

METALLURGICAL ABSTRACTS

	PAGE
I. Properties of Metals	281
II. Properties of Alloys	288
III. Structure (Metallography; Macrography; Crystal Structure).	293
IV. Dental Metallurgy	—
V. Powder Metallurgy	295
VI. Corrosion and Related Phenomena	295
VII. Protection (other than by Electrodeposition)	298
VIII. Electrodeposition	300
IX. Electrometallurgy and Electrochemistry (other than Electro- deposition)	300
X. Refining	301
XI. Analysis	301
XII. Laboratory Apparatus, Instruments, &c.	304
XIII. Physical and Mechanical Testing, Inspection, and Radiology.	305
XIV. Temperature Measurement and Control	307
XV. Foundry Practice and Appliances	308
XVI. Secondary Metals: Scrap, Residues, &c.	—
XVII. Furnaces, Fuels, and Refractories	310
XVIII. Heat-Treatment	310
XIX. Working	310
XX. Cleaning and Finishing	—
XXI. Joining	—
XXII. Industrial Uses and Applications	—
XXIII. Miscellaneous	—
XXIV. Bibliography	311
XXV. Book Reviews	—

AUTHOR INDEX TO ABSTRACTS

- ABRAHAMCZIK, E., 304.
 Afanas'ev, Ya. E., 308.
 Akimov, G. V., 284, 298.
 Anderson, R. E., 310.
 Armand, M., 281.
 Baldwin, W. M., Jr., 285.
 Band, W., 287.
 Bandel, G., 296.
 Barker, L. J., 288.
 Bates, L. F., 292.
 Bayer, K., 296.
 Belyakova, E. P., 294.
 Berkovsky, I. Ya., 308.
 Betty, B. B., 291.
 Bischof, W., 306.
 Blackstone, H. A., 295.
 Blank, A. I., 291.
 Bocharov, A. A., 288.
 Both, E., 290.
 Brandenberger, E., 297.
 Britton, H. T. S., 301.
 Brockman, F. G., 282.
 Brown, R. H., 309.
 Burghoff, H. L., 291.
 Busk, R. S., 310.
 Castelluccio, D., 286.
 Černjaev, I. I., 282.
 Chase, H., 300, 309.
 Chevenard, P., 306.
 Cohen, A., 302, 303.
 Cook, P., 307.
 Cook, T., 307.
 Copeman, D. A., 303.
 Corbett, R. B., 305.
 Cresswell, R. A., 299.
 Crosswhite, H. M., 303, 305.
 Čupr, V., 301.
 Danilov, V. I., 295.
 Dankov, P. D., 301.
 Dannenmuller, M., 293.
 Darrin, M., 297.
 Déribéré, M., 282.
 Dieke, G. H., 303, 305.
 Eckardt, W., 293.
 Eckart, F., 289.
 Eiselstein, H. L., 291.
 Evans, U. R., 297.
 Farquhar, M. C. M., 294.
 Fast, J. D., 281.
 Feitknecht, W., 297.
 Felorus, G. A., 287.
 Fel'vashnikova, Z. I., 287.
 Feuer, G., 302.
 Flirth, F. G., 305.
 Fisher, A., 283.
 Förster, F., 281.
 Fougner, C., 288.
 Francis, J. L., 309.
 Frenkel, Ya. I., 285.
 Frischmuth, B., 305.
 Frölich, W., 299.
 Frumkin, A., 301.
 Gemant, A., 310.
 Gerold, E., 292.
 Gerould, C. H., 293.
 Gilsol, J. H., 286.
 Goldovsky, M. L., 284.
 Gousser, B. W., 289.
 Gorbunova, K. M., 301.
 Grassner, F., 304.
 Gray, E., 302.
 Griffith, L., 302.
 Grissinger, B. D., 291.
 Grüner, P., 310.
 Gullet, L., Jr., 283, 291.
 de Haller, P., 297.
 Hallowes, A. P. C., 295.
 Hanemann, H., 281.
 Hausner, H. H., 295.
 Heidenreich, R. D., 293.
 Hessenbruch, W., 290, 310.
 Hillier, J., 304.
 Horn, L., 290, 296.
 Horvath, T., 302.
 Hoselitz, K., 289.
 Howe, H. E., 291.
 Howson, C., 309.
 Huston, F. P., Jr., 291.
 Ingall, D. H., 309.
 van Itterbeck, A., 285.
 Jaffee, R. I., 289.
 Jernstedt, G. W., 300.
 Joffe, A. F., 287.
 Joffe, A. V., 287.
 Jolivet, H., 281.
 Kanter, J. J., 290.
 Karlus, A., 292.
 Karpachev, S. V., 301.
 Kelton, E. H., 291.
 King, C. M., 305.
 Kirillova, N. M., 302.
 Kirkbride, J. N., 302.
 Klein, F. D., 308.
 Kobitzsch, R., 306.
 Kocals, E. A., 302.
 Köhler, W., 294.
 Komar, A., 294.
 Kovacs, E., 302.
 Kroll, W. J., 283.
 Krumholz, P., 300.
 Kucherenko, D. P., 308.
 Landau, L. D., 287.
 v. Laue, M., 287.
 Laurent, (Mme.) R., 283.
 Lawrie, R. D., 309.
 Leontis, T. E., 289.
 Levich, B., 301.
 van Liempt, J. A. M., 283.
 Linnik, V., 304.
 Lipson, H., 294.
 Lloyd, T. E., 308.
 Loh, H. Y., 305.
 Luneau, J., 292.
 Lyashenko, V. I., 287.
 McCutcheon, D. M., 307.
 McIntyre, G. H., 300.
 McNulty, R. E., 293.
 Maddigan, S. E., 295.
 Makepeace, G. R., 300.
 Masling, G., 291.
 Messner, O. H. O., 311.
 Mething, K., 291.
 Mikhailov, V. V., 294.
 Molnar, L., 302.
 Montgomery, H. E., 288.
 Morey, R. E., 309.
 Müller-Hillebrand, D., 285.
 Murphy, J. P., 289.
 Obrist, A. U., 298.
 Padley, H., 309.
 Pekar, S. I., 286.
 Petermann, R., 297.
 Pfarr, J. S., 295.
 Piper, T. E., 307.
 Pisarenko, N. L., 286.
 Platunov, B. A., 302.
 Pogodaev, K. N., 282.
 Rådeker, W., 284.
 Raltheil, K., 289.
 Rassman, G., 290.
 Redston, G. D., 289.
 Riott, J. P., 305.
 Ritzau, G., 292.
 Rogers, B. A., 305.
 v. Rosenberg, H., 298.
 Rossi, P., 287.
 Rubinstein, A. M., 282.
 Ruttewit, K., 297.
 Ryazhskaya, T. K., 288.
 Schellenberger, F., 299.
 Schichtel, K., 310.
 Schlechten, A. W., 283.
 Schulz, E. H., 292.
 Serin, B., 282.
 Sha'nikov, A. I., 287.
 Shestopal, V. M., 309.
 Schneider, D., 308.
 Siebel, E., 285, 291, 300.
 Smith, A. A., Jr., 291.
 Somenzi, V., 287.
 Spacek, J., 307.
 Späth, W., 284.
 Spisak, A. A., 300.
 Stäbli, G., 291.
 Stanford, E. G., 305.
 Stanworth, J. E., 289.
 Stepanov, F. N., 308.
 Stockmeyer, W., 281.
 Taylor, H. F., 309.
 Taylor, H. W., 305.
 Thomas, H., 288, 307.
 Turner, H. W., 309.
 Vicary, G. T., 309.
 Villat, M., 284.
 Voce, E., 295.
 de Vriend, J. A., 283.
 Walker, H. L., 293.
 Wallbaum, H. J., 291.
 Walti, R., 303.
 Wenderott, B., 306.
 Wentzel, K., 305.
 Wetzel, H., 281.
 Wickert, K., 296.
 Zener, C., 294.
 Zhdanov, G. S., 294.

METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

Volume 13

AUGUST 1946

Part 8

I.—PROPERTIES OF METALS

***On the Brittleness of Aluminium After Casting.** Henri Jolivet and Marcel Armand (*Compt. rend.*, 1946, **222**, (16), 946–948).—Experiments were carried out to determine the considerable brittleness suspected to exist in aluminium immediately after solidification down to much lower temperatures. The liquid metal was poured at 800° C. into a small metal mould heated to 650° C. The brittleness of the specimen was demonstrated by its appearance after bending through 90° at different temperatures during cooling. The metal consisted of: (a) iron and silicon traces, aluminium 99.99%; (b) iron 0.17, silicon 0.31, aluminium 99.52%; (c) iron 0.46, silicon 0.35, aluminium 99.19%. If t_1 is the temperature above which the specimens cracked in bending and broke, and t_2 the temperature above which the brittleness progressively disappeared and the specimens bent without cracking: for metal (a), t_1 and t_2 are independent of the rate of cooling and lie around 630° C., for (b) and (c) they are 580° and 570° C., respectively, for rapid cooling and 630° and 620° C. for slow cooling. After rapid cooling followed by reheating, brittleness does not recur below 620° C. Micro-examination supplied the explanation of the phenomenon. The metal containing appreciable silicon shows the aluminium-iron eutectic (Al–Al₃Fe) after slow cooling, and the aluminium-iron-silicon eutectic (Al–Al₄FeSi) after rapid cooling. The melting point of the latter is 575° C. The disappearance of brittleness on reheating is bound up with the diffusion and the solution of the silicon, which is accompanied by a coalescence of the eutectic.—J. H. W.

Metals as Getters. J. D. Fast (*Philips' techn. Rundschau*, 1940, **5**, 221–226; *Chem. Zentr.*, 1941, **112**, (I), 1451; *C. Abs.*, 1943, **37**, 1659).—In order to obtain the desired high vacuum in radio tubes, X-ray tubes, &c. and to maintain it after sealing, metals which absorb and fix gases are used, such as barium and zirconium. The properties on which the action of these getters depends are discussed. Barium and other metals used are attacked with the formation of a new phase. In this case, in contrast to the process involved in corrosion-resistant metals, it is essential that the chemical process be able to proceed continuously without the formation of a closed surface layer of the reaction products. The action of zirconium depends on the remarkably high solubility in this metal of most of the gases concerned in such evacuation of tubes. Details of the use of such metals are discussed.

***On Solutions of Metals [Cadmium] in Fused Salts.** (Karpachev) See p. 301.

***The Question of Magnetic Hysteresis in Iron and Nickel.** Fritz Förster and Hans Wetzol (*Z. Metallkunde*, 1941, **33**, 115–123; *C. Abs.*, 1943, **37**, 329).—Iron and nickel wires will show some size increase owing to magnetic hysteresis. With increasing temperature, the size of cold-drawn iron wire increases more rapidly. Evidence of this phenomenon decreases if the wire has been previously annealed. Magnetization increases with stress on either iron or nickel wires. Hysteresis curves are given for the two metals.

***Disintegration and Liquation of Hard Lead [and Lead-Antimony Alloys].** Wilhelm Stockmeyer and Heinrich Hanemann (*Z. Metallkunde*, 1941, **33**, 67–68; *C. Abs.*, 1943, **37**, 329).—Melting points and relative times for melting

* Denotes a paper describing the results of original research.

† Denotes a first-class critical review.

various lead-antimony alloys, containing up to about 13% of antimony, have been determined, as well as heat capacities and pouring temperatures for the different compositions. In setting up a standard practice for disintegration and liquation of lead-antimony alloys it is important to consider the heat capacity of the mould and ladle.

The Problem of Pure Manganese. The Chemical Balance Sheet of the Electrothermal Refining of Ferro-Manganese. M. Dérivé (Chim. et Ind., 1945, 54, (3), 172-176).—Detailed charge sheets are given showing the progress of refining ferro-manganese containing 78% of manganese (with carbon 6, silicon 1.5, and phosphorus 0.5%) when treated in an electric furnace, under an oxidizing slag, to yield a product containing 86.5% of manganese, less than 0.5% of carbon, and only traces of silicon and phosphorus.—J. C. C.

***Production and Properties of Nickel [Filaments for] Bolometers.** Frank G. Brockman (J. Opt. Soc. Amer., 1946, 36, (1), 32-35).—Nickel bolometer filaments as thin as 0.1μ have been made, and their properties investigated. The filaments, which were made by electrodeposition of nickel on to copper foil and subsequent electrochemical solution of the copper under stated conditions, appeared to possess the properties of bulk nickel.—H. J. A.

***Diffusion of Nickel in Rock Salt.** K. N. Pogodaev (Trudy Vostochn.-Sibir. Gosudarst. Univ., 1940, 2, (1), 65-86; Khim. Referat. Zhur., 1941, 4, (4), 12; C. Abs., 1943, 37, 4608).—[In Russian.] Cf. Zhur. Eksper. Teor. Fiziki, 1938, 8, 992-997. A number of problems connected with the structure of a solid body can be solved by studying diffusion in solid media. The diffusion velocity in the crystal lattice permits the determination of the possible energy levels occupied by the diffusing particles, and characterizes the behaviour of foreign ions in the lattice under the influence of thermal motion. The fundamental physical laws of diffusion can be studied under the simplest conditions when the diffusion takes place not in the polycrystalline metals, but in alkaline earth mono-crystals. The diffusion of nickel in rock salt was used for this purpose. The temperature dependence of nickel ions was studied in the interval 627° - 780° C. The relation between the coeff. of diffusion and the temperature is given by $D = 0.42e^{-13220/T}$ sq. cm./sec. There was satisfactory agreement of the experimental results with the results obtained from the Einstein equation. The diffusion of nickel and of copper ions in rock salt cannot be explained satisfactorily by the Dushman-Langmuir and Braune equations. By means of the Born cycle it was shown, on the example of nickel and copper ions in rock salt, that the possibility of the occurrence of diffusion can be determined by the energy ratio. The experimental and mathematical parts of the studies are described in detail.

***A New Method of Producing Spectral-Pure Platinum.** I. I. Černjaiev and A. M. Rubinstein (Compt. rend. (Doklady) Acad. Sci. U.R.S.S., 1945, 48, (5), 332-333).—[In English.] Spongy platinum is dissolved in *aqua regia*, and the solution evaporated twice with HCl and once with hot water. The resulting solution of H_2PtCl_6 is diluted and treated with KCl to precipitate K_2PtCl_6 , which is washed and dried, and then treated with hot KNO_3 solution. Reduction and nitrification occur, giving rise to a solution of $K_2Pt(NO_2)_4$, which is treated with ammonia to precipitate $(NH_3NO_2)_2Pt$, a salt which has negligible adsorption characteristics. Further purification is effected by oxidizing with gaseous chlorine to give $(NH_3NO_2)_2Cl_2Pt$, which is recrystallized several times and heated to produce pure metallic platinum, free from iridium, palladium, and iron.—G. V. R.

***Heat-Treatment of Semi-Conductors and Contact Rectification.** B. Serin (Phys. Rev., 1946, [ii], 69, (7/8), 357-362).—In making silicon-tungsten point contact rectifiers it is usual to heat the silicon at approx. 1000° C. for 1 hr. S. suggests that this treatment causes evaporation of impurities (e.g., aluminium and boron) from the surface of the silicon more rapidly than they

are supplied by diffusion from the interior. This produces a surface layer which changes the electrical characteristics of the metal-semiconductor contact. The conditions for the formation of this surface layer are discussed and a theoretical expression is developed. The surface layer increases the back-resistance and decreases the capacity of the contact, with improvement in the rectification efficiency.—W. H. R.

