

BOOKS

MHD—Magnetohydrodynamic generation of electrical power, edited by R. A. Coombe (London, Chapman and Hall, 1964; 30 s.), is one of the first volumes in a new series entitled *Modern electrical engineering*, intended to provide a number of inexpensive monographs at postgraduate or final-year student level covering topics of interest in all branches of electrical engineering.

Although for a reviewer to quote the 'blurb' or preface of a book is to invite a charge of laziness, in this case it seems justified, for the editor has provided an excellent description of his book in the preface, which reads as follows:

'The intention of this book is to provide for the interested scientist a survey of the principles and problems of MHD generation. It is designed so that a non-specialist may start with no previous knowledge of the subject but finish with the ability to read and understand the latest research papers.

When writing an introductory account of such a subject it is difficult to proceed in a strictly logical way. Many arguments can only be understood fully when their end product is appreciated. For this reason Chapter 3 has been written as an introduction covering the whole field of MHD generation. It is non-mathematical and is intended to survey the MHD scene so that the subsequent Chapters 4-8 can be better understood. Chapter 1 is a short chapter to show how MHD fits in as a specific method of Direct Conversion, and Chapter 2 gives a brief review of the history of the subject. The first three chapters are thus of an introductory nature.

The specialist Chapters 4-8 have been contributed by six scientists engaged on work relating to MHD generation, all of whom are recognised authorities on the subject-matter of their respective chapters...

Due to the form adopted, some repetition of ideas does occur from chapter to chapter. This is not seen as a disadvantage, however, for each consideration of a particular topic is usually made from a different point of view. As far as possible symbols have been kept distinct, though occasionally the same one is used for two quantities when there is no possibility of confusion. Units are in the MKS system throughout except for one or two exceptions where units of a special nature are used e.g. Angstrom unit. Also, in some places, the temperature is quoted in degrees Kelvin instead of Centigrade.

The text is based on a series of lectures given at the Royal College of Advanced Technology, Salford, in the latter part of 1962...

Magnetohydrodynamic (MHD) generation is a method of converting heat energy into electrical energy without the use of the conventional steam (or gas) turbines that perform the conversion via the intermediary of mechanical energy. Instead of the metallic conductors of the conventional electric generator (dynamo), the MHD generator uses a stream of ionized gas. Passage of this gas through a

strong magnetic field produces an electric current exactly analogous to that produced in the metallic conductor. The advantage is that the stream of ionized gas can be a direct product of the primary heat source (furnace or nuclear reactor) and that the generation efficiency can be much higher because the gas can be used at a temperature far above that which is ever likely to be possible in a turbine. MHD generation is the most promising method of 'direct conversion' for power levels exceeding 100 MW, and the most likely use for the system is as a 'topper', placed between the primary heat source and the steam turbine of an otherwise conventional generating system. It appears likely that such a combined system would have an overall conversion efficiency of 55% or even 65%, instead of the 45% which seems to be the limit for the conventional station alone.

There are many difficulties — high temperatures, problems of ionization, current collection, the disadvantage that direct current, instead of alternating current, is produced and conversion equipment is expensive. It is an interesting commentary on this book, however, that the problems to be solved are covered as adequately as the advances already made and the hopes for future successes.

To return to the editor's preface, the present reviewer has not actually tried to read the latest research papers on the subject, but he is pretty sure that he could: the authors' aims are fully realized. The introductory chapters in particular are concise and clear. They have been written by the editor, and their style can be gathered from the preface quoted. As a good lecturer repeats his salient points several times in an hour's talk, so the repetition of ideas from chapter to chapter in this book serves to remind the reader of unfamiliar topics and to co-ordinate the different sections of the subject. A creditable point of detail is the conversion of Wb/m^2 into gauss for those who are more familiar with c.g.s. units; symbols are consistent and listed alphabetically in 4 1/2 pages at the end.

