

secondary batteries which have been produced in quantity. As such it is, therefore, of interest not only to persons engaged in work on submarine and torpedo batteries, but to all persons who have an interest in large batteries of advanced design for any application

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### *Modern Batteries An Introduction to Electrochemical Power Sources*

By Colin A Vincent, with Franco Bonino, Mario Lazzari and Bruno Scrosati, published by Edward Arnold (Publishers) Ltd, 41 Maddox Street, London W 1, May 1984, 264 pp, price £14 50

This is a neat little book. According to its sub-title, it is an introduction to electrochemical power sources and it achieves this and a little more. It has eight chapters, all of which, with the exception of the first — the Introduction — have been written by one, and in some cases two, of the named authors.

The anonymous Introduction starts, inevitably, with Volta, but then rapidly chronicles the events leading to the development of the battery industry. This is followed by a brief, but useful section on nomenclature which is amplified by a Glossary at the end of the book. A short account of the circumstances leading to the demand for new battery systems is then given and the chapter closes with a survey of the more common types of battery and their applications, ranging from miniature batteries to batteries for load levelling.

The second chapter, Theoretical Background, starts from a simple electrode process and proceeds, through considerations of the double layer and interfacial potentials, to the thermodynamics of cells. The major portion of the chapter, dealing with current flow in an electrochemical cell, then follows, and the chapter concludes with a section on battery characteristics and performance criteria. This chapter gives a straightforward and readily understandable approach to the basis of cell operation, but at the same time it is made clear that the problems of developing new cells are complex and time consuming.

The following chapters are concerned with practical, or near practical, cells. Primary aqueous electrolyte cells are the first to be considered, starting with the Leclanché cell which is discussed in considerable detail, and continuing with alkaline manganese dioxide cells, zinc-mercuric oxide and zinc-silver oxide cells, metal-air batteries and magnesium-silver chloride batteries.

The next chapter deals with secondary aqueous electrolyte cells, and is concerned mainly with lead-acid and cadmium-nickel oxide cells which are treated, quite adequately, in the more-or-less standard manner, but iron-nickel oxide, zinc-nickel oxide, zinc-silver oxide and cadmium-silver oxide cells are also included.

There follows a chapter on normal temperature lithium-liquid electrolyte primary and secondary cells, which introduces the reader to the really

new types of cell, and gives a well reasoned discourse on the development of these batteries, on the problems involved, and on the difficulties which remain, particularly in the case of secondary cells

High temperature batteries are the subject of the next chapter which starts by considering electrodes and electrolytes before dealing with cells and batteries. Greatest prominence is given to lithium-metal sulphide batteries and sodium-sulphur batteries, but lithium-chlorine, calcium-metal sulphide, and other high temperature sodium batteries are also dealt with, in addition to primary reserve thermal batteries

Continuing with the new batteries, there is a chapter on solid state cells This starts with a discussion of the advantages of such systems, the particular requirements they must meet, and the major problem — that of a solid electrolyte material with high ionic conductivity at room temperature, which had to be overcome before such cells could be developed Suitable electrolyte materials are then discussed before going on to describe the nature and characteristics of the various types of cell that have been produced, including hydrogen concentration cells and polymer batteries

The final chapter is concerned with secondary hybrid cells, that is, cells in which one of the active materials is gaseous (fuel cells are not part of the subject matter of the book) This short chapter points out the energy density advantages of such cells, discusses briefly the oxygen electrode, and then proceeds to a description of iron-air, zinc-air and oxygen cells and their characteristics The zinc-chlorine cell receives rather more detailed attention and the chapter concludes with brief reviews of the zinc-bromine and hydrogen-metal oxide cells

There are two Appendices, one on Operational Modes and Charging Techniques for Secondary Batteries, the other lists a number of useful Electrical Quantities, Physical Constants, and Conversion Factors.

There are no references in the book, but at its end there is a Bibliography of about thirty books on closely related subjects, *e.g.*, electrochemistry, electrode kinetics, about twenty books on batteries, and a list of series, reports, proceedings, and journals concerned with batteries and power sources up to 1981

There are a few minor errors in the book, none of them serious, *e.g.*, on page 132 reference is made to reactions 4.12 and 4.13, respectively, when 4.15 and 4.16 would appear to be intended.

The authors, in common with many other persons, get in somewhat of a tangle with ambient temperature, "ambient" temperature, and room temperature, and, as a chapter heading, "Ambient Lithium Liquid Electrolyte Cells" can hardly be accepted either scientifically or semantically!

All in all, this is an excellent little book which can be used both by students and as a teaching manual. I think, too, that many persons actively engaged in work on batteries will, from time to time, be pleased to have the book by them, and, at the very reasonable price of £14 50, there is no reason why they should not have a copy.