. not exceeding 1160° C., is poured into billets under a protective atmosphere of carbon monoxide.—E. N.

***Control of Shrinkage Porosity and Mechanical Properties in Chill-Cast Phosphor-Bronzes, Leaded Bronzes, and Gun-Metals.—I–II.** (Pell-Walpole). See p. 317.

**Relining Lead Alloy Journal Bearings.** E. A. Wolfenden (*Metals and Alloys*, 1945, **22**, (1), 81–84).—A detailed account of good practice. A lead–tin alloy containing 20–25% tin applied at 625°–675° F. (330°–357° C.) is recommended for tinning and the lining metal (tin 3–5, antimony >8%, lead balance) should be poured at 625° F. (330° C.).—J. C. C.

**Technical Control in a Magnesium Foundry.** G. B. Partridge (*Found. Trade J.*, 1946, **79**, (1550), 5–8).—Read before the Birmingham, Coventry, and West Midlands Branch of the Institute of British Foundrymen. A general review dealing with melting technique, sand control, heat-treatment, and inspection.—J. E. G.

**Magnesium Die-Castings.** Ralph M. Heintz (*Machine Design*, 1946, **18**, (2), 101–104, 180; (3), 111–115).—The problems of the design of magnesium die-castings differ entirely from those in sand casting. This is shown by tables comparing tolerances, limits of draught, shrinkage, and minimum hole sizes and wall thicknesses for the two processes. Die-cast parts are classed as "decorative" (appearance being the chief consideration); "functional" (for working parts, in which strength is less important than lightness and cheapness); "structural" (in which moderate stresses are involved); and "stressed" (in which working stresses are high). The composition and physical and mechanical properties of a common die-casting alloy are tabulated, with references to American specifications. The economy in machining effected by using die-cast parts is emphasized. Practical recommendations are made for dimensions of holes and fillets, uniformity of section, and protective treatment. H. suggests that the use of die-castings could be considerably extended if modifications were made in production practice.—P. R.

**Mass-Production Precision Casting [of Stellite].** —— (*Machinery* (*Lond.*), 1946, **69**, (1762), 65–73).—An illustrated account is given of the equipment of the Haynes Stellite Co. for producing precision castings by the lost-wax process. Castings weighing from 0·002 to 5 lb. each have been regularly produced to dimensional tolerances of ±0·003 in.—J. C. C.

**Lateral Die Movement with Positive Lock.** N. Field (*Machinery* (*Lond.*), 1946, **69**, (1763), 118–119).—Details are given of the design of a die block in which the whole of the casting is formed within laterally sliding members.
—J. C. C.

**Castings and Weldings.** (Sir) Claude D. Gibb (*Found. Trade J.*, 1946, **79**, (1557), 179–184, 191).—Edward Williams lecture to the Institute of British Foundrymen.—J. E. G.

**Casting Reflections.** D. Howard Wood (*Found. Trade J.*, 1946, **79**, (1558) 219–222).—Presidential address to the Institute of British Foundrymen.
—J. E. G.

**Ingot-Casting Machines.** Karl Siedentopf (*Aluminium*, 1944, **26**, (5/6), 88–93).—Typical automatic casting machines are described and their technical and economical requirements are discussed.—E. N.

**On the Development of Water-Cooled Ingot Moulds.** A. J. Stelljes (*Aluminium*, 1944, **26**, (5/6), 94–95).—The development of water-cooled moulds for casting light metal ingots and their advantages over automatic casting machines are discussed. Details are given of a horizontal mould having a D section.—E. N.

**Specification-Purchasing of Die-Castings.** Herbert Chase (*Metals and Alloys*, 1945, **22**, (1), 76–80).—Reproduces and discusses examples of American purchase specifications, some requiring radiographic and breakdown tests and others specifying the type of machine to be employed.—J. C. C.

**Closer Co-operation Between the Foundry and Pattern Shop.** (1) W. C. Meredith. (2) H. S. W. Brittain (*Found. Trade J.*, 1946, **79**, (1550), 3–4; (1552), 49–52).—Two papers contributed to a discussion on the subject and read before the Sheffield Branch of the Institute of British Foundrymen.

Examples are given of typically bad pattern-making. The introduction is suggested of a " methods department " to contact the other departments and correlate information on castings for ultimate transmission to the pattern shop. —J. E. G.

**Core-Making Operations.** J. H. List (*Iron and Steel*, 1945, **19**, (8), 431–432).—Moulding and core operations used in the manufacture of castings for pump impellors are discussed, with special reference to the sand mixture used and the moulding technique employed for the production of good cores. —J. W. D.

**Determination of " Gas-Content " of Sand Cores.** —— (*Found. Trade J.*, 1946, **79**, (1560), 273–275).—Report of Sub-Committee T.S. 13 of the Technical Council of the Institute of British Foundrymen. Detailed instructions are given for determining the " gas-content " of sand cores.—J. E. G.