This is perhaps a convenient point to begin mention of the defects of the book, since many of the units quoted do not conform to the recognized standards: for example, J/m^3 instead of m^{-3} , $\text{Joules/m}^2/^\circ\text{C}$ instead of $\text{J/m}^2 \text{ deg C}$, kg/sec/m^2 instead of $\text{kg/m}^2 \text{ s}$. Standard forms have also been ignored in the lists of references, given at the end of each chapter; the explanation that (for example) 'Pennsylvania, 1961' refers to the published proceedings of the 2nd symposium on the engineering aspects of MHD, at Pennsylvania in March 1961, would have been more helpful on p. 16 than on p. 204. The index is not very useful, considering the large amount of information that the book contains.

The printing has been carried out directly from 'varityped' sheets and the book has thus inherited most of the defects of normal typewritten reports, particularly in the layout of mathematical equations. This may also explain, though not excuse, the large number of misprints — mostly simple typing errors. In a more expensive, or less well-written book, these would have been unforgivable: as it is, they distract from the pleasure of reading, and if this system of printing is to be used for the other books in the series it is to be hoped that more care will be taken over this point.

Such defects make the present volume less than perfect, but in spite of them, as was remarked earlier, the text

provides a first-rate introduction to a comparatively new subject. As well as the students for whom it is intended, anyone interested in future developments of science and engineering could read it with profit.

It is, by the way, worth noting that this promising method of producing electrical power is based on principles formulated in the days of Faraday and Maxwell, around a hundred years ago. Also, although ideas for practical systems date back sixty years or more, it was the study of plasmas for thermonuclear research and the development of rockets and heat-resisting materials that led, albeit indirectly, to the present successful experiments in MHD generation. There is scope for reflection, in this book, on the interactions of academic research and technological progress.

A.G.H.

Effect of ionizing radiation on high polymers, by T. S. Nikitina, E. V. Zhuravskaya and A. S. Kuzminsky (New York, Gordon and Breach Science Publishers Inc., 1963; \$ 4.95) has been translated from the Russian by Scripta Technica, Inc. It forms volume 13 of the publisher's *Russian tracts on advanced mathematics and physics*.

The book represents a thorough literature survey of the subject, although the facts are unfortunately mentioned in a very brief way. After a short first chapter, where the various types of radiation and their units of measurement are listed, chapter two describes the radiochemical processes occurring in polymers as a result of irradiation, mainly by

gamma rays. The most important processes are 'cross-linking', in which parallel macromolecules are joined to each other by cross bonds to give a kind of vulcanization, and 'degradation', in which the main molecular chains are split in a random manner and finally reduced to their constituent monomers. In addition, gas liberation and oxydation occur in the second case as a consequence of the bond rupture. As a result of these chemical changes, alterations are brought about in the physical properties of the materials, such as mechanical strength and electrical insulation.

Chapter three gives actual experimental data for various highly polymerized materials, which are classified under the two headings mentioned above, namely those that are cross-linked by irradiation (polyethylene, polystyrene, carbon-chain rubbers, polysiloxanes, p.v.c.) and those that are degraded (polymethyl methacrylate, polyisobutylene, fibres). It has been found that the aromatic structure of styrene, as well as the naphthalene and methyl ring structures, are around a hundred times less sensitive to radiation than are the cyclic chains. If introduced into a polymer of the latter kind they even reduce its rate of cross-linking. Sulphur also inhibits the rate of radioactive vulcanization of rubber.

Tables giving the measured effects of gamma radiation on the properties of elastomers and plastics are added in an appendix.

Taken as a whole, this is a useful first reference book for those faced with having to make a particular choice of organic materials to withstand the effects of irradiation.