***On the Growth of a Grain of Zinc.** Léon Guillet, Jr., and (Mme.) R. Laurent (*Compt. rend.*, 1946, 222, (13), 735–736).—It has been shown (*ibid.*, 1943, 216, (19), 642; *Met. Abs.*, 1944, 11, 323) that a grain of pure zinc grows considerably at elevated temperatures, without previous cold work. As the rate of growth diminishes rapidly isothermally, it is not possible to obtain a single crystal by this means. This, however, can be easily effected if the metal is subjected to a small permanent deformation before annealing. Small bars of zinc, 99.99% pure, hot rolled and cold drawn, containing 320 grains/sq. mm., were subjected to 1% plastic elongation, brought to 300° C. at a rate of 25° C. per day in an electric furnace, and held there for 96 hr. In general, the result was that the bars contained 4–6 crystals several cm. long. In a large number of tests the max. length was 86 cm. and the mean 30 cm. The crystallographic orientation was generally random and the bars were often covered with a surface layer of five crystals 0.1 mm. thick, which disappeared on annealing for 2 hr. at 400° C. This method of making single crystals is analogous to those described by other workers for aluminium, magnesium, iron, and tungsten.—J. H. W.

†**Survey of Literature on the Metallurgy of Zirconium.** W. J. Kroll and A. W. Schlechten (*U.S. Bur. Mines, Inform. Circ. No. 7341*, 1946, 50 pp.).—K. and S. critically review the literature dealing with the preparation of zirconium-bearing ores, the production of zirconium metal, and the production, properties, and uses of zirconium alloys, halides, sulphides, and phosphides. A bibliography of 218 references is given.—H. J. A.

***The Fusing Time of Fuses.**—III. J. A. M. van Liempt and J. A. de Vriend (*Z. Physik*, 1940, 117, 18–19; *Chem. Zentr.*, 1941, 112, (I), 1713; *C. Abs.*, 1943, 37, 2315).—Cf. *Met. Abs.*, 1935, 2, 644; 1936, 3, 37. The fusing time constant C was determined by the method of G. J. Meyer for various metals and alloys. The following values are reported for the metals (as $C \times 10^{-6}$): gold 575 ± 17 , aluminium 360 ± 10 , palladium 236 ± 2 , cobalt 210 ± 10 , zinc 200 ± 17 , magnesium 199 ± 9 , tantalum 167 ± 6 , iron 147 ± 2 , steel 105 ± 2 , cadmium 98 ± 4 , zirconium 63 ± 2 , and lead 32 ± 1 . The following values are reported for the alloys indicated: Konel (nickel 73, cobalt 17, iron 7, titanium 2.5, manganese 0.5%) 145 ± 6 , 80:20 copper-nickel alloy 262 ± 1 , 70:30 copper-nickel alloy 221 ± 4 , 55:45 copper-nickel alloy 135 ± 3 , 90:10 copper-nickel alloy 294 ± 12 , 70:30 nickel-copper alloy 150 ± 4 , 75:25 tin-lead alloy 32 ± 1 , 63:37 tin-lead alloy 31 ± 1 , 78:20:2 nickel-chromium-iron alloy 109 ± 2 , 58:42 iron-nickel alloy 79 ± 3 . Comparative measurements made on round wires and wires with edges showed that the form of the cross-section has no effect on the value found.

The Importance of Ultimate Extension as an Engineering Property of Materials. A. Fisher (*Metallurgia*, 1946, 34, (200), 77–84).—One of the properties in the ductility group, percentage ultimate extension, is discussed. It is considered that a condition of specific strain is far more common in engineering structures than is generally supposed. It is stated that, under a condition of specific strain, it is quite useless to use a material with a higher modulus of elasticity, a higher proof strength, or any higher property which moves the stress-strain curve to the left in the hope that higher strength will result, because such a move merely results in higher stress being generated. Under conditions of specific strain, a component will fracture if its available percentage extension is below that required under the imposed strain, irrespective of

its strength. Hence, percentage ultimate extension indicates a valuable property in any material to be used where stress concentrations exist.—J. W. D.

Comparisons Between Values of Hardness and Mechanical Strength. W. Späth (*Metallwirtschaft*, 1941, 20, (49/50), 1185-1187; *Chem. Zentr.*, 1942, 113, (1), 2322; *C. Abs.*, 1943, 37, 3379).—A discussion of the relation between stress and deformation and of the present state of the development of these two research fields leads to the conclusion that, in future, the recently gained knowledge of the mechanical properties will be applied also to the theory of hardness. This will influence the measurement of hardness, which will be made under consideration of the effect of deformation, hardening, and time of loading.

On the Hardening of Metals. G. V. Akimov (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1945, 47, (8), 546-549).—[In English.] The distribution of electron density in crystals with different types of bond (ionic, atomic, molecular, and metallic) is briefly considered and correlations between the metallic bond and metallic properties are discussed. It is suggested that the deformation-hardening of metals is due to localized transition from the metallic type of bond to the atomic type, so that rigid "electron bridges" are formed between atoms. The atomic bond corresponds to a higher energy level than the metallic bond and this is responsible for the considerable absorption of energy during deformation. The regions in which the transformation has occurred are regarded as having a continuous, rigid skeleton of atoms, with high strength and hardness, and low plasticity. When these regions are sufficiently continuous throughout the metal to isolate unchanged ductile regions, the plasticity is exhausted and the structure breaks on further deformation. The implications of this theory are discussed.—G. V. R.

***Wear in Non-Ferrous Metals by Dry Friction.** W. Rüdeker (*Metallwirtschaft*, 1944, 23, (22/26), 202-215).—An apparatus is described in which a revolving disc of metal wears an impression in the flat surface of a plate of the same or dissimilar metal under controlled conditions of load, time, &c. The load was kept constant at 7.9 kg./sq. mm.; the lubricants consisted of liquid air, air, water, and oil; the temperature varied from -190° to 700° C.; two disc speeds were used, 1.8 and 9.5 m./sec., and the duration of the test was the time during which a distance of 10,000 m. was traversed peripherally by the disc. The materials tested were: lead, zinc, Duralumin, Elektron, aluminium bronze, copper, nickel, and a few steels. The specimens were weighed before and after test and the resulting surfaces were examined by macro and micro methods for the effects of flow, grinding, &c. It is shown that: (1) wear was high at low temperatures, decreasing to a min. between 0° and 200° C. and then increasing again with increase of temperature; (2) lubrication gave results which varied, depending on the extent of chemical reaction between the lubricant and the metal surfaces, but, in general, wear was greater in water than in air; (3) variation of peripheral speed gave results depending on the nature of the surfaces in contact. It is concluded that welding processes play an important part in wear; such factors as the use of similar metals, especially when they have low melting points, direct contact of surfaces, and high temperatures, all of which favour welding, tend to increase the rate of wear; factors which prevent welding, such as the use of non-alloying metals, the formation of oxide films, and polishing due to flow, tend to decrease the effect of wear.—E. N.

Friction of Pure Metals and the Influence of Adsorbed Gases. The Temperature Coefficient of Friction. M. L. Goldovsky (*Uspekhi Fiz. Nauk*, 1941, 25, 373-376).—[In Russian.] A review.

***Researches on the Impurities in Volatile Metals, by Distillation in vacuo.** Marcel Villat (*Thesis: Ecole Polytechnique Fédérale, Zürich*, 1942, 57 pp.).—The general principles of the vacuum distillation of volatile metals are dis-

cussed, and the application of the method to the analysis of such metals is described in detail. The apparatus required, the experimental technique, and the course of typical experiments are fully described. The metal is volatilized from an externally-heated crucible in a high vacuum; the vapour, after passing through a steel-wool filter plug, is condensed on a water-cooled tube. The non-volatile residue remaining in the crucible may be analysed; in certain cases, analysis of the gas liberated before distillation begins is possible. The analysis of calcium, magnesium, zinc, cadmium, and the alkali metals is described and typical figures for the composition of the non-volatile residues are given. The separation of zinc from brass by distillation is examined; for this to give satisfactory quantitative results the sample must be very finely divided. An analogous analysis of aluminium, in which the metal is volatilized as $AlCl_3$ in a hydrochloric acid atmosphere, is described and discussed and typical results are given. The method is convenient for the determination and identification of small quantities of non-volatile impurities.—G. V. R.

Mechanics of Plastic Working. Erich Siebel (*Arch. Eisenhüttenwesen*, 1944, 18, (1/2), 13–22).—The basic equations of the plastic flow of polycrystalline materials are outlined and the application of these equations in the problems dealing with the strength of the material and with plastic working of metals are discussed.—V. K.

***Graphical Methods of Representing Some Conditions of Plasticity.** William Marsh Baldwin, Jr. (*Metals Technol.*, 1946, 13, (3); and *A.I.M.M.E. Tech. Publ.* No. 1980, 11 pp.).—The Huber-von Mises-Hencky equation defines the conditions under which plastic flow occurs in a metal subjected to multi-axial stress. The equation, when transferred to co-ordinates of a Cartesian system, describes a cylinder and the interpretation of this is discussed. The equation may be represented as a circle on an isometric plot and a rapid graphical method is given for determining relative strain rates, when the stresses are known, for a metal in the plastic state; conversely, the relative stresses may be determined if the strain rates are known.—W. H.-R.

***The Relation Between Adsorption and the Catalytic Activity of Metals.** A. van Itterbeek (*Meded. Kon. Vlaamsche Acad. Wetensch., Letteren Schoone Kunsten België, Klasse Wetensch.*, 1941, 3, (10), 3–20; *Chem. Zentr.*, 1942, 113, (II), 742; *C. Abs.*, 1943, 37, 4958).—On a very pure nickel film, the adsorption of hydrogen and carbon monoxide at temperatures up to 500° C. and pressures below 1 mm. was studied with the aid of a thermal-conductivity gauge. At ordinary temperatures activated adsorption of hydrogen occurs; at higher temperatures this increases and is apparently not to be attributed to diffusion adsorption. Comparison of the hydrogen and carbon monoxide isobars shows that at 167° and 329° C. the ratio of hydrogen : carbon monoxide is 3 : 1 and at two other temperatures the ratio is 2 : 1, corresponding, respectively, to the synthesis of methane and benzene. It is concluded that the occurrence of this stoichiometric surface ratio is related to the surface reactions. On a copper film neither hydrogen nor carbon monoxide is adsorbed until a small quantity of thorium is electrodeposited. In this instance also, temperatures exist at which the ratio of hydrogen to carbon monoxide is 3 : 1 and 2 : 1.

Modern Developments of the Theory of the Liquid State. Ya. I. Frenkel (*Izvest. Akad. Nauk S.S.S.R.*, 1941, [Fiz.], 5, (1), 10–11).—[In Russian.] A brief résumé of a review paper.—N. A.

***Surface Contacts Under High Pressure.** Dietrich Müller-Hillebrand (*Wiss. Veröff. Siemens-Werken*, 1941, 20, 85–103; *Chem. Zentr.*, 1942, 113, (I), 1033; *C. Abs.*, 1943, 37, 2632).—The contact resistance of oxidized and oxide-free surfaces was determined by current and voltage measurements. Rectilinear crossed bars whose overlapping surfaces were relatively heavily loaded were used. Oxide layers of copper, aluminium, magnesium, silver, zinc, and tin were tested. After dry storage in an oven at 125° C. for a period of 10–100 hr.,

the first three metals showed a marked increase in contact resistance, but the last three only a slight increase. Contact resistance is significant only if the oxide surfaces are complete; numerous fine cracks are sufficient to furnish paths for the current. With high contact pressures these cracks become more numerous. With constant hardness of the contact material the contact resistance is inversely proportional to the contact pressure, but directly proportional to the average radius of the paths of current flow. Experiments on oxide-free surface contacts (various forms of carbon, silver, copper, and zinc) show that the contact resistance is about inversely proportional to the 0.7 power of the compressive force. The roughness of the contact surfaces has a small, but still measurable, effect, in the sense that the rougher the surface the greater is the contact resistance. With aluminium and magnesium a tough oxide skin is formed even during the cleansing, which, in spite of high pressure, reduces the conducting surface. Finely-ground copper contacts show similar behaviour. On the average, the conducting points of contact were only about $\frac{1}{2000}$ - $\frac{1}{10}$ th of the contact surface. With great pressures the contact resistance greatly decreases. From the equation $R_k = cP^{-n}$ (in which R_k is the contact resistance, P is the compressive force, $n = 0.7$ to 2 depending on the oxidation of the surfaces) the relation between n and the number of conducting points, the ratio of bearing to conducting surfaces, and the variation in the average radius of conducting bridges can be derived.

***Theory of the Contact Potential Between Conductors in Equilibrium. II.—Contact Equilibria in Which Only the Electron Gas Enters. III.—Mathematical and Physical Laws for Equilibrium of Electrolytes. IV.—Contact Equilibrium Between a Metal or Alloy and a Solution of Its Ions.** D. Castelluccio (*Nuovo Cimento*, 1941, 18, 209-222, 289-297, 346-357; *Chem. Zentr.*, 1942, 113, (I), 722, 1107; *C. Abs.*, 1943, 37, 2248).—[II.]—The differential equation for the equilibrium of an electron gas in empty space, or within a metal in isothermal equilibrium, is derived by thermodynamic means. It is applied to the calculation of the thermal electron emission from metals and to the evaluation of the p.d. between two electrolytic conductors. For thermal emission the result has the form of the Richardson relation. The electrons follow the Fermi rather than the Boltzmann statistics. The potential calculated from the Volta effect is somewhat lower than the observed value. A general theory of the Peltier effect leads to results in qualitative agreement with experiment. [III.]—The differential equation for equilibrium in an isomeric liquid electrolyte is derived and an analogy between the state of a metallic ion in a gas and in a solution of an electrolyte is pointed out. [IV.]—The contact potential between the electron "atmosphere" of a metal and the ion atmosphere of a solution of salt of the metal is calculated; this is of importance in determining the solution tension of the metal. The case of a metal that is soluble or insoluble in the solid state is considered.

The Theory of Contact Potentials Between Metals and Semi-Conductors or Insulators. J. H. Gisolf (*Ned. Tijdschr. Natuurkunde*, 1942, 9, 49-65; *Chem. Zentr.*, 1942, 113, (II), 865; *C. Abs.*, 1943, 37, 5309).—A review of the work of Davydov, Mott, and Schottky on the thermodynamic equilibrium between electrons in metals and semi-conductors.

Nernst's Thermomagnetic Effect in Semi-Conductors and Metals. N. L. Pisarenko (*Izvest. Akad. Nauk S.S.S.R.*, 1941, [Fiz.], 5, (4/5), 417-421).—[In Russian.] It is shown that the magnitude and the sign of Nernst's effect in semi-conductors and metals can be explained by the dependence of the time of free travelling of electrons on the speed and by the occurrence of two types of transfer of current in semi-conductors.—N. A.

***Contact of Semi-Conductors with Metals and Electrode Potential Differences.** S. I. Pekar (*Izvest. Akad. Nauk S.S.S.R.*, 1941, [Fiz.], 5, (4/5), 422-433).—[In Russian.] The problem was considered theoretically in a different way

from that carried out earlier by Mott, so that the contact p.d.'s and their dependence on current density could be calculated.—N. A.

***Experimental Investigation of the Contact of Semi-Conductors With Metals.** V. I. Lyashenko, G. A. Felorus, and Z. I. Fel'vashnikova (*Izvest. Akad. Nauk S.S.S.R.*, 1941, [Fiz.], 5, (4/5), 434–441).—[In Russian.] The theory suggested by Pekar (cf. previous abstract) was experimentally examined and confirmed.—N. A.

***Contact of Semi-Conductors With Metals.** A. V. Joffe and A. F. Joffe (*Izvest. Akad. Nauk S.S.S.R.*, 1941, [Fiz.], 5, (4/5), 550).—[Résumé of the paper in Russian and English.] The resistance of semi-conductors was studied as a function of the contact p.d. between semi-conductors and metal electrodes. The Hole semi-conductors (Cu_2O , Cu_2S , and V_2O_5) possess an extra resistance with electrodes having a small work-function of emission (Al, Zn, Mg), while the electronic semi-conductors (WO_3 , TiO_2) possess an extra resistance with electrodes having a large work-function of emission (Au, graphite).—N. A.