**Elevating Trucks in the Foundry.** R. S. Turner (*Found. Trade J.*, 1946, **79**, (1558), 225–227).—A general illustrated account.—J. E. G.

**Apprentice Training in the Foundry.** John B. Longmuir (*Found. Trade J.*, 1946, **79**, (1552), 55–59).—Read before the Birmingham, Coventry, and West Midlands Branch of the Institute of British Foundrymen. A detailed account of a scheme used in a Works Foundry Training Centre.—J. E. G.

**Opportunities for the Foundry Technician in India.** J. Blakiston (*Found. Trade J.*, 1946, **78**, (1547), 393–397).—Read before the London Branch of the Institute of British Foundrymen. A review of recent metallurgical developments in India and future prospects for United Kingdom technicians. —J. E. G.

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

**Use and Working of Light Metal Scrap.** G. Gauthier (*Usine*, 1942, **51**, (5), 31–33; (6), 37–39; (7), 35–39; (8), 37–39; *Chem. Zentr.*, 1942, **113**, (II), 453; *C. Abs.*, 1943, **37**, 6612).—Reviews the origin and types of scrap, refining and purifying methods, melting furnaces, fluxes, and further uses of residues from melting.

## XVII.—FURNACES, FUELS, AND REFRACTORY MATERIALS

**The Ellipsoid Melting Furnace.** A. J. G. Smith (*Metallurgia*, 1946, **34**, (201), 153–154).—Briefly describes a modification of the horizontal-roller- or rocking-type furnace which has been used on the European continent in recent years, and gives particulars of some typical performances in melting red-brass swarf, nickel-silver grinding swarf, and Argentan alloy.—J. W. D.

**The Use of [Iron–Chromium–Aluminium] Alloy No. 2 for the Heating Elements of High-Temperature Furnaces.** I. I. Kornilov and N. V. Nikol'sky (*Izvest. Akad. Nauk S.S.S.R.*, 1945, [Tekhn.], (9), 825–830).—[In Russian] An alloy of iron with chromium 23–27 and aluminium 4–6% is recommended for use in furnaces operating at 1200°–1270° C.—N. A.

## XVIII.—HEAT-TREATMENT

***Blister Formation on Rolled [Aluminium Alloy] Plate.** Heinz Borchers and Othmar Castellani (*Metall u. Erz*, 1942, **39**, 407–409; *C. Abs.*, 1943, **37**, 6230).—The alloy studied had the composition aluminium plus copper 2·60, magnesium 1·80, manganese 0·65, silicon 0·29, iron 0·40, and titanium 0·17%.

Slight changes in the time and temperature of heat-treatment often have great effect on blister formation.

**Improved Treatments of Aluminium Alloys.** Max E. Tatman (*Metal Progress*, 1946, **49**, (2), 323–327).—Recent developments in heat-treatment are reviewed with special reference to alloy 24S (sheet, strip, and plate). Warping during a quench has been reduced by (1) air-cooling after removal from the furnace, (2) "fog-" or "spray-" quenching, (3) quenching the part in an upright position, and (4) stretching and/or rolling the quenched material. Methods (1) and (2) are found, however, to decrease strength and corrosion-resistance. A practice widely adopted in aircraft production is to roll annealed hydropress blanks into coils of sheet, which are then solution-treated and quenched with little or no distortion. The purpose of solution-treatment is explained and recommendations are made regarding duration, temp., and rate of cooling. The mechanical properties of aluminium-clad 24S-O are tabulated for various degrees of hardening, the alterations produced by a stated solution-treatment being shown in each case, and similar data for solution-treatment only are given for three other commercial "clad" alloys. —P. R.

**Bright Annealing of Brass.** Ernest F. Elliott (*Metal Progress*, 1946, **49**, (2), 346).—A brief illustrated account of a bottom-electrode salt-bath furnace for the full annealing of brass cartridges. The material enters at one end, is conveyed through a long ceramic pot containing commercial nitrates, enters the washer, and returns to the starting point for unloading.—P. R.

**Atmospheres for Annealing Metals.** C. E. Peck (*Metals and Alloys*, 1945, **22**, (1), 85–91).—Describes the production, characteristics, and applications of various atmospheres produced by American proprietary fuel-oil and ammonia burners.—J. C. C.

