

transfer learning technique will doubtless recommend it to all fourth-formers!

Apart from Mr. Fea's book, Mr. Moore's *The Observer's Book of Astronomy* is probably the best value for money of all books on astronomy. It has 216 pages of concisely presented information and is profusely illustrated.

Astronomy could provide the liberalizing force in our over-specialized school curricula. Of particular value is its potentiality as a unifying force between the individual subjects of the science curricula. While the books described would provide a more than sensible nucleus for the school library, there is still a need for more precise information presented in the form of problem solving.

JOHN HEYWOOD

PREPARATION OF ALLOYS BY ELECTRODEPOSITION

Electrodeposition of Alloys

Principles and Practice. By Abner Brenner. Vol. 1. Pp. xx+714. 171s. 6d. Vol. 2. Pp. xi+656. 157s. (New York and London: Academic Press, 1963.)

THE time-delay between the establishment of a reasonable scientific background to a subject of particularly practical interest and the actual attainment of the practical goal may often be measured in decades. In certain cases commercial security may preclude the publication of the development stage also. Electrodeposition is no exception to this. The manufacture of electroplated articles, to replace those of pure metal or to utilize thinner sections, was first applied to the noble metals, silver and gold, for obvious reasons. During the industrial revolution, the idea spread and a much wider range of deposited metals became available. The idea that alloys might be deposited, as distinct from pure metals (singly or in successive layers), was not immediately obvious, and, in any event, scarcely necessary, since the properties of electrodeposited pure metals could be varied over wide limits by control of the plating process.

Nevertheless, many alloys have been deposited without difficulty. The author of these two volumes estimates that of the 92 natural elements, 70 are metallic and 33 have been deposited from aqueous solution. Of these, only 14 are of significant commercial interest (I would hesitate to suggest that this statement will hold for long) and about 100 different alloys containing the 14 of interest have been electrodeposited so far. The commercial importance of this group is limited to brasses, bronzes, nickel-cobalt, lead-tin, tin-zinc, and various gold alloys. There is perhaps some justification, therefore, for the fact that no book dealing exclusively with alloy plating has ever appeared, apart from a small German booklet of 1914.

The author has adopted an unusual but extraordinarily useful classification of his subject in compiling this first authoritative work. The electrochemist, or any interested investigator, is provided with an excellent presentation of the background theory and its relationship to alloy plating. The practical plating man is supplied with all the relevant information for preparing and operating the baths required, and need look no further for his instructions. From an estimated 150 pages and eighteen months' work, the two volumes (split merely for convenience in handling) grew by a factor of 10. The combination of the basic science in a technology, even in such a narrow field, may point the way for similar textbooks in many other specialized subjects, where too often the background is too weak for a text-book and the practical aspects are eliminated or at least kept to a minimum.

Volume 1 contains the theoretical background (one-fifth), and a section on general practical considerations involved, which is also partly background (two-fifths).

The third part deals with the first group of alloys, those of copper and silver. In volume 2, there are five further groups of alloys dealt with, including not only those of immediate commercial interest but also even heavy metals such as tungsten and molybdenum and alloys containing germanium and phosphorus. The printing is clear, and the diagrams helpful. An author index and a subject index are common; but in this case there is, additionally, a patent index. The subject-matter is confined to deposition from aqueous solutions only.

The wealth of detail involved did not allow me to read every chapter, but encouraged reference to the volumes on specific topics. In each case, my appetite was readily satisfied, and some interesting suggestions prompted concerning work not primarily involved with electroplating, for example, the production of textures in thin films for work on anisotropy. There is therefore much of general scientific interest in these books, quite apart from the obvious value to electroplating, and despite the price the demand deserves to be heavy.

C. R. TITTLE

MICROMINIATURIZATION OF ELECTRONIC EQUIPMENT

Microminiaturization

Proceedings of the AGARD Conference, Oslo, July 24-26, 1961. Edited by G. W. A. Dummer. (AGARDograph No. 57.) Pp. x+355. (London and New York: Pergamon Press, 1962. Published for and on behalf of the Advisory Group for Aeronautical Research and Development, North Atlantic Treaty Organization.) 105s. net.

MICROMINIATURIZATION of electronic equipment is a new and important subject. It is interesting to note that in 1958 there were only a few companies in the United States engaged in this field, but by the present year the number has risen to a few hundred. Microminiaturization of electronic equipment allows equipment designed for performing a specific task to be considerably smaller and lighter than using conventional components and techniques, but owing to the high degree of control possible during manufacture, it will also be very much more reliable.

The three main systems of microminiaturization are micromodules, microcircuits and solid circuits, and largely because electronic systems are called on to perform more and more exacting tasks all these methods have their supporters in the endeavour to produce equipment to perform a complex task and, at the same time, be of reasonable size and weight and have a high reliability. It is for these reasons that microminiaturization has attracted the greatest attention from those concerned with military electronic equipments, where the improvement required in the reliability factor is the predominant factor. In most cases tooling to allow manufacture of the final product is a costly item, and so microminiaturization obviously begins to pay the biggest dividends when large numbers of the same unit are required, and particularly where it is reasonable to pay a higher price to obtain the maximum reliability. It is for this reason that military requirements have tended to force the pace in the development of microminiaturization techniques, although eventually as development proceeds and tooling costs are reduced it is expected that much civil equipment will begin to be based on these new techniques. It is for these reasons that we must look to the Advisory Group for Aeronautical Research and Development, North Atlantic Treaty Organization (AGARD), and similar bodies for sponsoring these developments.

In 1961 AGARD held a most important conference on "Microminiaturization", and the present volume is a report on this conference. It was held at Oslo, and all the North Atlantic Treaty Organization countries were well