On the Intermediate State of Supraconductors. L. D. Landau (*Izvest. Akad. Nauk S.S.S.R.*, 1942, [Fiz.], 6, (1/2), 79).—[In Russian.] A brief résumé of a paper including a theoretical consideration showing the possibility of an experimental confirmation of L.'s theory of an intermediate state of supraconductors.—N. A.

***An Investigation of the Intermediate State of a Supraconducting Sphere.** A. I. Shal'nikov (*Izvest. Akad. Nauk S.S.S.R.*, 1942, [Fiz.], 6, (1/2), 80–81).—[In Russian.] A brief résumé of a paper describing experiments which show that an intermediate state exists in a supraconducting sphere of tin. This was achieved by measuring the longitudinal inhomogeneity of the magnetic field in a 12–18- μ -thick cut made in the sphere.—N. A.

Supraconductivity and Magnetic Energy Between Currents. William Band (*Phys. Rev.*, 1946, [ii], 69, (5/6), 241).—A theoretical note.—W. H.-R.

Diamagnetism and Supraconductivity. William Band (*Phys. Rev.*, 1946, [ii], 69, (5/6), 241).—A theoretical note.—W. H.-R.

***Electrodynamic Interaction of Two Electrons and Welker's Theory of Supraconductivity.** Vittorio Somenzi (*Nuovo Cimento*, 1941, 8, 223–234; *Chem. Zentr.*, 1942, 113, (I), 168; *C. Abs.*, 1943, 37, 2259).—The exchange forces and interaction of two electrons are derived from the relativistic Hamiltonian function. The magnitude of the energy of interaction is considered for bound electrons, for quasi-free electrons, and for those bound to a single atom (alkaline earths). The results confirm the speculations of Welker (*Z. Physik*, 1939, 114, (9/10), 525–551; *Met. Abs.*, 1940, 7, 246), who calculated the diamagnetic moment of an electron gas on the basis of a void in the first Brillouin zone.

The Theoretical Meaning of the Justi-Zickner Investigation of Branched (Parallel) Currents in Supraconductors. M. v. Laue (*Z. Physik*, 1941, 118, 455–460).—Cf. *Physikal. Z.*, 1941, 42, 257–272. The experiments of J. and Z. on current distribution in coils in the supraconductive state are considered mathematically. It is concluded that the J.-Z. method offers no advantages over older methods as a means of detecting residual resistance in supraconduction. The correlation between the law of distribution and the extreme skin effect is discussed.—L. H.

Advantages of the Proposed Substitution of a Conventional [“ True Elastic ”] Limit. P. Rossi (*Met. Ital.*, 1941, 33, 77–81; *Chem. Zentr.*, 1942, 113, (I), 923; *C. Abs.*, 1943, 37, 2316).—R. is in favour of the new elastic limit proposed by Esser and Arend (*Arch. Eisenhüttenwesen*, 1940, 13, (10), 425–428; *Met. Abs.*, 1940, 7, 341), which uses a logarithmic representation of the function of various stress-strain characteristics of materials. The method is said to describe the properties of metals above or below the 0.2% proof-stress limit in a relatively simple manner. The problem is discussed by means of equations and curves and correlated to Hooke's law.

II.—PROPERTIES OF ALLOYS

High-Temperature Oxidation in Aluminium Alloy Forgings. Lawrence J. Barker (*Iron Age*, 1946, 157, (19), 60-64).—High-temperature oxidation was probably the greatest cause of rejection of aluminium alloy aircraft forgings during the war. The mechanism, causes, prevention, applications, and effect of this phenomenon are described, and a method of classifying it in terms of its effect on physical properties is discussed.—J. H. W.

***The Casting Properties of [Aluminium] Alloys.** A. A. Bochvar (*Sbornik. Nauch. Doklady Sektov Metallovedeniya i Termich. Obrabotki VNITO Metallurg*, 1940, 35-59; *Khim. Referat. Zhur.*, 1941, 4, (2), 76; *C. Abs.*, 1943, 37, 3384).—[In Russian.] A detailed study of two casting properties (solidification and formation of cracks) of eutectic alloys (aluminium-silicon and aluminium-copper) during casting under pressure and without pressure has revealed a close relation between the casting behaviour and the equilibrium diagram. The crack-forming property in alloys of the systems investigated decreases inversely with the content of the alloying addition.

***On the Quantitative Spectrographic Analysis of Solutions, with an Appendix on the Solubility of Silicon in Aluminium.** (Walti) See p. 303.

Bronze and Phosphor-Bronze. C. Fougner (*Tekn. Ukeblad*, 1941, 88, 213-214; *Chem. Zentr.*, 1942, 113, (I), 102; *C. Abs.*, 1943, 37, 2325).—F. describes the constitutional diagrams of copper-tin and copper-phosphorus alloys and discusses the ternary alloys of copper, tin, and phosphorus with reference to the effect of phosphorus on the properties of bronzes.

***Properties of Silicon Brasses and Bronzes Made by Using Ferro-Silicon.** T. K. Ryazhskaya (*Sudostroenie*, 1945, (2), 15-19).—[In Russian.] A study was made of the effects of silicon (using ferro-silicon temper alloys) on the mechanical and casting properties of (a) brasses containing silicon 1.5-4.5, copper 79-81, iron 0.6, lead 1.0, tin 0.3, aluminium 0.1, manganese 0.5, antimony 0.1%, and zinc the remainder, and (b) bronzes containing silicon 2.75-3.5, manganese 1-1.5, iron 0.3, lead 0.03, tin 0.25, nickel 0.1%, and copper the remainder. It was found that the mechanical properties of these alloys are mainly affected by their silicon content and that iron introduced by the temper alloy slightly reduces the ductility. Linear shrinkage of the alloys is reduced by increasing their silicon content, while their fluidity is increased.

—V. K.

***Changes in the Volume and Electrical Resistance of Copper-Beryllium Alloys During Heat-Treatment.** Hans Thomas (*Z. Metallkunde*, 1944, 36, (6), 136-140).—The volume and electrical-resistance changes occurring in a series of quenched and age-hardened alloys of copper with 0.9-3.6% beryllium and a few alloys containing up to 12% beryllium were investigated. From the data obtained it is concluded that: (1) at 170° C. there is a contraction in volume and increase in resistance due to low-temperature temper-hardening, (2) at 280° C. some reversion phenomena occur, (3) at 300°-375° C. the volume contracts and the resistance decreases quickly as a result of precipitation-hardening, (4) at 400°-600° C. reversion phenomena again occur, accompanied by a slow increase in volume and resistance. The eutectoid transformation $\alpha + \gamma = \beta$ takes place between 601° and 618° C., causing an increase in volume and resistance, and the anomalous changes which occur in alloys containing more than 3.6% of beryllium are attributed to this transformation.—E. N.

Properties of Some Cast Copper-Base Alloys at Elevated Temperatures. H. E. Montgomery (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 455-463; discussion, 463-465).—M. reviews existing literature on the high-temperature creep properties of cast copper-base alloys.—H. J. A.

***Effect of Copper and Some Other Metals on the Gold-Germanium Eutectic.** Robert I. Jaffee and Bruce W. Gonser (*Metals Technol.*, 1946, 13, (3); and *A.I.M.M.E. Tech. Publ. No. 1998*, 8 pp.).—In the gold-germanium system, the eutectic alloy at 12% of germanium melts at 356° C. and has an unusually fine eutectic structure. The corresponding eutectic valley in the ternary system gold-copper-germanium has been traced up to 30% of copper. Up to 10% of copper the phases present in the eutectic line are the face-centred cubic gold-copper solid solution and free germanium. At 20% of copper a new phase replaces the gold-copper solid solution. The effect of copper is to coarsen the eutectic structure. Hardness tests were made on the alloys, and also tensile tests of gold strip soldered with the ternary gold-copper-germanium alloys. Microstructures are reproduced of these alloys and also of gold-germanium alloys containing additions of silver, zinc, platinum, and nickel.

—W. H.-R.

***The Amphoteric Behaviour of PbSe as a Semi-Conductor.** F. Eckart and K. Raithel (*Naturwiss.*, 1941, 29, 572-573; *Chem. Zentr.*, 1942, 113, (I), 847; *C. Abs.*, 1943, 37, 5296).—The conductivity of thin PbSe films was studied (1 mμ thickness precipitated on glass) and compared with the results of Bauer (*Ann. Physik*, 1940, [v], 38, 84). Contrary to Bauer's observation, it was found that between 170° and 300° K. the conductivity did not decrease with increasing temperature, except at low selenium content. At low lead content the conductivity increases slightly with temperature.

***Properties of Cerium-Containing Magnesium Alloys at Room and Elevated Temperatures.** T. E. Leontis and J. P. Murphy (*Metals Technol.*, 1946, 13, (3); and *A.I.M.M.E. Tech. Publ. No. 1995*, 32 pp.).—The properties of magnesium-cerium alloys containing up to 10% cerium were examined at temperatures up to 700° F. (371° C.); the cerium was added in the form of "misch metal" and thus contained a large percentage of lanthanum and other rare earths which were included in the term cerium content. In general, the magnesium-cerium alloys retain much of their strength at elevated temperatures (400° F., 204° C.), and exhibit high resistance to creep over a wide range of temperatures. These properties are somewhat improved by additions of manganese and if the manganese content exceeds 1.1% the corrosion-resistance (in 3% aqueous sodium chloride) is greatly increased. Additions of aluminium tend to decrease the strength at high temperatures, but increase the ductility and electrical conductivity. Microstructures are reproduced and details given of creep tests, tensile tests, hardness tests, and measurements of the electrical and thermal conductivities.—W. H.-R.

***Water-Quenching of Some Typical Magnesium Casting Alloys.** (Busk and Anderson) See p. 310.

†Modern Hard Magnetic Materials. K. Hoselitz (*J. Sci. Instruments*, 1946, 23, (4), 65-71).—A general review of the magnetic characteristics of modern permanent-magnet alloys including Alni, Alnico, Alcomax, Comol, Vicalloy, and other alloys including copper-nickel-iron, copper-cobalt-nickel, cobalt-platinum, and various steels. The question of magnet design and ageing stability are discussed. For purposes such as for electricity meters and electrical instruments, stability of the magnet system is of the greatest importance. With all magnet materials there is measurable change in a period of 30 min. after magnetization. In quench-hardened steels structural changes may take place slowly and affect the magnetization by 20%, but nickel-aluminium alloys show no structural changes. The most favourable stabilizing treatments and conditions of storage are discussed.—W. H.-R.

***Iron-Nickel-Cobalt Alloy for Sealing to Glass.** G. D. Redston and J. E. Stanworth (*J. Sci. Instruments*, 1946, 23, (3), 53-57).—The differential expansion between a standard molybdenum rod and various iron-nickel-cobalt alloys was measured and the results are shown graphically; the transition

temperatures of the alloys were also determined. For sealing to borosilicate glasses, an alloy of the following composition is recommended: nickel 29 (± 0.5), cobalt 17, manganese 0.3, silicon 0.15, carbon ≥ 0.05 , phosphorus ≥ 0.01 , and sulphur $\geq 0.01\%$. The total percentage of nickel + cobalt should equal $46\% \pm 0.5$. Glasses can be made with coeffs. of expansion which match this alloy. Measurements were made of stresses in glass-alloy seals.

—W. H. R.

***Creep Tests at 620° C. on a Special Material for High-Temperature Service.** Eberhard Both (*Z. Metallkunde*, 1944, 36, (6), 149–152).—The material tested was DVL 42 (PMWC + Ti), consisting of nickel 37, cobalt 24.5, chromium 15, tungsten 5, molybdenum 5, and titanium 1.3%, with small amounts of manganese, silicon, iron, and carbon. Melting was done in a high-frequency vacuum furnace and the test specimens were cold-drawn wires 1.5 m. long and 4 mm. in dia. The specimens were loaded at 20 kg./sq. mm. for 300 hr. and thereafter given incremental loads of 5 kg./sq. mm. every 300 hr. until 35 kg./sq. mm. was reached, at which load one specimen was tested to fracture; the other specimens were tested similarly at loads of 40, 45, 50, and 55 kg./sq. mm. The results of long-time and extrapolated short-time tests are given in the form of graphs of creep strength and time-extension for 0.5 and 1% permanent extension at 620° C. It was found that the elongation at fracture, which averaged 8.3%, was independent of the final load and duration of test, but figures obtained for reduction of area were not so consistent, while no appreciable change in hardness took place. Mechanical tests on the fractured material showed that although the tensile strength and elongation were slightly less than for the original alloy, no serious embrittlement had occurred as a result of the loading at high temperature.—E. N.

***Permeability Measurements on Strip 0.1 to 0.01 mm. Thick.** Günther Rassman (*Z. Metallkunde*, 1944, 36, (6), 131–135).—The influence of sheet thickness, cold work, and heat-treatment on the magnetic permeability of 50:50 nickel-iron alloy, Mumetal, and silicon-iron (3.5% silicon) was investigated. After cold reductions of 70–96% the max. permeability of nickel-iron alloys was proportional to the thickness and degree of cold work, but the influence of these factors was lessened by annealing and vanished on heating at 1100° C. for 300 min. Similar results were obtained with the other two alloys.—E. N.

***The Influence of Small Additions of Thorium on the Life of Alloys for Heating Elements.** Werner Hessenbruch and Lore Horn (*Z. Metallkunde*, 1944, 36, (6), 145–146).—The influence of the addition of thorium, 0.015–2.1% (by analysis), on the life of 80:20 nickel-chromium alloy containing small amounts of manganese, silicon, and magnesium was investigated. Spiral wires 0.4 mm. in dia. were subjected to intermittent heating of 2-min. cycles at 1050° C. until final burn-through. With increase in thorium content there was a steady improvement in the oxidation properties, a corresponding decrease in the mechanical properties, and no evidence of discontinuity at 2.1% thorium. The solubility of thorium in nickel was found to be less than 0.01% at room temperature and less than 0.05% at 1000° C.; addition of chromium causes a reduction in these values.—E. N.

Symposium on Creep of Non-Ferrous Metals and Alloys. — (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 401–477).—The individual papers are abstracted below.—H. J. A.

Application of Non-Ferrous Metals and Alloys in Stress Design. J. J. Kanter (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 402–417; discussion, 417–419).—The creep characteristics of non-ferrous metals are briefly summarized, and a bibliography and series of abstracts dealing with the topic are appended.—H. J. A.

***Creep Characteristics of a Phosphorized Copper.** H. L. Burghoff and A. I. Blank (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, **161**, 420–438; discussion, 438–440).—The creep characteristics of copper wire (0.008% of phosphorus) as annealed to a grain-size of 0.013 mm., and as drawn to 84% reduction, are reported for temperatures of 300°, 400°, and 500° F. (150°, 205°, and 260° C.). The creep-resistance of the drawn wire decreases as recrystallization takes place.—H. J. A.

***Creep Properties of Cold-Drawn Annealed Monel and Inconel.** B. B. Betty, H. L. Eiselstein, and F. P. Huston, Jr. (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, **161**, 441–452; discussion, 452–454).—Creep data have been obtained for cold-drawn annealed Monel and Inconel at temperatures between 800° and 1100° F. (430°–590° C.). Inconel has approximately twice the load-carrying capacity of Monel at any temperature, but Monel compares favourably with many low-alloy steels so far as creep performance is concerned. The tensile and Izod properties of the materials at room temperature after creep testing are recorded and a type of round Izod test-piece suitable for these alloys is described.—H. J. A.