## XIX.—WORKING

**The Rolling of Metals.—VIII–XI.** L. R. Underwood (*Sheet Metal Ind.*, 1946, **23**, (227), 475–489, 494; (228), 677–684, 696; (229), 883–892; (230), 1097–1106; (231), 1291–1306).—[VIII.]—Nadai's solution of Von Karman's equation is discussed and the effect of the application of front and back tension on roll pressure and neutral plane are considered. Orowan's theory of rolling is discussed in some detail. This theory enables the pressure distribution between the rolls and the material to be obtained by a graphical method of integration of the equation of friction hill for the case of variable coeff. of friction and/or variable constrained yield stress. In the theory the assumptions of plane sections remaining plane and of slipping friction are abandoned. [IX.]—Quantitative use is made of the various theories and the means for allowing for the effect of work-hardening, front and back strip tension, and roll flattening are considered. [X.]—The calculation of specific roll pressure with flattening and the derivation of Hitchcock's expression for the length of the flattened arc of contact is considered. [XI.]—The general nature of lateral spread is indicated and the chief experimental work on the subject reviewed to show the influence on spread of such factors as width/thickness ratio, roll diameter, coeff. of friction between the rolls and the material, &c. The principal formulæ that have been proposed to calculate spread are discussed and the special case of wire flattening is considered briefly.—R. Gr.

***The Relationship Between the Working Properties and Final Rolling Reduction Before Annealing of Sheets of Duralumin-Type Alloys Containing 3% and 4% of Copper, Made from Chill- and Continuously Cast Billets.** (Hartmann). See p. 316.

**Magnesium Practice at I.G. Farben.** —— (*Iron Age*, 1946, **157**, (26), 68).—Abstract of a report of the Combined Intelligence Objectives Sub-Committee on German magnesium production and fabrication.—J. H. W.

**A Reliable Method for Estimating the Technological Plasticity [of Magnesium Alloys].** E. M. Savitsky (*Zavod. Lab.*, 1945, **11**, (10), 978–984).—[In Russian] It is shown that for magnesium and its alloys the magnitude of the greatest possible reduction in height during compression is a reliable guide to the capacity of the material for working under pressure.—N. A.

***The Spinning of Zinc Ribbon from Ingot Zinc for Use in Extractor Boxes in the Reduction Works at Government Gold Mining Areas, Limited.** J. C. Phillips (*J. Chem. Met. Min. Soc. S. Africa*, 1945, **46**, (3/4), 119–123; discussion, 123–124; also (abridged) *Metal Ind.*, 1946, **68**, (20), 392).—Before the war the zinc shavings used as a precipitant for gold were made from imported sheet zinc. P. discusses the difficulties encountered and the apparatus finally evolved for producing zinc ribbon by an alternative method. Molten zinc was poured on to a water-cooled rotating mandril and strips of zinc ribbon approx. 0·002–0·004 in. thick were produced.—H. J. A.

**Working of Zinc and Zinc Alloys.** O. H. C. Messner (*Schweiz. Arch. angew. Wiss. Techn.*, 1944, **10**, (12), 387–388).—Technological aspects of working of zinc and zinc alloys are discussed.—V. K.

***The Effect of Die Friction on the Temperature Distribution in the Drawing Material and on the Heating of the Die.** Erich Siebel and Robert Kobitzsch (*Mitt. K.-W. Inst. Eisenforsch.*, 1943, **26**, (7), 91–95).—Thermodynamic considerations of the flow of heat generated by the deformation and by the friction on the surfaces of the drawn material show that its surface temperature is proportional to the coeff. of friction, resistance to deformation, and the square root of the product of speed of drawing and die length. At high speeds of drawing most of the heat generated remains in the drawn material.—V. K.

**" Reactive " Wire Drawing.** John E. Parton (*Wire Ind.*, 1946, **13**, (148), 210).—A letter, suggesting that the term " reactive wire drawing " should be restricted to the process in which the back tension is a fixed proportion of the forward tension and is applied by means of differential gearing. For processes in which the back tension is independent of the forward tension, " pre-stressed wire drawing " or " drawing pre-stressed wire " are considered to be more suitable descriptions.—J. C. C.

**Wire-Drawing Machines—Past, Present, and Future.** N. Davidson (*Wire Ind.*, 1946, **13**, (148), 211–214).—An address to the staff school of Frederick Smith and Co., Ltd., briefly reviewing progress in machine design since 1930 and referring to the use of individual motors for each block and to Vaughan D.C. and Morgan Connor A.C. machines. There is a future for special machines designed for specific products. Mention is made of the possibility of developing extrusion or swaging as methods for wire production.—J. C. C.

**German Practice in Extruding Zinc Alloys.** Sam Tour (*Iron Age*, 1946, **157**, (26), 54).—Abstract of a Joint Intelligence Objectives Agency report on the German war-time use of extruded bars, shapes, and tubes of high-stress zinc-base alloys as substitutes for free-cutting brass.—J. H. W.

