

a given motion, both in position and velocity, with limitations on the permitted accelerations of all parts of the linkage. There can be no question but that British mechanical design would benefit considerably if the underlying principles of kinematic synthesis were more clearly enunciated and more widely known. This chapter is a step in the right direction, but a far more fundamental examination and exposition of the properties of the four-bar chain are required to fill the present gap. Such matters as are treated in the chapter on straight-line motion would fall out of such an analysis as important special cases. Until such time as this is attempted, the designer will be content to rely upon atlases of curves, such as those recently produced at the Massachusetts Institute of Technology.

The authors and publishers are to be congratulated on their production of a most valuable book. It is sincerely to be hoped that this pioneering effort will inspire others to enter the field with works which will be of more direct value to practising engineers and which will make a greater appeal by adopting a fundamentally different approach, more in tune with the British engineer's background.

R. H. MACMILLAN

¹ Macmillan, R. H., "The Freedom of Linkages", *Math. Gaz.*, 34, No. 307, 26 (1950).

presentation; yet at the same time the book is such as should be made compulsory general reading for every engineering undergraduate. It is, indeed, a cause for reflexion that Ricardo started on the research work that was to shape his life's work when Bertram Hopkinson suggested to him that he should stop reading for the Mechanical Sciences Tripos at the end of his first year in order to assist in Hopkinson's work on knock, and thus left Cambridge labelled only with a pass degree.

While the chapter headings suggest that this is a comprehensive work on the high-speed internal combustion engine, its weakness as its strength is that it makes no pretence at being other than a monograph. There are neither footnotes nor references, nor is there more than occasional remark on the sources on which the author has drawn beyond his own laboratories; thus the reader unacquainted with the field might be led to accept as gospel certain matters which are open to dispute, and in matters where he might like to study more deeply, no clue is available as to where he should turn for more detailed information. This, however, is carping criticism, since an engineer whose writings display the full apparatus of scholarship is scarcely likely to have found time for the hard and laborious work involved in great mechanical design. D. B. WELBOURN

¹ *Proc. Inst. Mech. Eng.*, 152, No. 2, 143 (1945).

THE ART AND SCIENCE OF DESIGN

The High-Speed Internal-Combustion Engine

By Sir Harry R. Ricardo. Fourth edition, rewritten and reset. Pp. ix+420. (London and Glasgow: Blackie and Son, Ltd., 1953.) 40s. net.

SOME years ago the reviewer was discussing tank design with one of its leading German exponents, who prefaced his comments on tank engines by remarking that German designers had found their inspiration in the translation of an early edition of the present book, and that he could not understand why so little attention had been paid to Ricardo's work in his own country.

Although this book is called the fourth edition, comparison with the third edition quickly shows that the impression thus given is entirely misleading; both books should be found on the shelves of every engineer, since not only does each contain much that is not to be found in the other, but also, taken together, they offer a fascinating insight into the workings and development of a powerful mind faced with the creative problems of design and manufacture.

Sir Harry Ricardo, in his presidential address¹ to the Institution of Mechanical Engineers, presented an autobiographical sketch of his development as an engineer which held his audience spellbound. Into this, his latest monograph, he has distilled such balanced wisdom on his own special field as every designer would wish to be able to do. Here are to be found the analysis of much research work, carried on over a period of almost fifty years, the experience and the conclusions he has drawn from it, the guesses and the surmises, the rational and the apparently irrational preferences; in short, the whole wealth of mind that is needed for great creative engineering. No engineer who has reflected on the problems facing himself can fail to be stimulated by the unique

LOGIC FOR MATHEMATICIANS

Logic for Mathematicians

By Prof. J. Barkley Rosser. (International Series in Pure and Applied Mathematics.) Pp. xiv+530. (London: McGraw-Hill Publishing Co., 1953.) 85s.

THERE are many expert mathematicians who know little or nothing of symbolic logic. They have, of course, heard of Whitehead and Russell's "Principia Mathematica"; but cannot spare the time from their own researches to master its formidable difficulties. Now they have the chance to become acquainted with the subject much more easily. Prof. Rosser, by using Quine's technique, invented since the writing of "Principia Mathematica", claims to have condensed most of its three large volumes with its "out of date and extremely unwieldy symbolic machinery" into one book of moderate size.

The first chapter is addressed to those mathematicians who are not only completely ignorant of symbolic logic, but are also sceptical of its importance. This and the next four chapters seek to convert the unbeliever and to lead him very gently into the true faith, encouraging him by frequent references to the application of logical principles to ordinary mathematical theorems. But the reader who expects a mere confirmation of what he has always known will experience many shocks. "Some of these basic logical principles used by all (or almost all) mathematicians may actually not be valid. . . . Actually, some . . . have been subjected to severe criticism, notably certain uses of *reductio ad absurdum*". Moreover, "there is equally no guarantee that the symbolic logic is itself valid". However, from these principles—none known to be invalid, though some under suspicion—can be derived the existing body of mathematics, which is certainly useful in science and engineering.