***Creep Data on Die-Cast Zinc Alloy.** E. H. Kelton and B. D. Grissinger (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, **161**, 466–471; discussion, 471).—A test method involving the bending of a die-cast zinc alloy beam is described and beam creep-test data at 25° C. and various stresses for a zinc die-cast alloy are presented.—H. J. A.

***Creep Properties of Some Rolled Lead-Antimony Alloys.** A. A. Smith, Jr., and H. E. Howe (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, **161**, 472–475; discussion, 475–477).—Alloys of lead containing antimony, bismuth, and copper were cast and rolled to 0.1 in. thickness; 16-in. lengths of this material were then clamped together and creep tests conducted on the specimens at 30° and 100° C.—H. J. A.

***Flow Velocity of Zinc Alloys Under Constant Load.** G. Masing, K. Miething, and H. J. Wallbaum (*Nachr. Ges. Wiss. Göttingen, Math.-physikal. Klasse*, 1940, **2**, 1–5; *Chem. Zentr.*, 1941, **112**, (I), 1787; *C. Abs.*, 1943, **37**, 2325).—Zinc-copper alloys containing 0.75–3% of copper were studied for the purpose of explaining the surprising fact that the flow velocity of zinc under constant load is reduced with increase in the copper content so long as the copper is taken into solid solution. At higher copper content the flow velocity increases again.

The Elastic Modulus of Metallic Alloys. Léon Guillet, Jr. (*Rev. Mét.*, 1943, **40**, (3), 91–94).—A review article in which the experimental methods for determining the elastic modulus of alloys are critically discussed. The general types of results obtained by various workers are presented and general conclusions are reached. It is difficult to obtain high moduli if the metallic properties such as malleability are to be preserved; usually the modulus of a binary alloy is intermediate between those of the components. Treatments which raise the elastic limit and the presence of impurities or additions which affect mechanical properties markedly have little effect on the elastic modulus. High elastic moduli are obtained for intermetallic compounds, but in these cases malleability is lost.—G. V. R.

***Experiments on the Proof of Damage Stress and Work-Hardening in Fatigue Tests [on Steels and Duralumin].** Erich Siebel and Gustav Stähli (*Arch. Eisenhüttenwesen*, 1942, **15**, (11), 519–527).—Wöhler curves for notched specimens were determined for two carbon and an alloy steel and a Duralumin alloy. Similar specimens were subjected to an impact test after a preliminary number of reversals at a series of bending stresses. The number of reversals at any stress at which the impact values begin to decrease were plotted to obtain “damage lines.” It is shown that the more the bending stress exceeds the limiting fatigue stress values, the smaller the number of reversals at which

damage starts. The values of the damaging stress are increased by machining off 0.3 mm. from the surfaces of the notches. The same materials were then used to study "damaging" of smooth specimens by measuring the increase in the number of reversals after polishing the surfaces of the specimens which had been subjected to a preliminary number of reversals under the limiting stress. It is shown that the damaging is initiated at the surfaces and that the number of reversals can be increased several hundred per cent. by removing the damaged layer electrolytically or mechanically. It was not found possible to remove the "damaging" by intermediate annealing. Similar results were obtained in tension-compression tests.—V. K.

***Changes in Materials Produced in Fatigue Tests.** Alfred Karius, Erich Gerold, and Ernst Hermann Schulz (*Arch. Eisenhüttenwesen*, 1944, 18, (5/6), 113-124).—Changes in the damping capacity and elastic moduli caused by reversed bend stresses were determined for a number of carbon and alloy steels and non-ferrous alloys by using the Förster instrument (*Z. Metallkunde*, 1937, 29, 109; *Met. Abs.*, 1937, 4, 460). The results show that all these materials behave similarly. The damping capacity of the specimens subjected to reversed bend stresses not much greater than the limiting stress increases, while the elastic modulus decreases with the increasing number of reversals, the curves being asymptotic. At still larger stresses an inflection in curves of these properties and a second rapid increase of the damping capacity or decrease of the elastic modulus are obtained. These two distinct stages in the changes of these properties are explained by the plastic deformation occurring in the first and by the formation of cracks taking place in the second stage. Additional experiments confirmed the view that the changes in the first stage depend on the stressed volume of the material, while the changes in the second stage are independent of this volume. Changes in the above-mentioned properties were not found to be suitable for the determination of the "damage lines" (see preceding abstract).—V. K.

***The Magneto-Resistance of High-Coercivity Alloys.** L. F. Bates (*Proc. Phys. Soc.*, 1946, 58, (2), 153-164).—Using various ferromagnetic alloys of high coercivity, the change of resistance of specimens subjected to longitudinal and transverse magnetic fields was measured. The changes in the cases of the permanent-magnet materials Alni, Alnico, and Alcomax II were such as to decrease the resistance in the presence of the magnetic field and were thus in marked contrast to those for pure ferromagnetics. The results, which are fully described, are discussed from the point of view of the domain theory of ferromagnetism. It is suggested that the magnetostriction deformation of the domain boundaries or grain boundaries plays an important part.—G. V. R.

***Alloys for Electrodes of Thermoelements and Compensation Leads.** (Berkovsky and Stepanov) See p. 308.

The Representation of Quaternary Systems by Temperature-Concentration Cross-Sectional Diagrams. Günther Ritzau (*Wiss. Veröff. Siemens-Werken, Werkstoff-Sonderhefte*, 1940, 44-49; *Chem. Zentr.*, 1942, 113, (I), 153; *C. Abs.*, 1943, 37, 2255).—Three ideal types of 4-component diagrams are developed geometrically. They are represented by temperature-concentration sections.

Deductions which May be Made from a Solidification Diagram. J. Luneau (*Rev. Mét.*, 1942, 39, (7), 218-223).—The interpretation of the diagram showing liquidus and solidus curves for a continuous series of binary solid solutions is discussed. Assuming ideal diffusion conditions and the maintenance of equilibrium, equations and graphical constructions are developed for determining the mass ratios of liquid and solid present at a given temperature, the proportions of the components in the mass of solid deposited on cooling through a small temperature range, and the actual mass of solid deposited. Application of these methods to more complex forms of equilibrium diagrams is briefly considered and reference is made, without illustration, to the practi-

cal case where diffusion is limited and equilibrium is not maintained during the liquid-solid transformation.—G. V. R.

***The Zones of Immiscibility in the Liquid State in Alloys.** M. Dannenmuller (*Rev. Mét.*, 1943, 40, (3), 85-90).—Methods for determining regions of liquid immiscibility in alloy systems are critically discussed and a method is proposed in which the homogeneous melt is allowed to cool relatively rapidly in a crucible of special shape, designed to make sure that a longitudinal section of the cold ingot, when ground and polished, will reveal small quantities of inhomogeneity. The results to be expected from the cooling of alloys of various compositions are discussed with reference to a typical equilibrium diagram and the application of the method to the ternary alloys of lead and zinc with aluminium, cadmium, copper, and tin is described. The previous results of other authors for the latter three systems are corrected by the present work.—G. V. R.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

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

***Electron Metallographic Methods and Some Results for Magnesium Alloys.** R. D. Heidenreich, C. H. Gerould, and R. E. McNulty (*Metals Technol.*, 1946, 13, (3); and *A.I.M.M.E. Tech. Publ.* No. 1979, 22 pp.).—The general methods of electron microscopy are reviewed, with special reference to the study of magnesium and its alloys by the polystyrene-silica replica method. A special etching reagent has been developed, consisting of equal parts of methyl iodide and dry methyl alcohol, with a crystal of iodine to initiate the reaction. Photographs are reproduced showing slip-bands and twins in pure magnesium and of precipitates and other structures of magnesium alloys. In alloys containing aluminium and small amounts of iron a new "fine structure" has been discovered in which an iron-aluminium phase is present. The presence of this "fine structure" has an important effect on the stress-corrosion properties of magnesium alloys and examples are discussed.—W. H.-R.

***The Effect of Impurities on the Efficiency of $K_2Cr_2O_7$ Etching Agents.** W. Eckardt (*Oberflächentechn.*, 1942, 19, 25-26; *Chem. Zentr.*, 1942, 113, (II), 949; *C. Abs.*, 1943, 37, 4999).—Magnesium alloys are not coloured in alkali bichromate solutions made up of pure salts. Addition of small amounts of CrO_3 (usually present in commercial salts) causes a dull black coloration. On further addition of traces of silver salts the coloration becomes brighter; silver salts are usually present in commercial alkali bichromate because $K_2Cr_2O_7$ is evaporated in silver-containing dishes.

***Grain-Sizes Produced by Recrystallization and Coalescence in Cold-Rolled Cartridge Brass.** Harold L. Walker (*Univ. Illinois Eng. Exper. Sta. Bull.* No. 359, 1945, 55 pp.).—A study has been made of the grain-size and Rockwell hardness of specimens of 70 : 30 brass, cold reduced by 5-70%, after annealing in molten lead or lead-bismuth alloy at 300°-700° C. for periods up to 8 hr. Before final cold working the material was annealed at 750° C. and had a grain dia. of 0.48-0.57 mm. and a Rockwell H hardness of 74-80.5. All the hardness curves showed first a gradual loss in hardness with time (recovery), followed by a rapid decrease (due to recrystallization), and finally a slow decrease in hardness during which period the grain-size increased by coalescence, i.e., by the absorption of unstrained grains by other unstrained grains. The grain-size when recrystallization was just complete (before coalescence) was dependent only on the degree of deformation and was inde-

pendent of time and temperature, being represented by: $\log \text{grain-size} = -n (\text{percentage deformation})^{\frac{1}{2}} + b$. The constant, b , is a function of the grain-size prior to final deformation. No evidence was found of the existence of a "germinant annealing temperature range" in which large grains were produced.—J. C. C.

***Investigations of the Structure of Electrodeposited Zinc.** W. Köhler (*Korrosion u. Metallschutz*, 1943, 19, (7), 197–199).—The crystal structures of zinc electrodeposits made from sulphate, bright sulphate, and bright cyanide zinc baths were investigated, using powder camera and Geiger counter methods. Comparison readings were made with filings of ordinary pure zinc. The rates of solution of the deposits in normal sulphuric acid were also compared. The deposits from sulphate baths showed a marked anomaly in the X-ray studies and the final rates of solution of these deposits in acid were much greater than those of the deposits from the cyanide bath.—A. B. W.

***On the Growth of a Grain of Zinc.** (Guillet and Laurent) See p. 283.

The Numerical Symbol of Close-Packing of Spheres and Its Application in the Theory of Close-Packings. G. S. Zhdanov (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1945, 48, (1), 39–42).—In order to interpret the characteristics of structures produced by the close-packing of spheres, a system of nomenclature is developed which allows the periodicity, Bravais lattice, cell dimensions, atom co-ordinates, and space group to be described by a numerical symbol. This simplifies classification of such structures and facilitates the interpretation of complex close-packed structures.—G. V. R.

***A Theoretical Criterion for the Initiation of Slip-Bands.** Clarence Zener (*Phys. Rev.*, 1946, 69, (3/4), 128–129).—A theoretical note. Relief of shear stress within a slip-band results in a large concentration of shear stress just ahead of its advancing edge, which may be called the spearhead. The condition for propagation of the slip-band is that this concentration of stress is sufficient to produce plastic deformation in front of the spearhead. Z. deduces the relation: yield strength $= C(d/D)^{\frac{1}{2}}G$, where d is the spacing of the atomic planes parallel to the slip-band, D is a measure of the grain diameter, G is the shear modulus, and C is a numerical coeff. whose magnitude is of the order unity. Data for copper alloys support the general views.—W. H.-R.

***X-Ray Investigation of Nitrides and Carbonitrides of Titanium.** E. P. Belyakova, A. Komar, and V. V. Mikhailov (*Metallurg*, 1940, (4), 5–8; *Khim. Referat. Zhur.*, 1941, 4, (1), 96; *C. Abs.*, 1943, 37, 1358).—[In Russian.] The Debye X-ray method indicated that at 1000°–1500° C. the reduction of TiO_2 by a mixture of hydrogen and nitrogen forms Ti_2O_3 and TiO . At 1700° C. and higher, some titanium nitride is formed, as shown by chemical analysis; the lines of titanium nitride are not observed on X-ray photographs, owing to its transformation into a solid solution with TiO . Reduction by solid carbon in nitrogen at 1100°–1500° C. produces neither the free nitride nor the free carbide of titanium. At 1900° C., TiO_2 is completely reduced in 3 hr. to the nitride and carbide, which form a solid solution.

***The Accurate Determination of Cell Dimensions from Single-Crystal X-Ray Photographs.** Margaret C. M. Farquhar and H. Lipson (*Proc. Phys. Soc.*, 1946, 58, (2), 200–206).—It is pointed out that for certain applications, such as the determination of molecular weights, it is desirable to be able to determine cell dimensions accurately from single-crystal photographs. An accuracy of the order of 0.005% may be obtained by methods of measurement and calculation analogous to those already employed in powder photography. Using the van Arkel method of film mounting, the positions of resolved α doublets with Bragg angle near 90° are measured and the value of one of the cell dimensions is deduced from each. These are plotted against $\sin^2 \theta$ and extrapolated to give a final result at $\sin^2 \theta = 1$. The use of the method for an orthorhombic crystal is illustrated for thallium hydrogen tartrate. The

spots used are those lying on the zero layer line of a symmetrical oscillation photograph obtained with an axis of the crystal oscillating symmetrically with respect to the X-ray beam. For the salt investigated, $a = 7.6395$ kX., $b = 10.9945$ kX., $c = 7.9100$ kX., these values being correct to 0.0005 kX. The dependence of the results on the assumed camera radius and the methods of measurement are discussed.—G. V. R.

Microradiography. S. E. Maddigan (*Indust. Radiography*, 1946, 4, (4), 22–25, 28–30).—In microradiography, enlargements are made of radiographs of thin specimens, so revealing the gross structure and supplementing photomicrography. The X-rays used may be generated by a tungsten target, operating at voltages appropriate to the specimen, or characteristic X-rays may be used. Both techniques are capable of revealing the structure, but the latter method is essential where the phases or inclusions present must be identified. The applications discussed include the examination of: Cu–Sn–Pb, Cu–Ag, Cu–Pb, and Cu–Fe alloys; Ni_3P_2 in a copper-base alloy; leaded brass; and cartridge brass. The preparation of specimens is described.—L. M.

***X-Ray Investigation of Liquids.** V. I. Danilov (*Izvest. Akad. Nauk S.S.S.R.*, 1941, [Fiz.], 5, (1), 30–42).—[In Russian.] A number of liquids (salol, benzophenol, &c.) lose the property of crystallization when all impurities in them are completely removed. Other liquids cannot be undercooled below a temperature range characteristic of the liquid, even after a thorough purification and preliminary overheating. Metals and a number of liquids belong to the second group.—N. A.

V.—POWDER METALLURGY

General Rules for Powder Metallurgy. Henry H. Hausner (*Machinist (Eur. Edn.)*, 1946, 90, (8), 290–291).—The effects of processing on the physical properties of compacts of metal powders are given in 13 “trend charts” or graphs.—J. H. W.

VI.—CORROSION AND RELATED PHENOMENA

***Attack of Various Atmospheres on Copper and Some Copper Alloys at Elevated Temperatures.** A. P. C. Hallows and E. Voce (*Metallurgia*, 1946, 34, (200), 95–100).—Based on the first part of British Non-Ferrous Metals Research Association Report R.R.A. 527. Three high-conductivity and two arsenical coppers and six aluminium bronzes (containing from 2 to 6% aluminium), forming a group of alloys of high scaling resistance; a group of nine alloys containing small amounts of common elements added individually to copper; and three industrial copper alloys for elevated-temperature use, were tested for intermittent oxidation and scaling at 400° C. in five different atmospheres. The five atmospheres consisted of (i) dry air, free from acid impurities; and (ii) dry air as in (i) with the addition of (a) 10% water vapour, (b) 0.1% sulphur dioxide, (c) 5% sulphur dioxide, or (d) moist hydrochloric acid. The work is described and conclusions resulting from the investigation are given.—J. W. D.