**Production Processes: Their Influence on Design. VII.—Deep Drawing.** Roger W. Bolz (*Machine Design*, 1946, **18**, (1), 119–126).—Practical limits for reduction are indicated for various types of die, work, and material. In many instances tapering, necking, upsetting, &c., can be combined to obviate expensive machining operations. The rubber-die-forming process, which is described, often permits the blanking and forming of parts in one operation; it is especially successful with light alloys, copper, and light-gauge steel sheet. The stretch press is often used for parts with fairly symmetrical contours and without considerable reverse bends, but the marginal allowances are so great that scrap may reach 33%. B. states that (1) the high-speed mechanized press is best suited to the production of large numbers of drawn parts having plain shapes requiring a single operation, (2) round cross-sections are the most easily produced, (3) the drawing of flanged parts results in increased wear on dies: the radius of the drawing edge should be carefully controlled and recommendations are made on the relation between radius and gauge in stainless steel, magnesium and aluminium alloys, nickel, Monel metal, and Inconel, (4) corner radii should be as great as possible (at least 5 times the gauge) and especially generous allowances should be made in rubber-die forming, (5) the depth of hollows and height of projections should not exceed twice the gauge, (6) drawn parts should be flat-bottomed, and (7) in deep-drawing irregular parts the tendency to form bulges or wrinkles should be counteracted by making depressions, &c., before drawing. Desirable ductilities for 19-gauge soft sheet are given for a number of metals and alloys and recommendations are made regarding the framing of specifications, the deep drawing of magnesium, drawing speeds for different materials, and tolerances.—P. R.

**Production Processes: Their Influence on Design. VIII.—Swiss Automatic Machining.** Roger W. Bolz (*Machine Design*, 1946, 18, (2), 117–119).—The high-precision automatic screw machine developed for use in the clock and watch industries is now widely used to produce small parts in which high precision is required. The machine and available capacity ranges are described and the speed and accuracy of Swiss and American machines compared. Suitable attachments permit centering, boring, reaming, tapping, slotting, and light milling.—P. R.

**The Manufacture of [Steel-Backed Sintered Lead-Bronze] Wrapped Bushes.** —— (*Machinery* (*Lond.*), 1946, 68, (1756), 713–718).—Describes press operations in the forming of a standard range of wrapped bronze bushes from strip steel, coppered on one side and coated on the other with lead-bronze alloy (applied in powder form and bonded by sintering).—J. C. C.

**Brazed Stampings Reduce Engine Weight.** Paul Klotsch (*Machine Design*, 1946, 18, (2), 123–127).—An illustrated description of a 26-h.p. automobile engine, which weighs 58 lb. and is constructed largely from sheet-metal stampings. The sheet-steel cylinder-block assembly is brazed with copper, which is applied to the joints as sheet, wire, or paste. The crankshaft pulley, fan assembly, and fan pulley are also copper brazed. The crank-case is an aluminium alloy casting and the pistons are of heat-treated aluminium alloy. —P. R.

**Combination Method of Forging Magnesium [Alloys].** A. L. Rustay and F. B. Roto (*Machinery* (*Lond.*), 1946, 69, (1764), 129–136).—All standard magnesium alloys can be finish-forged under a hammer, provided that the initial metal movement is accomplished by blocking in a slow-moving hydraulic press. By this procedure, the need for using very large hydraulic finishing presses is obviated. Forging should be carried out at 700°–725° F. (371°–385° C.) and the blocker dies should be maintained at 600° F. (315° C.). Reheating, when necessary, should be at 600°–650° F. (315°–343° C.). Some typical forgings are illustrated and reference is made to the use of special coating treatments for protecting magnesium alloys.—J. C. C.

**Recent Research in Metal Machining.** D. F. Galloway (*Proc. Inst. Mech. Eng.*, 1945, 153, 113–127; discussion, 128–132).—In reviewing recent research on metal machining, G. discusses chip formation under three headings: (1) continuous chips formed *without* built-up edge, (2) continuous chips formed *with* built-up edge, (3) discontinuous chips. Chip formation is shown to be a process of deformation and ultimate failure by shear, and an approximate quantitative analysis of the process is given. The action of cutting fluids and the results of practical research in rough machining, finish-machining, finish-turning, and boring operations are discussed.—H. J. A.

**Oxidation by Friction of Machined Metals.** K. Lipacher (*Anz. Maschinenwesen*, 1941, 63, (71), 21–22; *Chem. Zentr.*, 1942, **113**, (I), 415; *C. Abs.*, 1943, **37**, 6226).—No pairs of metals are yet known which do not undergo oxidation during friction, but some react better than others, *e.g.*, brass/brass, brass/steel, and brass/chromium. Rust-free steels always give very poor results. If it is impossible to eliminate unfavourable combinations, it is recommended that a galvanic coating be applied. The use of lubricants such as graphite and high-molecular oils is also helpful. Other means are discussed.

