

[The latest information I have is that there is a 1966 German edition of the *Physikalische Taschenbuch*—this is not recorded in the above volume.] S. WEINTROUB

## METALLURGY OF CHROMIUM

### Chromium

By A. H. Sully and E. A. Brandes. Second edition. (Metallurgy of the Rarer Metals, No. 1.) Pp. xiii + 373. (Butterworths: London, 1967.) 95s.

THE second edition of this successful book has been prepared by E. A. Brandes. It is, like the first, a well-balanced review of the metallurgy of chromium covering its occurrence, extraction, purification, fabrication, properties and use. The tables and text of the original seven chapters have been expanded and brought up to date where appropriate and a new chapter has been included.

As dictated by its current role, a substantial part of the book is devoted to the industrial application of chromium as a surfacing material. There are chapters on electro-plating and chromizing in which techniques are described in some practical detail and a review is made of the current understanding of the processes. The chapter on physical properties has been revised and up-dated to include the interpretation of the anomalous variations in such properties as Young's modulus, coefficient expansion and internal friction which occur along with the magnetic transition at 310° K. The section covering equilibrium diagrams now includes several additional binary systems.

The new chapter on mechanical properties and fracture forms an important part of the revision since it covers an area in which recent research has been largely concentrated. Work before 1966 is summarized with particular emphasis on the brittleness problem which remains a major obstacle to the more widespread use of chromium as a structural material. The effects of temperature, strain-rate, grain size, purity and alloying on the mechanical properties of chromium are surveyed. While the coverage is complete, little attempt is made to discuss hypotheses as to the mechanisms underlying brittleness, which is surprising in view of Brandes's own contributions to the field.

In any text of this nature, it is likely that individual readers will regret a lack of emphasis in their own area. In the present instance, the purification of chromium using the iodide process and the properties of chromium-metal oxide alloys in general, seem worthy of greater emphasis. Russian work on the electron-beam and tungsten arc-welding of chromium could have been profitably included, as could data on the diffusion of foreign atoms in chromium, particularly bearing in mind the importance of impurity additions to the properties of the host.

Subjective matters apart, the book achieves its aim as a textbook and a readable work of reference. While repetition of information, particularly in the earlier chapters, may prove a minor irritation to those working through the book, it is a price which must be paid if it is to do such double duty. It is 100 pages longer than the first edition, but the inclusion throughout the text of new material among the old has been done unobtrusively. Half-tone reproduction, however, has deteriorated and is now barely good enough for some of the electron micrographs which are included.

Despite the intensive research which has been carried out in the thirteen years since this book was first published, unalloyed chromium remains an intractable engineering material. Those engaged in the development of heat-resistant chromium-base alloys, however, may take some comfort from the fact that one of Brandes's textual revisions has been to omit Sully's original conclusion that "... the potentialities of chromium-base alloys as engineering materials are not all that good ...".

A. GILBERT

## MATHEMATICAL LOGIC

### From Frege to Gödel

A Source Book in Mathematical Logic, 1879-1931. By Jean van Heijenoort. (Source Books in the History of the Sciences.) Pp. x + 660. (Harvard University Press: Cambridge, Mass.; Oxford University Press: London, 1967.) 148s.

MOST logicians will want to own this collection of classic papers which have shaped the subject as it is today. They will have often seen references to them but will probably not have read many, because nearly half of them are not easily accessible and they were originally written in seven languages, only five (out of forty-six) being in English. Most of the others are translated into English here for the first time.

The translations have been made by mathematical logicians and are very good, accurate rather than fluent, but this is perhaps desirable in a collection which is intended as a reference source rather than a course of reading. Each paper is accompanied by explanatory notes which are most helpful. Even that daunting paper of Löwenheim containing the first (incomplete) proof of the Löwenheim-Skolem theorem, the one which starts straight out with: "We put  $I_{jk} = I_j + I_k + I_{jk}$ , . . .", now becomes intelligible. Although there have been several other selections of papers on mathematical logic published recently this volume overlaps very little with them; for example, it has only one paper in common with each of Benacerraf and Putnam's *Philosophy of Mathematics* and Davis's *The Undecidable*. All but five of the papers are presented here in their entirety. The printing and layout are excellent and the price is very reasonable for a work of this kind and size.

The book starts with a complete translation of Frege's *Begriffsschrift*, his first work in logic, containing, amongst other things, a complete and accurate propositional and first order functional calculus, a remarkable achievement when one considers that it was many years before the latter was fully rediscovered and that as late as 1938 eminent logicians were stating incorrect versions. This is really the basis of modern mathematical logic.

After selections from Peano and Dedekind follow the most important papers on the paradoxes, by Burali-Forti, Cantor, Richard, Russell's letter to Frege and Frege's reply. Then the attempts to avoid the paradoxes by Russell and Zermelo, and the further development of axiomatic set theory by Fraenkel, Skolem, von Neumann. The Löwenheim-Skolem theorem is represented by the original papers of these two authors, and Skolem's first work on primitive recursive arithmetic is here. The formalist intuitionist dispute is well documented with papers by Hilbert, Weyl, Bernays, Brouwer and Kolmogorov, and some of the positive contributions of intuitionism (fan theorem, bar theorem) by Brouwer are presented and put into perspective by some very helpful notes of Charles Parsons.

Herbrand's theorem and the Gödel completeness theorem are here, and the incompleteness theorems are well covered, starting with Finsler's 1926 paper "Formal Proofs and Undecidability". Many will be interested to read this and the notes discussing its relation to Gödel's work, which is represented by his first abstract, main paper and also a less well known short paper "On Completeness and Consistency" giving generalizations. Amongst the other papers appear the well known contributions of Padoa, Wiener and Schönfinkel and Post's "Introduction to a General Theory of Elementary Propositions" containing consistency and completeness proofs for the propositional calculus.

Undoubtedly a valuable addition to the bibliography of mathematical logic for the English speaking world.

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