Tube Corrosion Held to a Minimum by Continuous Check on [Oil Refinery] Dehydrator-Water pH. J. S. Pfarr and H. A. Blackstone (*Refiner*, 1942, 21, 16–18; *C. Abs.*, 1943, 37, 5230).—The pH of the waste water used for cooling condensers for crude gasoline is recorded continuously and controlled to 7.5–8 by addition of ammonia, thereby practically eliminating corrosion of iron and copper alloys.

***Causes of the Serious Corrosion of Lead in an Intensive-System Sulphuric Acid Plant.** Kurt Wickert (*Chem.-Zeit.*, 1940, 64, 411-413; *Chem. Zentr.*, 1941, 112, (I), 1734; *C. Abs.*, 1943, 37, 2143).—The extensive destruction of the lead was characterized by deeply corroded drop-form cavities. The lead so destroyed was of standard quality; the bismuth content was less than the permissible limit. The corrosion was found to be due to chlorine, the action of which was further intensified by the formation of NOCl in the presence of nitric acid. Sulphur dioxide retarded the corrosion of the lead by chlorine and NOCl. The chlorine came from the tap-water in the system.

***Corrosion Studies on Lead Alloys.** K. Wickert (*Korrosion u. Metallschutz*, 1942, 18, (11/12), 357-361).—A series of lead alloys was studied, using methods aiming at the determination of their suitability for employment in intensive-system sulphuric acid plants. A method of test with "mixed acid" (30 ml. sulphuric acid, density 1.735; 2 g. NOHSO_4 ; and 0.1 ml. conc. hydrochloric acid) at 90° C. in a sealed tube gave results in agreement with service experience. Silver was the only alloy addition that improved the behaviour of lead in this test. Silver and also nickel and copper are stated to improve alloyed leads by neutralizing the effects of deleterious constituents. The action of conc. hydrochloric acid and of sulphuric acid (density 1.735) at 90° C. on the same lead alloys is also described, as well as some electrochemical studies of protective film formation. The action of the nitrosyl compounds is discussed and their ability to increase attack attributed to the property of splitting off NO-ions, which behave in a similar manner to H-ions.—A. B. W.

***The Scaling of Nickel Containing Various Additions.** Lore Horn (*Z. Metallkunde*, 1944, 36, (6), 142-145).—The rate of scaling of the following nickel alloys was investigated: (1) nickel with up to 1.7% cerium, (2) nickel with up to 3.4% thorium, (3) nickel with up to 2.25% beryllium, (4) nickel with up to 29.2% chromium and containing traces of manganese and silicon. Polished sheets of the alloys were exposed in air for 50-160 hr. at temperatures up to 1200° C., the increase in weight was recorded at intervals, the colours of the oxide films examined, and the composition of the films ascertained by X-ray methods. The well known parabolic law of oxidation was found to be followed by the alloys of nickel-thorium and nickel-cerium, which formed only one type of oxide film. Deviations from the law were found to occur with the alloys of nickel-chromium and nickel-beryllium, owing to the formation of more than one type of film; nickel with up to about 8% chromium formed oxide skins consisting mainly of NiO, with 8-19% chromium the skin was a mixture of NiO and Cr_2O_3 , while with 29.2% chromium the skin was mainly Cr_2O_3 , which was relatively thick and slowed down the rate of oxidation. Nickel-beryllium alloys with more than 1.5% beryllium had oxidation rates similarly retarded.—E. N.

***Special Phenomena in Oxidation of Heat-Resisting Steels and Alloys.** Gerhard Bandel (*Arch. Eisenhüttenwesen*, 1941, 15, (6), 271-283; discussion, 284).—The mechanism of the formation, growth, and breaking-up of the protective oxide layer is considered in relation to the formation of the non-protective, iron-oxide-rich layer. The latter forms first and the rate of replacement by the former depends on the temperature, alloy and atmosphere composition, and the initial surface condition of the specimen. Time, temperature, atmosphere, inclusions, and alloy composition affect the breaking-up and replacement of the protective layer at higher temperatures. Experimental data on the above aspects of oxidation are given.—V. K.

Corrosion and Chemical Behaviour of Zinc and Zinc Alloys. K. Bayer (*Korrosion u. Metallschutz*, 1942, 18, (11/12), 362-365).—The behaviour of zinc and zinc alloys when subject to atmospheric corrosion or attack by natural waters, at both normal and elevated temperatures, is surveyed and the

results of the more important German investigations in this field are briefly cited.—A. B. W.

***Contribution on the Chemical Corrosion [by Lactic Acid] of Zinc Alloys.** K. Ruttewit (*Korrosion u. Metallschutz*, 1942, 18, (11/12), 365–368).—Tests of various zinc alloys in 1% lactic acid solutions at room temperature revealed no composition that could be recommended as a substitute for the materials hitherto used for coinage, uniform decorations, &c. Only a few additions improved the corrosion behaviour in lactic acid, *viz.*, mercury, cadmium, and magnesium and their effects were only small. Alloys containing 10% aluminium and 0.1–0.5% silicon retained a bright surface in spite of a relatively large loss in weight.—A. B. W.

***Chemistry and Morphology of Films in Corrosion Studies with Zinc.** W. Feitknecht and R. Petermann (*Korrosion u. Metallschutz*, 1943, 19, (7), 181–188).—The conditions for formation and the more important properties of seven forms of hydroxide and oxide of zinc occurring in immersed corrosion of zinc are presented in tabular form. Diagrams of the X-ray powder lines of these forms are also given for identification purposes. In solutions more than 0.025 molar in zinc, the corrosion velocity diminishes fairly uniformly and rapidly with time. In more dilute solutions the attack is more irregular and appears only to slow down slightly with time. The corrosion velocity shows a marked min. at solutions 0.025 molar in zinc in the presence of the least carbon dioxide concentrations. Accordingly, the corrosion velocity is independent of the conductivity of the solution, but depends only on the protective action of the film. The chemical and morphological properties of the films are correlated with the corrosion velocity. The slowest attack occurs under conditions where basic chloride III is stable and is therefore related to the formation of a laminar, stable α -hydroxide. The irregularities in very dilute solutions are to be attributed to the formation of a film, composed largely of oxide in one case, and in others of ϵ - and β -hydroxides. In the case of oxide films the attack is very much faster than in the other cases. Although local elements play an important part, the decisive factor for the corrosion velocity is not the conductivity of the solution, but the protective action of the films, which is itself a function of the chemical nature of the corrosion product. It follows from this that, in corrosion research, greater interest should be shown in the chemistry of the oxides, hydroxides, and basic salts.—A. B. W.

Recent Work on Corrosion and Oxidation. U. R. Evans (*J. Chem. Soc.*, 1946, 207–214).—A lecture. E. classifies corrosion and oxidation reactions as film-forming or non-film-forming, gives examples of each type, and briefly reviews the inhibition of corrosion.—H. J. A.

Corrosion Criteria—Their Visual Evaluation. Marc Darrin (*Bull. Amer. Soc. Test. Mat.*, 1946, 138, 37–39; also (abridged) *Metal Ind.*, 1946, 68, (18), 351–352).—When local corrosive attack takes place, loss of weight is not sufficient to specify the extent of corrosion. D. suggests standard terms for reporting various types of aqueous corrosion, especially when of a local nature, and describes the use of a standard report form to obtain “corrosion scores.” The method has been used satisfactorily for six years.—H. J. A.

***Investigation of the Cavitation Phenomena.—I-II.** E. Brandenberger and P. de Haller (*Schweiz. Arch. angew. Wiss. Techn.*, 1944, 10, (11), 331–341; (12), 379–386).—[I.]—The effects of the speed of impact, jet area and temperature, and speed of water jet on the erosion of a mild carbon steel were studied in a specially-designed apparatus (*Schweiz. Bauzeit.*, 1933, 101, 243). It is shown that for the comparison of the erosion test results all these factors have to be taken into account. The nature of the erosion was studied in an impact-wave apparatus and was supplemented by mechanical, metallographic, and X-ray examinations. The results obtained for a number of ferrous and non-ferrous materials show that the behaviour of metals in these

tests cannot be correlated with their behaviour under any standard static mechanical tests, but that the changes in crystal structure were similar to those produced under dynamic impact loading. [II.]—A study, by back-reflection photographs, of the changes in the crystal structure at the surfaces of the specimen exposed to erosion showed that the crystals gradually break up into smaller units and finally develop small cracks. It is believed that the process of fracturing in erosion tests is different from that of the static or fatigue fracture, owing to the rôle the cleavage of crystals assumes in this case.—V. K.

*Theory of Polyelectrode Electrochemical Cells and Corrosion Problems. G. V. Akimov (*Acta Physicochim. U.R.S.S.*, 1945, 20, (6), 808-832).—It is pointed out that study of corrosion phenomena in alloys involves consideration of the behaviour of polyelectrode systems. The theory of such systems is considered for five electrodes connected in parallel and in series; for cases of low internal and external resistance, where polarization phenomena are important; and for high resistance, internal and external, where polarization can be neglected. It is shown how the polarity of electrodes, with initial electrode potentials intermediate between those of the extreme anode and cathode, is affected by increasing or decreasing polarization, areas and positions of electrodes, the values and ratios of the resistances in the various branches of the external circuit, and the internal resistance of the electrolyte. Experimental data illustrating the conclusions of the theory are given and discussed and the factors important for the qualitative solution of cases more complex than those rigidly treated are described. The bearing of the work on corrosion phenomena, and particularly intercrystalline corrosion, is discussed by reference to aluminium-copper alloys and certain stainless steels. Not only the initial electrode potentials, but also the relative areas and polarization characteristics of the constituent electrodes must be considered.—G. V. R.

VII.—PROTECTION

(Other than by Electrodeposition.)

*On the Formation and Estimation of Oxide Films on Aluminium. Andreas Ulrich Obrist (*Thesis: Eidgenössische Technische Hochschule, Zürich, 1944*, 64 pp.).—Various existing methods for the production of oxidized layers on aluminium and its alloys are discussed in detail and methods for the determination of the oxide content of aluminium are critically reviewed. Apparatus for the production of films under controlled conditions by anodic oxidation in oxalic acid is described, together with the technique of the quantitative removal of the film from the metal, which is dissolved away in ethereal hydrochloric acid. From micrometer measurements of the film produced in various conditions the rate of growth was determined. The variation with film thickness of the capacity of the film was studied and gave a dielectric constant of 7.58. An improved method for the determination of oxide in aluminium is fully described and is based on the solution of the metal in air- and moisture-free conditions in ethereal hydrochloric acid, followed by solution of the oxide residue and colorimetric estimation of the aluminium present. From results obtained, the density of the film, which is amorphous at ordinary temperatures, but crystalline after annealing at 900° C., is calculated as 3.10. The water content of the film produced in various conditions was determined and found to agree with the formula AlOOH . The effect of temperatures up to 600° C. on the rate of growth of films is also discussed.—G. V. R.

Modern Methods of Phosphatizing [of Zinc Alloys]. H. v. Rosenberg (*Oberflächentechn.*, 1941, 18, 169-170; *Chem. Zentr.*, 1942, 113, (I), 1806; *C. Abs.*, 1943, 37, 3039).—The various Bonderizing and Parkerizing processes

for phosphatization produce layers of 0.003–0.015 mm. thickness. Zinc alloys containing aluminium are pickled with sodium hydroxide before phosphatizing in order to remove the aluminium from the surface. Rinsing after phosphatizing in hot, chromate-containing baths has a favourable effect. Applications of phosphatizing are discussed.

***The Tinning of Cast Iron.** R. A. Cresswell (*Iron Steel Inst. Advance Copy*, 1946, 13 pp.; also (abridged) *Found. Trade J.*, 1946, 78, (1549), 435–439; *Engineering*, 1946, 161, (4194), 526–528; and *Canad. Metals*, 1946, 9, 37–41, 44).—An investigation describing methods of hot tinning cast iron directly, without the application of an intermediate metal coating. For the dip tinning of cast iron, the nitrate process is preferred. In this process the work is mechanically cleaned by machining, shot-blasting, or sand-blasting and degreased either in trichlorethylene vapour or in a hot alkaline metal-cleaning solution. It is pickled either in 10% by weight inhibited sulphuric acid at 85° C. for 30 sec. or in cold 50% by vol. hydrochloric acid for 2–5 min., rinsed in water, and dried. The article is then immersed in a fused mixture of equal parts by weight of sodium nitrate and potassium nitrate at 350°–400° C. for 15 min. The work is removed, cooled, washed with cold water, and further pickled for 1 min. in cold 10% by vol. hydrochloric acid, fluxed in an aqueous solution containing 25% by weight of the zinc chloride–sodium chloride eutectic (82% ZnCl_2 , 18% NaCl) and then transferred to the tin pot which is maintained at 300° C. The time of immersion should be at least 3–5 min.; longer times (up to 30 min.) give better adhesion. The work is then drained and either cooled in air or quenched in paraffin oil. The chloride process is preferred for tinning by wiping. In this process the work is mechanically prepared as in the nitrate process. The surface is then brushed with an aqueous solution containing 25% by weight of the zinc chloride–sodium chloride eutectic mixture and the article heated to 270°–300° C. Some previously melted zinc chloride–sodium chloride eutectic flux is then poured on to the surface at 300° C., washed over the surface for 1–2 min., excess of flux removed, and a quantity of molten tin poured over the surface and wiped by means of steel wire brushes or scrapers. When tinning is complete, excess metal is drained off, the article allowed to cool, and any flux residues removed by washing.—J. E. G.

***Causes and Prevention of Speck Formation on Hot-Tinned Wires.** Fritz Schellenberger (*Draht-Welt*, 1940, 33, 611–613, 625–627; *Chem. Zentr.*, 1941, 112, (I), 1733; *C. Abs.*, 1943, 37, 2326).—The cause of speck formation on hot-tinned wires is usually a porous layer. The formation of an intermediate iron–tin layer does not prevent pore formation since, according to S., this intermediate layer is not formed from the iron of the part to be tinned, but rather is formed as a result of the following processes. As the part is passed through the flux, a FeCl_2 film is formed on the iron, which is reduced to iron upon introduction into the tin bath. It is this thin iron film which then forms the iron–tin film with the tin. The wire surface may therefore be defective, even if an intermediate film has been formed. The best protection against pore formation is a flawless wire surface. A 5% solution of H_2SO_4 , to which CuSO_4 may be added, is recommended as a pickle. A solution of ZnCl_2 45, NH_4Cl 1–2, and NaCl 1% is especially suitable as a soldering solution for a preliminary treatment. In place of the protective layer of organic material on the tin bath, a layer composed of ZnCl_2 70, NH_4Cl 20, and NaCl 10% should be used. Pore formation is further reduced by the use of baths of very pure tin and by keeping clean all parts which come in contact with the wire to be tin coated.

***Influence of the Composition on the Formation of Zinc Flowers on Hot-Galvanized Steel Parts.** Werner Frölich (*Oberflächentechn.*, 1941, 18, 142–143; *Chem. Zentr.*, 1942, 113, (I), 264; *C. Abs.*, 1943, 37, 2701).—By adding 0.1–

0.2% of cadmium to the zinc bath, zinc coatings with large, zinc-oxide crystalline formations are obtained; antimony additions give smaller crystals. The yellow colouring caused by too high an antimony content can be eliminated by the addition of 0.001% of aluminium. Additions of tin and cadmium have the same effect, but promote at the same time the formation of zinc flowers.