**Machining Powder-Metal Parts.** Harry L. Strauss, Jr. (*Machinist* (*Eur. Edn.*), 1946, **90**, (13), 539).—The tool materials recommended and the coolants required for boring, drilling, reaming, and milling powder-metal parts are given. Variations in structure of these parts may be met by: (1) spots of different density, (2) porosity and voids, and (3) poor core structure. Carbide is recommended for machining copper–nickel and copper–chromium alloys, and high-speed steel for brass and copper.—J. H. W.

## XX.—CLEANING AND FINISHING

**Soft-Water Rinse Improves Aluminium Finishes.** Robert S. Herwig (*Iron Age*, 1946, **158**, (2), 58–59).—Increased production and fewer rejects result from the use of rinse water of zero hardness in the electroplating or anodizing of aluminium products.—J. H. W.

**Cleaning and Sterilization of Receptacles and Utensils Used in Dairy Work.** Georges Ray (*Chim. et Ind.*, 1946, **55**, (1), 23–30).—The respective advantages and disadvantages of steel and aluminium alloys as used in the dairy industry are discussed.—H. J. A.

**The Influence of Manufacturing Defects Due to Melting Technique on the Ability of Some Alloys to be Polished.** Edmund R. Thews (*Oberflächentechn.*, 1942, **19**, 3–4; *Chem. Zentr.*, 1942, **113**, (I), 2192; *C. Abs.*, 1943, **37**, 3384).—Iron-containing bronzes and special brasses sometimes show hard spots which cannot be polished with the usual agents. Addition of aluminium prevents the formation of such spots, which are caused by iron carbides. The lack of ability of copper alloys to take a good polish is often due to insufficient attention to the properties of the alloying materials with regard to melting technique.

***The Electrochemical Polishing of Metals. I.—The Electrochemical Polishing of Nickel.** V. I. Lainer (*Zhur. Priklad. Khim.*, 1945, **18**, (4/5), 236–246).—[In Russian] Nickel can be successfully polished electrochemically in $H_2SO_4$ solution in a very short time; the optimum concentration of acid is 68·7% (sp. gr. 1·6) and the temp. 40° C.—N. A.

**Ultra-Fine Surfaces on Metals.** Kenneth Rose (*Metals and Alloys*, 1945, **22**, (1), 70–75).—A general review of methods of producing fine surface finishes and measuring surface roughness.—J. C. C.

**Metal Finishing. VIII.—Paints, Varnishes, and Enamels.** H. Silman (*Sheet Metal Ind.*, 1946, **23**, (229), 949–953, 956).—The reasons for the use of pigments in paints, lacquers, and enamels are explained. Of the white pigments, the chief non-reactive metallic are antimony trioxide, titanium oxide, and lithopone, with white lead (basic lead carbonate essentially) and zinc oxide as the leading reactive whites. Methods of producing these materials and their properties in relation to paints are described.—R. Gr.

## XXI.—JOINING

**Bonding of Rubber to Metal.** G. Proske (*Gummi-Zeit.*, 1942, **56**, 183–184, 195–196, 207–209; *C. Abs.*, 1943, **37**, 5619).—A general review, with quantitative data and recipes, of various processes for bonding natural and synthetic rubber mixtures to metals.

**A New Method for Obtaining More Secure Adhesion Between Rubber and Aluminium.** G. Génin (*Ind. Chim.*, 1941, 28, 266–267).—A discussion of the Yates process.

**" Araldit "—A New Plastic Material for Joining Light Metals.** E. Preiswerk and A. von Zeerleder (*Schweiz. Arch. angew. Wiss. Techn.*, 1946, **12**, (4), 113–119).—Describes a new thermoplastic material " Araldit-Ciba," developed for joining light-metal parts such as sheets, tubes, &c. The pieces to be united are cleaned of dirt and grease and then held together to prevent movement. The powdered plastic is spread around the joint, which is then warmed to 120°–220° C. for 5–120 min., when the powder melts and fills the joint, final hardening taking place on cooling below 100° C. An intimate bond is formed without the application of pressure. Properties of pure Araldit are: tensile strength 7–8 kg./sq. mm., bending strength 1200–1300 kg./sq. cm., impact strength 13–14 kg./sq. cm., and elastic modulus 30,000–31,000 kg./sq. cm. The strength of joints made between light metals, and measured in terms of shear strength, is 2·3 kg./sq. mm. from −58° to 80° C., decreasing slightly between 80° and 100° C. and rapidly to 0·7 kg./sq. mm. at 120° C., after which the Araldit again becomes liquid. Joints subjected to alternating-bend tests at a load of 11 kg./sq. mm. have a life of more than 20 million reversals; failure, when it occurs, usually takes place outside the bond. The plastic is resistant to water, aliphatic and aromatic compounds, and anodic oxidation, if not heated above its softening temp., 80° C.; it is tasteless, odourless, and non-poisonous, and can therefore be used in the construction of food containers. Flanged and butt joints between light metals, light metals and aluminium bronze, and light metals and steel are illustrated.—E. N.