M. Barbier

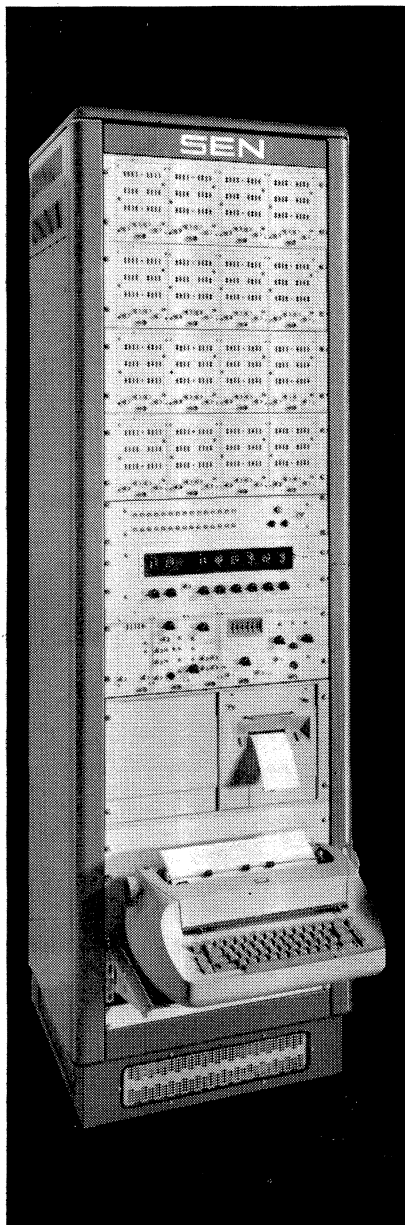
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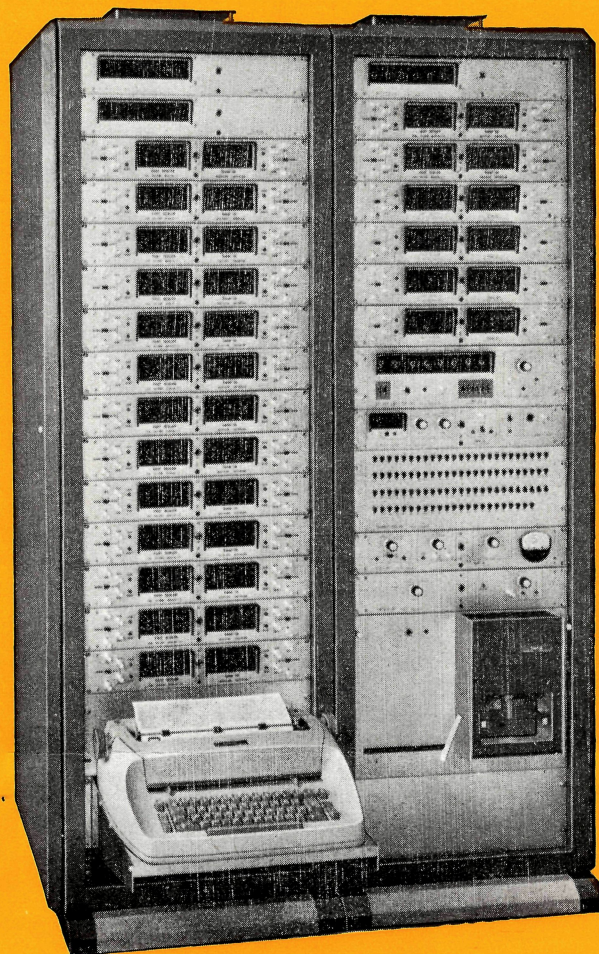
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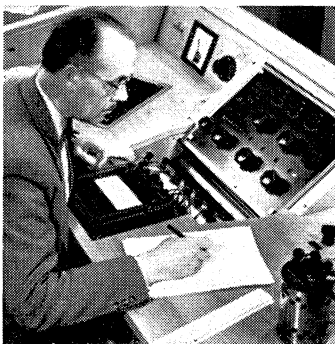
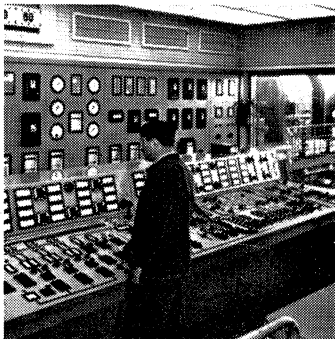
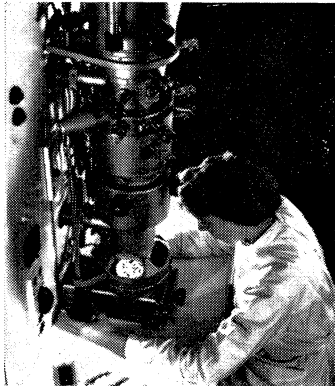
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