Surface-Conversion Coatings. George W. Jernstedt (*Bull. Amer. Soc. Test. Mat.*, 1945, (137), 29-35; also (abridged) *Metal Ind.*, 1946, 68, (21), 407-409).—Surface-conversion coatings are formed by the chemical modification of metallic surfaces in order to secure greater resistance to corrosion. J. gives a general review of the topic, which includes the phosphate treatment of steel, oxide, sulphide, and oxalate treatments of copper alloys, anodic and chemical treatments of aluminium or magnesium, and phosphate or chromate treatment of zinc.—H. J. A.

VIII.—ELECTRODEPOSITION

Preparing Die-Castings for Plating. Herbert Chase (*Iron Age*, 1946, 157, (21), 58-61).—The production-line polishing, buffing, and tumbling, and the use of conveyors and fixtures to expedite operations in the preparation of zinc alloy die-castings for plating in a plant with an output of 70 tons daily are described.—J. H. W.

Nickel Dipping [Before Enamelling]. G. H. McIntyre (*Found. Trade J.*, 1946, 79, (1550), 9-11).—A paper read before the 7th Annual Forum, Porcelain Enamel Institute, Inc. (U.S.A.). It is submitted that nickel dips promote adhesion of porcelain enamels to sheet iron and steel, minimize, or, at least, decrease fish-scaling, and control or decrease copper-heading. Full working details are given of a recommended sequence of operations.—J. E. G.

Chromium-Plated Tools Have Longer Life. Andrew A. Spisak (*Machinist (Eur. Edn.)*, 1946, 90, (9), 343-345).—The increase in tool life produced by chromium plating is discussed and the process of slowly-controlled chromium plating required for this purpose is described.—J. H. W.

***Investigations of the Structure of Electrodeposited Zinc.** (W. Köhler) See p. 294.

Pre-Polishing Cuts Plating Time 40%. G. R. Makepeace (*Machinist (Eur. Edn.)*, 1946, 90, (6), 205).—The saving of time which can be achieved by smooth polishing, instead of rough grinding, before chromium plating, is described.—J. H. W.

IX.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

***Theory of the Deposition of Metals from Aqueous Solutions.** P. Krumholz (*Natuurwetensch. Tijdschr.*, 1942, 22, 108-111; *Chem. Zentr.*, 1941, 112, (I), 2083; *C. Abs.*, 1943, 37, 2980).—The effect of NaF and of FeNH_4 alum on the reduction of AgNO_3 by FeSO_4 in an aqueous solution was studied. In the presence of NaF the reduction proceeded practically quantitatively. In the presence of 1.5×10^{-3} mols. of Fe^{+++} /l. the reduction was only 45% complete. In the presence of gold the retarding effect of ferric ions could be observed, although it was less pronounced. Thus, the rate of crystallization of the silver was affected sooner than the rate of nuclei formation by the gold. It can be assumed that the reduction in the rate of nuclei produced by the ferric ions formed during the reduction is nullified by the NaF. The similar effect of the ferric ions on the rate of crystallization is likewise destroyed. By making use of the assumption of Zsigmondy, that metal in true solution is first formed

during the reduction, it is possible to derive an explanation for the effect of the ferric ions on the rates of nuclei formation and crystallization, which are determined by the supersaturation of the solution with silver. This effect is greater, the more slowly the transition from dissolved to solid silver takes place in relation to the process of reduction in the solution. In the case of gold the solubility can be assumed with certainty to be less than 10^{-12} mols./l.

*On Solutions of Metals [Cadmium] in Fused Salts. S. V. Karpachev (*Izvest. Akad. Nauk S.S.S.R.*, 1941, [Fiz.], 5, (1), 43-46).—[In Russian.] An investigation was carried out to determine carbon-electrode potentials as functions of the concentration of metallic cadmium dissolved in fused mixtures of potassium, sodium, and cadmium chlorides. It is shown that the relationship found obeys the thermodynamic law: $E = \text{const.} - \frac{RT}{2F} \ln C$.—N. A.

*The Motion of Solid and Liquid Metallic Bodies in Solutions of Electrolytes. —I. A. Frumkin and B. Levich (*Acta Physicochim. U.R.S.S.*, 1945, 20, (6), 769-808).—[In English.] In connection with electrocapillarity and electrokinetic phenomena, particularly with reference to the influence of the electrolyte on the motion of the mercury electrode in polarographic studies, the behaviour of charged particles moving in an electrolyte under the action of an external electric field is theoretically investigated. Non-conducting particles, ideally polarizable and incompletely polarizable metallic particles are separately considered. The theoretical principles involved and the results obtained are fully discussed.—G. V. R.

The Existence of Local Couples in Metal Electrodes. V. Čupr (*Chem. Listy*, 1941, 35, 185-188, 201-205; *Chem. Zentr.*, 1942, 113, (II), 139; *C. Abs.*, 1943, 37, 5318).—Cf. *Korrosion u. Metallschutz*, 1942, 18, (1), 15-20; *Met. Abs.*, 1945, 12, 23. A theoretical study and discussion of the concept of Wagner and Traud (*Z. Elektrochem.*, 1938, 44, 391-402; *Met. Abs.*, 1938, 5, 491).

†The Mechanism of Electrode Measurements. H. T. S. Britton (*J. Sci. Instruments*, 1946, 23, (5), 89-94).—A general lecture describing the measurement of electrode potential. The various standard electrodes (hydrogen electrode, glass electrode, &c.) are described and discussed.—W. H.-R.

Elementary Electrocrystallization Processes. K. M. Gorbunova and P. D. Dankov (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1945, 48, (1), 15-17).—[In English.] The theory of the isolated growth of a face of a single crystal forming part of the electrode of an electrolytic cell is briefly discussed. The effect of overvoltage on the discharge of the ions is considered and it is postulated that, initially, a two-dimensional nucleus forms at the edge of the face, or at the respective trihedral angle. Chains of structural particles may then be deposited along the edge of the nucleus. Further accumulation of ions near the electrode causes formation of more nuclei (on the one already formed) and more chain growth. Growth therefore proceeds by multi-stage layer formation. The course of the deposition in its later stages is discussed in detail and shown to be essentially periodic. The processes are considered mathematically.—G. V. R.

X.—REFINING

The Problem of Pure Manganese. The Chemical Balance Sheet of the Electrothermal Refining of Ferro-Manganese. (M. Dérivé) See p. 282.

XI.—ANALYSIS

*On the Formation and Estimation of Oxide Films on Aluminium. (Obrist) See p. 298.

***Spot Plate Tests for Copper, Silver, and Nickel.** E. A. Kocsis, Gy Feuer, T. Horvath, E. Kovacs, and L. Molnár (*Mikrochem. ver. Mikrochim. Acta*, 1941, 29, 166-169; *Chem. Zentr.*, 1942, 113, (I), 2685; *C. Abs.*, 1943, 37, 3009).—Cf. Kocsis and R. Horvai, *Mikrochem. ver. Mikrochim. Acta*, 1941, 29, 44-45. As reagents, use a 0.2% solution of *m*- and *p*-aminobenzoic acid and of *o*- and *p*-aminophenol. With Cu, *m*-aminobenzoic acid gives a yellowish-green spot on filter paper after drying when much Cu is present. It will detect 1 γ of Cu in 0.025 c.c. at a limiting concentration of 1 : 25,000; *p*-aminobenzoic acid behaves likewise but requires 10 γ of Cu; *p*-aminophenol gives, with more Cu, a greyish-blue spot or, with 1 γ of Cu, an olive-green spot with light brown border. The ring starts from the original colour of the reagent. With Ag, *o*-aminophenol gives a reddish-brown or dark yellow spot (2 γ), according to Ag concentration or, with 0.2 γ , a thin yellow ring; *p*-aminophenol gives a light brown spot with dark edges with 0.4 γ of Ag at a limiting concentration of 1 : 62,500. With Ni, *p*-aminophenol gives a blue-grey spot with salmon edges when as little as 0.4 γ of Ni is present at a limiting concentration of 1 : 62,500. Blank tests are made in each case.

***Internal Standard Method of Spectrographic Analysis, as Applied to the Determination of Lead in High-Purity Zinc.** Laurence Griffith and John N. Kirkbride (*J. Soc. Chem. Ind.*, 1946, 65, (2), 39-48).—A controlled d.c. arc and solutions of Zn dried on graphite electrodes are used in the determination of Pb in Zn in routine control of electrolytic plant. The arc carries 16 amp. over a 6.1 mm. gap and the control of the ignition is by a Tesla-type transformer, which is not described in detail. The source is found sufficiently uniform for the major part of the error to arise in the photometric processes and these are examined in detail. A plate calibration pattern is made with a rotating sector, background densities are read beside each Pb line measured, and each Bi line is used as an internal standard. Each microphotometer reading is converted to an energy reading from the calibration line and line : energy ratios are plotted on a logarithmic scale against log Pb conc. The method is based on synthetic standards made from Zn containing <0.1 p.p.m. of Pb and the calibration line is straight between 2 and 125 p.p.m. The effects of varying arc length, slit width, arc current, depth of crater, exposure time, and plate development time are all carefully examined. Mechanical rocking of the developer is used instead of brush development to save labour, and this is blamed for some of the residual error, which is expressed by an average deviation of 1.6 to 2.1% of the amount present.—E. VAN S.

***Determination of Tin with Cupferron in the Presence of Antimony.** Élio Gray (*Compt. rend.*, 1941, 212, 904-906; *Chem. Zentr.*, 1942, 113, (I), 518; *C. Abs.*, 1943, 37, 2298).—The method described is as follows: (a) oxidize the solution of SnCl_2 and SbCl_3 with hydrogen peroxide, boil off the excess peroxide, cool, and add a slight excess of ammonia; (b) add a little more (not over 5%) than twice the theoretical quantity of cupferron solution and then for every 100 c.c. of the suspension of Sn precipitate add 1 c.c. of 1% gelatin solution and a few drops of 2% tannin solution, filter, wash, ignite, and weigh as SnO_2 .

The Use of β -Naphthoquinoline for the Gravimetric Determination of Tungsten. B. A. Platonov and N. M. Kirillova (*Uchen. Zapiski Leningrad. Gosudarst.-Univ., Ser. Khim. Nauk*, 1940, (5), [(54)], 269-275; *Khim. Referat. Zhur.*, 1941, 4, (4), 73; *C. Abs.*, 1943, 37, 4983).—In precipitating tungstic acid, β -naphthoquinoline can replace cinchonine. The determination of W is given in detail, but with no other innovation.

***Determination of Zinc in Aluminium Alloys.** A. Cohen (*Helv. Chim. Acta*, 1943, 26, 75-88; *C. Abs.*, 1943, 37, 5333).—Method: Dissolve 5.00 g. of alloy in 200 c.c. of 9N- H_2SO_4 + 0.8 c.c. conc. HCl. When, after heating, no more hydrogen is evolved, add 5-10 c.c. of 30% H_2O_2 and boil to

remove the excess. At a volume of 250 c.c., remove all Cu by electrolysis. After all Cu has been deposited, filter and wash the residue with hot, dil. H_2SO_4 . Then to the filtrate add 40 c.c. of conc. H_2SO_4 , cool, and, while stirring, introduce 25 c.c. of reagent (prepared by dissolving 54 g. of HgCl_2 and 70 g. of NH_4CNS in 1 l. of hot water). The total volume of solution from which the $\text{Zn}[\text{Hg}(\text{SCN})_2]$ is precipitated should be about 400 c.c. If the volume is larger, add 10 c.c. of conc. H_2SO_4 for each 50 c.c. of excess volume. This concentration of acid has been found favourable for complete precipitation of the zinc compound. After an hour (or 12 hr. if only 0.01% Zn is present), filter and wash until no red $\text{Fe}(\text{CNS})_3$ is left. Transfer the precipitate and ashless paper filter to a porcelain crucible and heat in an electric muffle furnace to light redness. Since poisonous Hg fumes are evolved during the heating, it should take place under a good hood. Cool, transfer the ash to a beaker, and dissolve the ZnO by heating with 10 c.c. of 25% NaOH solution for 10 min. Dilute to 100 c.c. and filter. To recover Zn in the residue, wash it from the filter into a beaker, digest with 5 c.c. of 9N- H_2SO_4 , and finally add a drop of conc. H_2O_2 . Cool, add NaOH in slight excess, boil a few minutes, and filter. To the combined filtrates, add 1–2 c.c. of 50% tartaric acid solution and electrolyse with stirred electrolyte, about 2 amp. of current, and with Cu-plated cathode. Rinse the deposit with water and alcohol, dry at about 90° C., and weigh. The procedure as given provides for the determination of small quantities of Zn, but, with smaller samples, it can be used with as much as 20% of Zn. When a 1-g. sample is used with 20% of Zn, the results are likely to be about 0.75% too low, although 0.2–0.3% of Pb can be precipitated with the Zn.

***Electrolytic Determination of Zinc in Magnesium Alloys.** A. Cohen (*Helv. Chim. Acta*, 1943, 26, 89–91; *C. Abs.*, 1943, 37, 5333).—A procedure, very similar to that given in the preceding abstract, is described, in which the Zn is first precipitated from H_2SO_4 solution as $\text{Zn}[\text{Hg}(\text{SCN})_2]$, the precipitate is converted into ZnO, the residue is dissolved in NaOH, and from the basic solution Zn is deposited electrolytically.

Methods for the Evaluation of Metallic Zinc in Zinc Dust. D. A. Copeman (*J.S.African Chem. Inst.*, 1942, 25, 62–69; *C. Abs.*, 1943, 37, 1098).—The methods available for determining Zn in Zn dust are listed. The $\text{Fe}_2(\text{SO}_4)_3$ reduction method, the gas volumetric method (measurement of H_2 evolved), and the CuSO_4 reduction method are discussed in detail and the drawbacks noted. No method seems entirely satisfactory.

Spectrochemical Analysis with the Oscillograph. G. H. Dieke and H. M. Crosswhite (*J. Opt. Soc. Amer.*, 1946, 36, (4), 192–195).—For spectrochemical analysis where speed is of more importance than precision, it is useful to connect several photo-electronic amplifying valves set in the focal plane of a grating spectrograph to a single oscillograph. A mechanical switch, synchronized with the time-base of the oscillograph, can then be used to show the output of each valve in turn, so that several spectrum lines appear as lines on the screen, whose relative levels indicate their relative intensities. For better quantitative work, the intensity of a line of the main constituent of an alloy is fed to the oscillograph at right-angles to the output from the lines of selected impurities, each of which gives a short, oblique line whose slope is a function of concentration of the impurity. With a transparent scale quantitative readings can be made. Examples of steel analysis are illustrated and precautions are outlined.—E. VAN S.

***On the Quantitative Spectrographic Analysis of Solutions, with an Appendix on the Solubility of Silicon in Aluminium.** Rudolf Walti (*Thesis: Eidgenössische Technische Hochschule, Zürich*, 1943, 71 pp.).—[In German.] A method of analysis for solutions of Al and its alloys is based on the use of a new type of carbon electrode for liquids, which is flooded with the solution to be

analysed at the rate of about 20 ml./min. A spark with high capacity and low self-induction, at about 12,000 V., plays between the surface of the solution and an upper electrode of pure carbon. A small quartz spectrograph is used and the method of calibration depends on the uniformity of development and of the exponent b in the equation $I = nc^b$, connecting the line intensity, I , for an impurity, with its concentration, c . Tables for the product of plate contrast-factor and b are given for Mg, Mn, Fe, Cu, and Si in Al, both alone and in the presence of various concentrations of other alloying elements. The value of n in the equation is checked by repeating the spectrum of one standard solution on each plate. Two spectrum lines are used for each element. By a modification of the method using extra NaCl in the solution Si can be estimated up to 13%, with an accuracy comparing well with that of chemical estimations. A method for distinguishing between *dissolved* and *graphitic* Si in Al alloys uses the fact that only the *dissolved* Si forms SiO_2 when dissolved in acid; the rest of the Si remains insoluble. A complete separation of the soluble and insoluble fractions is made by washing the colloidal SiO_2 off the Si with 1% HF solution. The solution of SiO_2 in acid is then dosed with AlCl_3 to provide an internal standard line and is tested spectrographically to determine the Si. The results obtained for the solubility of Si in Al containing about 1% of Fe are slightly higher than usual below 400° C., but lower at 550° C.—E. VAN S.