**Soft Solders and Soldering Technique.** L. G. Earle (*Sheet Metal Ind.*, 1946, **23**, (227), 515–521; (228), 719–724; (229), 945–948, 954).—The history and properties of solders are described, the fundamentals of joint formation and solder penetration discussed, and the practical application of these principles is considered. Advice is given on the technique of soldering various types of articles.—R. Gr.

***A Study of the Behaviour of Ruthenio–Palladium in Torch Flames, with the Object of Improving Soldering Technique.** R. H. Atkinson and G. P. Gladis (*Metals Technol.*, 1946, **13**, (3); and *A.I.M.M.E. Tech. Publ.* No. **1982**, 9 pp.).—Palladium–ruthenium alloys used for jewellery were found to undergo surface damage in areas which had been repeatedly heated when ornaments were built up by soldering. This was regarded as due to heating in atmospheres which were alternately oxidizing and reducing. Laboratory samples of ruthenio–palladium (4·5% ruthenium) were repeatedly heated and cooled using (*a*) oxy-acetylene, (*b*) air–acetylene, (*c*) oxy-city gas, and (*d*) oxy-hydrogen flames, in reducing, oxidizing, and neutral conditions. The samples were then examined microscopically and submitted to bend tests. The results are tabulated and photomicrographs are reproduced. The oxy-acetylene flame produced the least damage and the air–acetylene flame was the next most satisfactory. In all cases reducing flames caused most damage. The oxy-acetylene flame can also be used without fear on the normal platinum solders.—W. H.-R.

**Silver Simplifies Shunt Soldering.** U. L. Smith and Paul MacGahan (*Machinist* (*Eur. Edn.*), 1946, **90**, (9), 339).—The soft soldering of ammeter shunts was often imperfect. Silver soldering, although producing a much better joint, was too slow for volume production until high-frequency induction heating was used. This method of silver soldering is briefly described.—J. H. W.

**Silver Alloys Braze Auto Parts.** Adolph Bregman (*Machinist* (*Eur. Edn.*), 1946, **90**, (6), 208–209).—The use of low-m.-p. alloys, improved methods of application, and better heating methods and equipment increased the application of silver alloys for brazing automobile parts. The particular applications of these alloys are tabulated.—J. H. W.

**Electric-Furnace Brazing.** H. D. Hendrick (*Machinery* (*Lond.*), 1946, **68**, (1752), 585–591).—Furnace brazing with copper, brass, and silver solders is described. Furnaces, atmospheres, brazing alloys, fluxes, and questions of joint design are briefly considered.—J. C. C.

***On a New Type of Defect in Light-Metal Welds and Its Elimination.** H. Mäder (*Aluminium*, 1944, **26**, (5/6), 83–84).—Blisters in the vicinity of welds in aluminium–magnesium–manganese alloys are attributed to the trapping of evolved gas. They can be eliminated by the addition of further constituents to the alloy, which increase its freezing range, thereby allowing the gases to escape before complete solidification. The properties of the new alloy, " Berghaus-Aluminium, Al–Mg 75," were studied and compared with those of the alloy Al–Mg 7. After normal solution-treatment at 580° C. for 30 min., the new alloy has a layer-corrosion-resistance equal to, and a stress-corrosion-resistance superior to, that of Al–Mg 7.—E. N.

**The Practical Significance of Recent Work on the Pressure Welding of Light Alloys.** R. F. Tylecote (*Sheet Metal Ind.*, 1946, **23**, (230), 1165–1167, 1178).—In a short historical survey of the subject it is stated that pressure welding of aluminium by hammering while hot was used extensively in Germany over 40 years ago. The principles and technique of the modern method of pressing together the cold metals are described. Pickling or, preferably, scratch brushing the surfaces is necessary prior to welding, which is accomplished by a minimum critical deformation to break up the thin oxide film followed by recrystallization. Applications of the method are cited.—R. Gr.

