Book Reviews

The Structure of Metals and Alloys (5th Edition)

W. Hume-Rothery, R. E. Smallman, C. W. Haworth

Pp 407 (Institute of Metals, 1969) £3 10*s* ($10.50)

"The Structure of Metals and Alloys" first appeared as a slim volume from the pen of Professor Hume-Rothery, in 1936, as No. 1 in the Institute of Metals' Monograph and Report Series. It at once had a well-deserved success – at a time when the market for texts in metallurgical science was much more restricted than now – and was reprinted frequently. It was indeed revolutionary because it marked the first systematic attempt to analyse why equilibrium diagrams have the forms they actually do. Electron/atom ratios, Hume-Rothery rules, the concept of size-factor, became as familiar for up-to-date metallurgists as the ego, super-ego and id for knowledgeable psychoanalysts.

At roughly eight-yearly intervals new editions have appeared, latterly with the co-operation of Professor G. V. Raynor. Progressively more was included about the defect structure of pure metals, and in this latest edition two new co-authors join Professor Hume-Rothery, whose lamented death was announced shortly before publication date. The most noticeable change from early editions is the complete rewriting of the second part of the book, dealing with crystal defects. The section of the 4th edition that dealt with iron alloys has been deleted since Professor Hume-Rothery had published a separate monograph on this subject.

When one compares the 5th edition with earlier ones one can see how much effort has gone into the revision. For instance, the interpretation of the Hume-Rothery rules has had to be totally recast in the light of recent work on Fermi surfaces, and such matters as the Engel-Brewer theory receives conscientious treatment. No attempt is made to take the line that, because the Hume-Rothery rules have seemed satisfactory for so long, there might be a good case for leaving well alone. In his retirement, as always before, Professor Hume-Rothery was an extremely careful and conscientious scientist. Many other points of detail in the sections dealing with phase diagrams and alloy crystal structures have been brought up to date by the authors.

The second part of the book has become more authoritative than it was before. The geometry of dislocation configurations is treated in detail, and so is the formation of loops and other configurations from the coagulation of point defects. The standard is as high as one would expect in view of Professor Smallman's distinguished work in this field. A brief but lucid section (the authors are particularly clear in explaining the nature of dislocation contrast in electron microscopy) deals with the experimental observation of dislocations. Stacking faults and their regularities (there is an echo of the Hume-Rothery rules here!) receive detailed attention; it is perhaps a pity that the interesting regularity advanced by Bolling and others in the AIME Journal of Metals for April 1969 appeared too late to receive due consideration. Many new electron micrographs are included and, mostly, these effectively illustrate points made in the text, though in one or two instances the sheer volume of material to be interpreted makes for obscurity: thus, the dislocation dipoles in fig. 96 are hard for the beginner to discern!

The short section on alloy- and work-hardening is concise but clear, and a number of more advanced topics, such as superdislocations in ordered alloys, are usefully touched upon. Recrystallisation is also covered in a concise manner, but it is a pity that subgrain structures are accorded much less space than they were in the previous edition. It is no doubt largely an expression of the change in pace and emphasis in modern fundamental metallurgical research that in the first part of the book, thoroughly revised though it is, more than 75% of the references are more than ten years old, whereas in the second part, few references go back more than ten years, so that historical perspective is somewhat lacking here.

The criticisms are minor, while the book's virtues are as solid as ever. Libraries, private and institutional, will be well advised to restock with the 5th edition.

R. W. CAHN