Spectral Intensity Measurements with Photo-Tubes and the Oscillograph. (Dicke, Loh, and Crosswhite) See p. 305.

Advances in Microchemistry. V.—Quantitative Inorganic Micro-Analysis. F. Grassner and E. Abrahamczik (*Chemie*, 1942, 55, (39/40), 299–305; (41/42), 312–318; *C. Abs.*, 1943, 37, 5331).—A comprehensive review and classification of specific methods for the micro-determination of the various elements. A *bibliography* is given of over 360 references.

Thermoelectric Tester for Checking the Composition of Metals. (Rogers, Wentzel, Riott, and Corbett) See p. 305.

***Researches on the Impurities in Volatile Metals, by Distillation in vacuo.** (Villat) See p. 284.

†**The Mechanism of Electrode Measurements.** (Britton) See p. 301.

XII.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

***Further Improvement in the Resolving Power of the Electron Microscope.** James Hillier (*J. Appl. Physics*, 1946, 17, (4), 307–309).—It is pointed out that though theory indicates that the electron microscope should have a resolving power of 5–10 Å., only 10–15 of over 25,000 exposures made in the author's laboratory (1940–1945) definitely showed a resolving power as good as 20 Å. Owing to the recent development of a new source and telescopic viewing of the final image, magnifications of 300,000 at high intensity are obtained, with a high proportion showing resolutions of 20 Å. This work shows the limiting factor as regards resolution to be lack of axial symmetry in the magnetic fields of the lenses. Attention to this factor has produced resolutions of approximately 10.5 Å., corresponding to a useful magnification of the order of 200,000. It is concluded that the calculated limiting resolving power is obtainable in practice.—G. V. R.

***An Optical Method for Testing Surface Quality.** (Frischmuth) See p. 305.

"**Micro-Profilometer.**" A Device for Studying the Microprofile of Surfaces by the Interferential Method. V. Linnik (*Compt. rend. (Doklady) Acad. Sci.*

U.R.S.S., 1945, 47, (9), 630–631).—[In English.] An optical arrangement is described by means of which the topography of a surface may be studied.

—H. J. A.

A Lens to Supplant the Spectrograph Slit. Carl M. King (*J. Opt. Soc. Amer.*, 1946, 36, (3), 164–168).—Describes the use of a concave, cylindrical lens of short focal length to replace the slit of a grating (or prism) spectrograph and the way in which a secondary aperture and lens system are combined with this lens to provide the equivalent of a continuously-variable slit width in the range 10–130 μ . The advantages claimed are ease of manufacture, durability, ease of maintenance, and high light-efficiency.—E. VAN S.

Spectral Intensity Measurements with Photo-Tubes and the Oscillograph. G. H. Dieke, H. Y. Loh, and H. M. Crosswhite (*J. Opt. Soc. Amer.*, 1946, 36, (4), 185–191).—Describes a method of using a grating spectrograph with photo-electronic amplifying valves to register the light intensity from a single spectrum line on the oscillograph, using a time-base derived from the current used for the light source if a discharge tube is being examined. When an arc or spark is examined it may be more informative to examine light intensity as a function of the source voltage or source current, with a separate time-base for calibration. An oscillograph capable of dealing with high frequencies is necessary and the photo-electronic amplifier valves must be selected carefully. Differences between the behaviour of different lines in the same spectral source can be detected in this way, as a preliminary to the selection of lines for analysis.—E. VAN S.

Spectrochemical Analysis with the Oscillograph. (Dieke and Crosswhite) See p. 303.

The Geiger-Müller X-Ray Spectrometer. F. G. Firth (*Indust. Radiography*, 1946, 4, (4), 17–21, 47).—Details are given of an X-ray spectrometer using an asymmetric focusing system, in which a divergent X-ray beam irradiates a flat or curved specimen oscillated at the Bragg angle. The diffracted beams are detected by a Geiger tube situated on a radial arm, with the specimen as centre, which scans an arc that is measured in terms of twice the Bragg angle by a graduated scale. The Geiger tube is linked with appropriate counter circuits and a strip-chart-pen recorder. The applications of the instrument discussed include particle-size determinations, identification of substances (e.g., slags, ore minerals), and the determination of optimum sintering temperature and phase changes in powder metallurgy.—L. M.

Thermoelectric Tester for Checking the Composition of Metals. B. A. Rogers, K. Wentzel, J. P. Riott, and R. B. Corbett (*U.S. Bur. Mines, Rep. Invest.* No. 3690, 1943, 6 pp.; *C. Abs.*, 1943, 37, 3709).—The idea of using the thermoelectric character of metals as a means of distinguishing between them is old. An apparatus for quick and routine determinations is described and its use illustrated.

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

***An Optical Method for Testing Surface Quality.** B. Frischmuth (*Schweiz. Arch. angew. Wiss. Techn.*, 1944, 10, (12), 386).—Discusses principles of an optical method of testing surface quality, based on simple constructional alterations on an ordinary metallurgical microscope.—V. K.

†**The Supersonic Method for the Detection of Internal Flaws.** E. G. Stanford and H. W. Taylor (*Metallurgia*, 1946, 34, (200), 59–66).—The principle of the supersonic flaw detector is discussed and a description is given of the equipment used. The results of an investigation to develop a scheme whereby the equipment could be used in production on a routine basis are given, and the examination, in the laboratory, of the results obtained with

the apparatus when used to explore aluminium and aluminium alloy billets and various types of semi-finished components is reported. Special consideration is also given to the preparation of the surface of the material undergoing inspection and to the routine inspection and laboratory investigation of rectangular sections and of cylindrical bar. From the data obtained, it is concluded that the equipment achieves remarkably good results when used for the inspection of extruded samples of simple shape.—J. W. D.

***Investigation of the Heat of Friction and the Temperature Distribution in Wear Tests.** Erich Siebel and Robert Kobitzsch (*Mitt. K.-W. Inst. Eisenforsch.*, 1943, 26, (7), 97–106).—A method of calculating temperature gradients of specimens subjected to wear test is outlined. The formulæ obtained were applied to the calculation of temperature gradients existing in steel-copper, steel-zinc, and steel-bakelite specimens, tested by dry-wear tests at a speed of 3.12 m./sec. and at surface pressures varying from 100–1000 kg./sq. cm. It is shown, in the case of steel-copper, that temperatures increase with time and surface pressures, while for steel-zinc and steel-bakelite specimens, limiting temperatures (i.e., those of liquid-phase formation for zinc and the decomposition of bakelite) are reached in a thin surface layer in which wear of the specimens takes place.—V. K.

***Investigation of the Cavitation Phenomena.—I-II.** (Brandenberger and De Haller) See p. 297.

“T.R.” Machine for the Mechanical Testing of Metals at Elevated Temperatures.—I, II. Pierre Chevenard (*Rev. Mét.*, 1942, 39, (11), 321–330; (12), 353–359).—[I.]—The experimental aspects of the accurate measurement of the creep of metals at high temperatures are discussed in detail and a machine with several desirable features is described. The specimen is small (4 mm. dia. \times 32 mm. long). Loads are transmitted to it by the lever principle and elongations are magnified 1000 times and automatically recorded as an ink tracing on a drum. During an experiment, a thermostatically-controlled furnace surrounds the specimen. The tracing is made by a pen on the end of a lever which is mechanically controlled by an electric motor. The motor is in turn controlled by a sensitive electrical contact mechanism, lying at the end of a lever which is operated by changes in the length of the specimen. The separate components of the machine, which includes apparatus for applying loads at various constant speeds, are described and specimen results for several materials are given. [II.]—The use of the machine described above for the investigation of relaxation phenomena is described. Some modifications of the arrangements are necessary, but are easily made. The specimen is subjected to a rapid extension under load and its length is then maintained constant. The relaxation of the load is recorded automatically as an ink tracing on a drum. The specimen length during the experiment is automatically controlled by an electrical device, employing the same type of contact mechanism as previously described. Any slight extension of the specimen sets in motion an electric motor, which operates in such a way as to reduce the load slightly. The consequent movement of the lever by which loads are applied is made use of for the recording device. Specimen results are given and discussed in some detail.—G. V. R.

The Importance of Ultimate Extension as an Engineering Property of Materials. (Fisher) See p. 283.

Comparisons Between Values of Hardness and Mechanical Strength. (Spath) See p. 284.

***Application and Limits of Microhardness Measurement.** Wilhelm Bischof and Berthold Wenderott (*Arch. Eisenhüttenwesen*, 1942, 15, (11), 497–504; discussion, 505).—The effects of the surface condition and friction on hardness values obtained under loads varying from 3 g. to 100 kg. were studied on pure copper, aluminium, and iron, and martensite, using Vickers, Briniskop, and

Lipps hardness testers. It was found that with loads <100 g., the hardness value is greatly affected by the amount of surface distortion caused by polishing and that hardness values under small loads are greater than those under larger loads, owing to the surface friction of the indenter. A study of the relative magnitude of the elastic and plastic deformations which occur during an indentation was made by the method of measuring the depth or the length of the diagonals of the indentation. The results showed that these are affected by the magnitude of the load and by the structure of the material tested. The choice of loads for microhardness measurement of various phases present in the structure of an alloy depends on the grain-size of the phases present; the relation between these quantities is considered.—V. K.

The Elastic Modulus of Metallic Alloys. (Guillet) See p. 291.

***Changes in Materials Produced in Fatigue Tests.** (Karius, Gerold, and Schulz) See p. 292.

Inspection of Mass-Produced Aero-Engine Castings. P. Cook (*Machinist (Eur. Edn.)*, 1946, 90, (9), 325–328).—The rigid inspection system and detailed checking of proof castings required to ensure good quality and to reduce scrap components in a mechanized foundry making light alloy castings are described.

—J. H. W.

Inspection in a Mechanized Foundry. T. Cook (*Found. Trade J.*, 1946, 78, (1538), 133–145).—Read before the Scottish branch of the Institute of British Foundrymen. An illustrated account of the inspection of patterns, core-boxes, and the finished castings.—J. E. G.

RADIOLOGY

Radiographic and Fluoroscopic Interpretation of Casting Irregularities. Thomas E. Piper (*Iron Age*, 1946, 157, (18), 46–49).—The use of X-ray and fluoroscopic methods to improve non-destructive inspection of aircraft castings is described. The relative definition produced by the fluoroscope and by radiography is discussed and the appearance of 14 types of defect is illustrated.

—J. H. W.

Industrial Applications of X-Ray Stress Analysis. Don M. McCutcheon (*Indust. Radiography*, 1946, 4, (4), 9–16).—The degree of sharpness of the diffraction spots obtained from metals provides a qualitative means of assessing surface stresses. Quantitative measurements can be made by measurement of the diffraction angles, using reference lines from a standard substance recorded on the same film. The techniques are discussed. Examples of qualitative and quantitative stress analysis are given and related to other factors, e.g., applied stress and compressive stress due to surface peening by shot-blasting. The application of the Geiger-counter to this work is described.—L. M.

Microradiography. (Maddigan) See p. 295.

The Geiger-Müller X-Ray Spectrometer. (Firth) See p. 305.

XIV.—TEMPERATURE MEASUREMENT AND CONTROL

***Errors Resulting from Using Compensating Leads with Chromel-Alumel Thermocouples.** Joseph Spaeck (*Instruments*, 1945, 18, (8), 539).—Calculations are given of the errors which may arise when using nickel-copper alloy (composition not specified): copper compensating leads, for the cases when both "cold junctions" are at 300° F. (149° C.) and when they are at 290° and 300° F. (143° and 149° C.), respectively. Errors of 14°–26° F. (8°–14° C.) may be introduced. It is recommended that the lead wires should be of the same composition as the thermocouple elements.—J. C. C.

***A New Thermocouple, Unaffected by the Temperature of the Cold Junction.** Hans Thomas (*Z. Metallkunde*, 1944, 36, (6), 140–141).—An investigation of

nickel-copper alloys suitable for use as thermocouples is reported. Particulars are given of a new couple, having limbs consisting of two nickel-copper alloys of different compositions (not exactly stated). It has a linear temperature-millivolt relationship over the range 400°–850° C. At 600° C., variation of the cold junction from: (1) –50° to 110° C. gives an error of 13° C., (2) 0° to 110° C. gives an error of 1° C. The oxidation-resistance of the couple is somewhat superior to that of Constantan.—E. N.

*Alloys for Electrodes of Thermoelements and Compensation Leads. I. Ya. Berkovsky and F. N. Stepanov (*Tochn. Ind.*, 1940, 11, (6), 13–17; (7), 14–18; *Chem. Zentr.*, 1941, 112, (I), 1845; *C. Abs.*, 1943, 37, 2322).—[In Russian.] The thermoelectric powers and their isotherms were determined for alloys of the systems copper-nickel, nickel-chromium, nickel-aluminium, nickel-manganese, and nickel-silicon. The effect of various admixtures on these properties was studied. The suitability of various alloys for the production of compensation wires and the relation between the mechanical, electrical, and physical properties of such alloys and their composition were also investigated. Fusion, casting, and rolling, and subsequent machining and working of these alloys are discussed.

XV.—FOUNDRY PRACTICE AND APPLIANCES

American Practice of Sand Casting Aircraft and Motor Components in Aluminium Alloys. Ya. E. Afanas'ev (*Aviatsion. Prom.*, 1940, (1), 12–19).—[In Russian.] Data obtained on a tour in the U.S.A. are given.—D. A.

*On the Brittleness of Aluminium After Casting. (Jolivet and Armand) See p. 281.

The Manufacture of Plated Inlay: Steel-Lead Bronze. D. Shneider (*Vestn. Inzhen. Tekhn.*, 1941, 39; *Chem. Zentr.*, 1942, 113, (I), 922; *C. Abs.*, 1943, 37, 2325).—Tractor bearings in Babbitts and lead-bronze (copper 70, lead 30%) were tested for 2500 hr. The test showed the superiority of the lead-bronze. Centrifugal pouring caused lead stratification, therefore the inlays were made by hand-pouring, using a flux of borax 84, boric acid 8, and silica 8%. The output was low and up to 50% rejects resulted. As a better method, it is advisable to heat steel sheet to 1100° C., pour a 6-mm. thick lead-bronze layer, apply pressure, and cut out the inlays.

*The Casting Properties of [Aluminium] Alloys. (Bochvar) See p. 288.

Experiments on Developing Rapid Melting of Scrap Bronze. D. P. Kucherenko (*Tsvet. Metall.*, 1941, (4), 27–29).—[In Russian.] Melting was carried out by introducing the charge into a liquid melt.—N. A.

Comments and Observations on Experimental X-Ray Diffraction Stress Methods and Technique for Sand-Cast Magnesium Alloy Structures. Frank D. Klein (*Indust. Radiography*, 1946, 4, (4), 41–46, 49).—K. reaches the under-mentioned conclusions, which are discussed *in extenso*: (1) the foundry equipment used for aluminium alloy castings cannot be used for magnesium castings without modification, (2) there is insufficient correlation and exchange of information between designer and foundryman, (3) sufficient study and/or knowledge of magnesium alloy castings is lacking, (4) a study of the control of grain-size is lacking, (5) refining and pouring temperatures require correlation with thickness and accessibility of section, (6) production should be controlled by physical and chemical tests, and (7) (American) designers and foundrymen should adopt alloys other than the magnesium–6% aluminium–3% zinc alloy now more or less standard.—L. M.