**The Welding of Non-Ferrous Metals.—VII.** E. G. West (*Sheet Metal Ind.*, 1946, **23**, (227), 553–564; (228), 755–761; (229), 961–970; (230), 1168–1177; (231), 1375–1382).—W. considers the resistance welding of aluminium alloys in a series of sections on the specific requirements of aluminium and its alloys for satisfactory welding, machine data, properties of spot welds, seam welding, and resistance butt welding. The effect of aluminium oxide films as an advantage owing to their high electrical resistance, and disadvantages in other directions, are indicated. Aluminium and its alloys require up to eight or nine times the power required for steel spot welds and the requirements of machines for this purpose are high currents, accurately controlled, flowing for short times, with exact synchronization of the required pressure. Information is given about the preparation of the metal surfaces, machine setting, electrodes, and control-test methods. The results of metallurgical examination of spot welds by various authorities are described, and it is stated that the resistance to corrosion is reduced by spot welding. The possibilities of seam welding are discussed, and it is stated that the advantage of high speed for thicknesses up to 0·1 in. almost outweigh the plant cost. Alloys are easier to weld than aluminium. The technique of seam welding and the properties of the welds are described. Experiments on pressure welding, and the trends in flash and butt welding are referred to briefly. Aluminium and several of its alloys are now brazed on a production basis, although only on a small scale in this country. The subject is dealt with in the sections on: fundamentals of aluminium brazing, fluxing, filler metal, methods used—*i.e.* flame, furnace, dip, electric—properties of brazed joints, and applications. The welding of magnesium alloys requires particular types of joint, care in fluxing, and cleaning of the metal surfaces. The properties of the alloys are described. The welding processes that may be used are chiefly the oxy-gas methods, while the heliarc or argon-arc methods are being developed commercially; resistance welding is confined to spot welding up to thicknesses of about 12 S.W.G.; pressure welding is also possible. These methods are described and details of technique are explained.—R. Gr.

**How to Weld Aluminium.** —— (*Iron Age*, 1946, **157**, (25), 50–55; (26), 60–64; **158**, (1), 67–71; (2), 53–57).—A comprehensive review of modern techniques in welding aluminium, including gas, carbon-arc, metallic-arc, atomic-hydrogen, inert-gas-shielded-arc, and resistance welding, brazing, and soldering. The weldability of various aluminium alloys, electrode size and type, joint edge preparation, pre-weld cleaning, and the final inspection of joints are discussed.—J. H. W.

***Spot Welding of Light Metals in the Manufacture of Aircraft.** W. Heiz (*Schweiz. Arch. angew. Wiss. Techn.*, 1944, **10**, (8), 241–252).—Technical and economic factors controlling the production of spot-welded joints are reviewed. The effects of the spot diameter and distances between spot joints on the strength of the joints were studied and the relationship between these quantities is graphically presented. It is shown that the strength of a spot joint increases with the spot diameter and that an optimum distance between spots gives highest strength values. Macrostructures illustrating various types of spot-weld defects are given and various methods of revealing and controlling these defects are described.—V. K.

***Welded Magnesium Alloys and Their Alternating Tension–Compression Fatigue Strength.** (Thum and v. Manteuffel). See p. 317.

**Cleaning of Magnesium Alloy Sheet for Spot Welding.** K. E. Dorcas and N. H. Simpson (*Aero Digest*, 1945, **48**, 107, 112).

**Welding Small Platinum Heaters and Electrodes.** A. R. Morris (*J. Sci. Instruments*, 1946, **23**, (4), 84–85).—A note describing a device for welding thin platinum wires. The wires are accurately located on a base-plate and are heated by an oxy-coal-gas flame. The weld is accomplished by hammering a small punch held accurately above the wires.—W. H.-R.

**Welding with Powdered Metal.** —— (*Iron Age*, 1946, **157**, (25), 69).—A new welding technique involves the use of a spray of powder metal instead of the usual welding rod. The equipment consists virtually of an ordinary welding torch, but with a special nozzle and sixteen independent controls, many of them in the handle of the torch. The process is somewhat restricted at present by the number of powder metals and fluxes available, but interesting results have been obtained in welding, brazing, and hard and plastic surfacing with lead, tin, zinc, cadmium, aluminium, copper, iron, magnesium, manganese, nickel, silver, and alloys of these containing beryllium, bismuth, carbon, cobalt, molybdenum, and tungsten.—J. H. W.

**Joining of Zinc and Zinc Alloys.** O. H. C. Messner (*Schweiz. Arch. angew. Wiss. Techn.*, 1944, **10**, (11), 356–358).—Various joining methods, *viz.* riveting, soldering, and welding of zinc and zinc alloys are briefly reviewed.—V. K.

**The Repair of Casting Defects by the Slavyanov (Arc) Method of Welding.** I. F. Mart'ynenko (*Sudostroenie*, **1945**, (2), 19–21).—[In Russian] Problems arising in the welding of copper-base casting alloys are reviewed. Satisfactory results in welding lead-free alloys were obtained with electrodes containing: aluminium 7–8, manganese 1·5–2, iron 0·6–1, zinc 3–4%, and copper remainder. The electrodes were coated with fluxes containing: ferrosilicon 60, manganese ore 40, and sand 10 parts by weight. The weld metal obtained possesses mechanical properties equal to those of the parent metal. —V. K.

**Improvements in Manual Arc Welding.** W. J. Conley (*Metal Progress*, 1946, **49**, (1), 103).—Improved practice has permitted the use of larger electrodes and heavier currents, with the economy in time and material which is shown for T joints and butt joints. It requires a larger capacity in welding machines, but results in easier welding.—P. R.

**Measurement and Effect of Contact-Resistance in Spot Welding.** Robert A. Wyant (*Elect. Eng.*, 1946, 65, (1), 26–33).—Static and dynamic methods of measuring contact-resistance are described, with special reference to the spot welding of aluminium alloys.—E. V. W.

**Application of Quality Control to Resistance Welding.** L. S. Hobson, R. S. Inglis, and R. P. McCants (*Elect. Eng.*, 1945, 64, (8), 573–575).—Standard samples of material identical with production parts are welded under production conditions and then tested to destruction in a torsion device. The diameter, torque, and angle at failure are measured and combined into a single figure indicative of weld quality. This figure is plotted on control charts.
—E. V. W.

**Projection Welding for Short Runs.** R. O. Klenze (*Machine Design*, 1945, **17**, (11), 101–106).—Pressure-type resistance welding machines can be economically adapted for production of limited numbers of parts by the temporary mounting of inexpensive fittings. Illustrated examples are considered in detail. K. recommends that (*a*) the part be carefully designed and the welding procedure accurately established and followed, (*b*) parts must be clean, this is of the first importance, (*c*) a satisfactory heat balance must be maintained between parts of different thickness, and (*d*) preliminary experimental welds should be made in the case of large projections.—P. R.

***The Strength and Safety of Welded Connections.** M. Roš (*Schweiz. Arch. angew. Wiss. Techn.*, 1946, **12**, (1), 1–12; (2), 48–63; (3), 73–92).—A study of the working stresses in welded joints from considerations of experimental fatigue results and analytical methods. Assuming values for riveted joints and the Mises–Hencky relation for failure under combined stresses, expressions and curves are obtained for the permissible limiting-stress conditions in the fusion zone of: (1) longitudinal, circumferential, and spiral butt seams in pressure lines, boilers, and gas cylinders, and (2) V- and X-butt welds, longitudinal and transverse fillet welds in plates and beams. Both (1) and (2) are further subdivided into Classes I and II, which may or may not have been machined or heat-treated. The new formulæ, together with specifications for static tests, are designated EMPA 1945; they are compared with, and replace, those in use from 1935 to 1944.—E. N.

## XXII.—INDUSTRIAL USES AND APPLICATIONS

**Light Alloys in Shipbuilding.** A. A. Pravdin (*Sudostroenie*, **1945**, (3/4), 31–36).—[In Russian] Economic and engineering aspects of the application of light alloys in shipbuilding are reviewed.—V. K.

**Progress Report on Light-Metal Bearings.** R. Sterner-Rainer (*Motortechn. Z.*, 1941, **3**, 259–262; *Chem. Zentr.*, 1942, **113**, (I), 260; *C. Abs.*, 1943, **37**, 3378).—The application of light-metal alloys for slide bearings is reviewed. Special attention is given to the use of alloy KS 1275, a eutectic aluminium–silicon alloy with copper 1, nickel 1, and silver 1%. Light metals can replace bronze as bush metals when the characteristics of the light metals are properly taken into consideration.

**Deformation Under Pressure of Brazed Aluminium Tank.** L. W. Combs (*Product. Eng.*, 1943, **14**, 581–582).

**Aluminium and Its Alloys in Canning.** T. D. Smith (*Sheet Metal Ind.*, 1946, **23**, (228), 699–706; (229), 909–912).—A brief account of the use of aluminium and its alloys for canning in various countries. The materials available and their advantages are indicated, the methods of fabrication are described and illustrated, and methods of protection are given. The method of impact extrusion of cans of aluminium and its alloys is shown. Examples of the use of the materials are listed.—R. Gr.

# TELCON METALS

TELCON TCM

## ★ Magnetic Alloys

**MUMETAL**
**RADIOMETAL**
**RHOMETAL**

High magnetic permeability and low electrical loss are outstanding characteristics of TELCON nickel-iron alloys MUMETAL, RADIOMETAL and RHOMETAL. They are used extensively for transformer cores, chokes, shields, cathode ray tube magnetic screens, indicating instruments, etc.

## ★ Resistance Alloys

**TELCUMAN**
**PYROMIC**
**CALOMIC**

TELCON resistance alloys include: (*a*) TELCUMAN, a copper-manganese alloy with low temperature co-efficient for use in laboratory and other precision equipment. (*b*) PYROMIC and CALOMIC nickel-chromium and nickel-chromium-iron alloys for all types of wire-wound resistors.

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**Glass Sealing Alloys**
**TELCOSEAL**
for glass to metal seals.

**TELCON**
**BERYLLIUM-COPPER**
**ALLOY (Cu—Be 250)**
for spring and diaphragm parts.

*Full details on request to the Sole Manufacturers*

**THE TELEGRAPH CONSTRUCTION & MAINTENANCE CO. LTD.**
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