A New Feeding Technique for Castings. T. E. Lloyd (*Iron Age*, 1946, 157, (17), 62–64).—The use of an exothermally-reacting compound—"Thermoto-

mic"—in feed gates for ferrous and non-ferrous castings to provide better metal feeding into the mould is described. The mixing of the compound and its use as a core and facing material and typical applications in roll and bearing castings are discussed.—J. H. W.

Duplex Pump Castings. R. H. Brown (*Found. Trade J.*, 1946, 78, (1541), 223-233).—Read before the Bristol and West of England Branch of the Institute of British Foundrymen. A general illustrated account.

—J. E. G.

The Formation of Banded Structures in Horizontal Centrifugal Castings. C. Howson (*Found. Trade J.*, 1946, 78, (1545), 346 (letter); 79, (1555), 135-137, 143).—Correspondence and further discussion on this paper. See *Met. Abs.*, this vol., p. 135.—J. E. G.

Use of the Cumulative Curve for Foundry Sand Control. R. E. Morey and H. F. Taylor (*Amer. Foundryman*, 1946, 9, (1), 65-75).—See *Met. Abs.*, this vol., p. 187.—J. E. G.

Pressure Die-Casting. G. T. Vicary (*Found. Trade J.*, 1946, 78, (1540), 201-204).—Read before the Bristol and West of England Branch of the Institute of British Foundrymen. A general account.—J. E. G.

Producing 70 Tons of Die-Castings Daily. Herbert Chase (*Iron Age*, 1946, 157, (19), 76-80).—The equipment and procedures used in producing 70 tons of zinc die-castings daily in the world's largest single plant is described and the extensive mechanization of the system of handling castings is discussed in detail.—J. H. W.

Some Casting Troubles. J. L. Francis (*Found. Trade J.*, 1946, 79, (1554), 103-110; discussion, 110-111).—Read before the East Anglian Section of the London Branch of the Institute of British Foundrymen. A general illustrated account in which are discussed, with the aid of typical examples, the causes of defective castings.—J. E. G.

The Technological Principles of Casting Design. Victor M. Shestopal (*Found. Trade J.*, 1946, 78, (1539), 173-175).—Discussion on the paper. See *Met. Abs.*, this vol., p. 100.—J. E. G.

Some Pattern-Shop Methods and Their Advantages to the Foundry. H. W. Turner (*Found. Trade J.*, 1946, 78, (1544), 315-320).—Read before the Slough Section of the Institute of British Foundrymen. A fully illustrated account.—J. E. G.

Is the Pattern-Shop an Asset or a Liability? H. Padley (*Found. Trade J.*, 1946, 79, (1553), 83-87, 92; discussion, 92).—Read before the West Riding of Yorkshire Branch of the Institute of British Foundrymen. A general account dealing with pattern-shop equipment, the essentials of a good pattern, and the application of machinery to the construction of patterns.

—J. E. G.

Inspection in a Mechanized Foundry. (Cook) See p. 307.

Foundry Education and Recruitment. Douglas H. Ingall (*Found. Trade J.*, 1946, 79, (1551), 25-29; discussion, 29-32).—Read before the London Branch of the Institute of British Foundrymen. A general review of some typical technical courses in foundry technology in operation at the present time.—J. E. G.

Technical Records in the Foundry. R. D. Lawrie (*Found. Trade J.*, 1946, 78, (1547), 387-390; discussion, 1946, 79, (1553), 89-91).—Read before the Scottish and the Lancashire Branches of the Institute of British Foundrymen. A general illustrated account, in which are detailed the chief advantages to be gained from the keeping of technical records in the foundry.

—J. E. G.

XVII.—FURNACES, FUELS, AND REFRACTORY MATERIALS

Development of the Industrial Vacuum Melting Furnace. Werner Hessenbruch and Karl Schichtel (*Z. Metallkunde*, 1944, 36, (6), 127–130).—A description is given of the development of the vacuum furnace, from its inception as a laboratory appliance to the modern high-frequency furnace of 5000 kg. capacity, working at temperatures over 1800° C. with a vacuum of 0.1 mm. of mercury. Present applications of such furnaces are cited; working with controlled atmospheres and using combined reaction and degassification processes, they have great possibilities for the production of pure metals and alloys.—E. N.

XVIII.—HEAT-TREATMENT

***Water-Quenching of Some Typical Magnesium Casting Alloys.** R. S. Busk and R. E. Anderson (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 278–288; discussion, 289–290).—Time-temperature cooling curves for $\frac{1}{2}$ -in. test bars of magnesium alloy indicate that there is a great difference between water-quenching and either air- or oil-quenching. Quenching magnesium-base magnesium-aluminium-zinc casting alloys from the solution-heat-treatment temperature may have a beneficial effect on the properties after subsequent ageing; the extent of this improvement in mechanical properties depends on the composition of the alloy. The possibility of the alloy cracking when being quenched is investigated. The relationship required between quenching temperature and the temperature of the water bath to avoid cracking a specially designed notched plate of magnesium alloy is indicated. The alloys considered are in the composition range: magnesium with aluminium 6–12 and zinc 0–4%, with 0.2% manganese.—H. J. A.

***Induction Heating of Hollow Metallic Cylinders.** Andrew Gemant (*J. Appl. Physics*, 1946, 17, (3), 195–200).—It is pointed out that rigorous formulæ exist for the variation of heat input with frequency for solid metal cylinders subjected to induction heating, but that analogous equations for hollow metal cylinders are usually presented in an approximate form. A rigorous expression for the heat input in this case is derived and is valid for the whole frequency range. Examples of its use in numerical computations are given and comparisons are made between the accurate results and those obtained by the use of various approximate equations. In general, below the frequency for which the depth of penetration is equal to the wall thickness, exact and approximate equations agree accurately. For higher frequencies, the approximate formula gives a somewhat higher heat input value. For still higher frequencies (penetration markedly less than wall thickness), deviations become small again. The maximum deviation between the rigorous and approximate equations is about 10%.—G. V. R.

***Heat-Treatment of Semi-Conductors and Contact Rectification.** (Serin) See p. 282.

XIX.—WORKING

The Rolling of Aluminium Materials. P. Grüner (*Aluminium*, 1944, 26, (4), 54–59).—An account of the factors involved in the rolling of pure aluminium, aluminium-copper-magnesium, and aluminium-zinc-magnesium alloys. Types of billets, correct rolling temperatures, permissible reductions, and edge-cracking are discussed and typical structures illustrated by micro- and X-ray photographs.—E. N.

*Grain-Sizes Produced by Recrystallization and Coalescence in Cold-Rolled Cartridge Brass. (Walker) See p. 293.

Machining of Zinc Alloys. O. H. C. Messner (*Schweiz. Arch. angew. Wiss. Techn.*, 1944, 10, (12), 389–390).—Machining characteristics of zinc and zinc alloys are reviewed.—V. K.

XXIV.—BIBLIOGRAPHY

(Publications marked * have been received.)

AMERICAN SOCIETY FOR METALS. **Corrosion of Metals.** [5, Metal Congress Lectures.] 6 × 9 in. Pp. 192, with 70 illustrations. 1946. Cleveland, Ohio: The Society, 7301 Euclid Avenue. (\$3.00.)

*BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Carl Schenck Torsion Bar Testing Machine.** (FIAT Final Report No. 402.) [Mimeographed.] 9½ × 7¼ in. Pp. 5. London: H.M. Stationery Office. (6s.)

*BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Ferro-Alloy Manufacture and Use.** (FIAT Final Report No. 485.) [Mimeographed.] 9½ × 7¼ in. Pp. 14. London: H.M. Stationery Office. (1s. 6d.)

*BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **German Aluminium Foil Industry.** (Final Report No. 374. Item No. 21.) [Mimeographed.] 9½ × 7¼ in. Pp. 20. London: H.M. Stationery Office. (2s.)

*BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **German Electroplating Industry.** (Final Report No. 429. Item No. 21.) [Mimeographed.] 9½ × 7¼ in. Pp. 85. London: H.M. Stationery Office. (8s. 6d.)

*BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **German Non-Ferrous (Copper-Base) Foundry Industry.** (Final Report No. 296. Item No. 21.) [Mimeographed.] 9½ × 7¼ in. Pp. 132, with numerous illustrations. London: H.M. Stationery Office. (11s.)

*BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **German S.A.A. Factories.** (Final Report No. 295. Item No. 2.) [Mimeographed.] 9½ × 7¼ in. Pp. 36. London: H.M. Stationery Office. (3s. 6d.)

*BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **German Vacuum Evaporation Methods of Producing First-Surface Mirrors, Semi-Transparent Mirrors, and Non-Reflecting Films.** (JIOA Final Report No. 9.) [Mimeographed.] 9½ × 7¼ in. Pp. 41. London: H.M. Stationery Office. (4s.)

*BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Light Alloy Manufacture at Aluminiumwerke Göttingen G.m.b.H., Göttingen.** (Final Report No. 505. Item No. 21.) [Mimeographed.] 9½ × 7¼ in. Pp. 7. London: H.M. Stationery Office. (1s.)

*BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Manufacture and Application of Specialized Magnetic Materials Generally.** (Final Report No. 8. Item No. 21.) [Mimeographed.] 9½ × 7¼ in. Pp. 97. London: H.M. Stationery Office. (8s. 6d.)

*BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Non-Ferrous Metal Rolling Mill Practice in Germany.** (FIAT Final Report No. 406.) [Mimeographed.] 9½ × 7¼ in. Pp. 30. London: H.M. Stationery Office. (3s.)

*BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **"Press-Welding" Aluminium for Aircraft Radiators.** (FIAT Final Report No. 417.) [Mimeographed.] 9½ × 7¼ in. Pp. 8. London: H.M. Stationery Office. (1s. 6d.)

- *BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Production of Beryllium [at the] "Degussa" [Factory].** (Final Report No. 319. Item No. 21.) [Mimeographed.] $9\frac{1}{2} \times 7\frac{1}{4}$ in. Pp. 11. London: H.M. Stationery Office. (1s. 6d.)
- *BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Recovery of Aluminium Alloys from Aircraft Scrap.** (Final Report No. 376. Item No. 21.) [Mimeographed.] $9\frac{1}{2} \times 7\frac{1}{4}$ in. Pp. 84, with numerous illustrations. London: H.M. Stationery Office. (8s.)
- *BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Report on Visit to Germany and Austria to Investigate Alloys for Use at High Temperature.** (Final Report No. 396. Item No. 21.) [Mimeographed.] $9\frac{1}{2} \times 7\frac{1}{4}$ in. Pp. 76. London: H.M. Stationery Office. (8s.)
- *BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Rheinmetall Borsig A.G., Düsseldorf.** (Final Report No. 322. Item No. 2.) [Mimeographed.] Pp. 3. London: H.M. Stationery Office. (6s.)
- *BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Rolled Non-Ferrous Metal Industries in Germany.** (Final Report No. 402. Item No. 21.) [Mimeographed.] $9\frac{1}{2} \times 7\frac{1}{4}$ in. Pp. 94. London: H.M. Stationery Office. (9s. 6d.)
- *BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Telefunken Gesellschaft für Drahtlose Telegraphie m.b.H.; Special Materials for Radio Valves.** (Final Report No. 276. Item No. 7.) [Mimeographed.] $9\frac{1}{2} \times 7\frac{1}{4}$ in. Pp. 20. London: H.M. Stationery Office. (2s.)
- *BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **The German Pin and Allied Products Industry.** (Final Report No. 471. Item No. 36.) [Mimeographed.] $9\frac{1}{2} \times 7\frac{1}{4}$ in. Pp. 71. London: H.M. Stationery Office. (6s. 6d.)
- *BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **The Wrought Light Alloy Industry in the Ruhr.** (Final Report No. 375. Item No. 21.) [Mimeographed.] $9\frac{1}{2} \times 7\frac{1}{4}$ in. Pp. 58, with numerous illustrations. London: H.M. Stationery Office. (6s. 6d.)
- *BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Visit to Metallgesellschaft A.G., Frankfurt a.M.** (Final Report No. 504. Item No. 21.) [Mimeographed.] $9\frac{1}{2} \times 7\frac{1}{4}$ in. Pp. 13. London: H.M. Stationery Office. (1s. 6d.)
- *BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Welding.** (FIAT Final Report No. 497.) [Mimeographed.] $9\frac{1}{2} \times 7\frac{1}{4}$ in. Pp. 163, with numerous illustrations. London: H.M. Stationery Office. (14s.)
- *BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Welding of Aluminium and Aluminium Alloys, with Particular Reference to the Manufacture of Pressure Vessels.** (Final Report No. 392. Item No. 21.) [Mimeographed.] $9\frac{1}{2} \times 7\frac{1}{4}$ in. Pp. 31. London: H.M. Stationery Office. (3s.)
- *COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Hugo Schneider A.G. Messingwerke Aluminium Werke, Leipzig.** (Item No. 21. File No. XXXI-57.) [Mimeographed.] $9\frac{1}{2} \times 7\frac{1}{4}$ in. Pp. 6. London: H.M. Stationery Office. (6d.)
- *COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE. **Refining of Cobalt, Nickel, Zinc, and Cadmium.** (Item No. 21. File No. XXXI-20.) [Mimeographed.] $9\frac{1}{2} \times 7\frac{1}{4}$ in. Pp. 26. London: H.M. Stationery Office. (2s. 6d.)



In your post-war planning
leave your

PRESSING

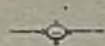
problems to

FISHER

AND

LUDLOW

LIMITED



Head Offices

Rea Street . . . Birmingham, 5

Established 1852

HIGH STRENGTH



BIBLIOTEKA GŁOWNA
Politechniki Śląskiej

P 99/LXXII.

*We can place at your disposal experience
covering 36 years of progressive development.*

"DURALUMIN" "DURAL"

REGISTERED TRADE MARKS

Telephone.
EAST 1221

JAMES BOOTH & COMPANY, LIMITED

ARGYLE STREET WORKS, NEECHES, BIRMINGHAM, 7

Telegrams: BOOTH
BIRMINGHAM, 7

UNITED ANODISING LIMITED

(Controlling Alumilite and Alzak Ltd., Aluminium Protection Company
Limited, British Anodising Limited.)

ELECTRO-BRIGHTENING, SULPHURIC ACID ANODISING, DYEING AND SEALING

The processes now owned or controlled by the United Anodising Group of Companies have played
a vital part in the war effort.

Members of the Group own or are exclusive Licensees for the United Kingdom, India, Australia
and the Union of South Africa.

BRITISH PATENTS Nos.

378,521	401,579	436,154	412,193	540,146	449,175
381,402	406,988	436,481	412,205	558,926	463,790
387,806	407,208	440,287	479,063	559,393	483,776
391,903	409,679	489,169	483,727	559,394	525,734
393,996	407,457	491,974	489,220	359,494	528,314
396,204	413,814	496,613	537,474	382,287	474,609
401,270	433,484	528,748	558,925	429,344	476,161

The Australian, Indian and Union of South Africa Patents Numbers will be given on application.

The Authorisations given by the Minister of Aircraft Production or other Government Departments
for the use of patented processes for war purposes do not of course cover ordinary commercial use.

In view of the extended use of anodising, including use of the processes covered by the patents
mentioned above, favourable consideration will be given to grants of licences and sub-licences to
approved manufacturers.

All enquiries should be addressed to:—

UNITED ANODISING LTD., 40, Brook Street, London, W.1. Mayfair 4541.

ALL COMMUNICATIONS REGARDING ADVERTISEMENTS SHOULD BE ADDRESSED TO THE ADVERTISING MANAGERS,
MESSRS. T. G. SCOTT & SON, LTD., TALBOT HOUSE, ARUNDEL STREET, LONDON, W.C.2.

PRINTED IN GREAT BRITAIN BY RICHARD CLAY AND COMPANY, LTD., BUNGAY, SUFFOLK.