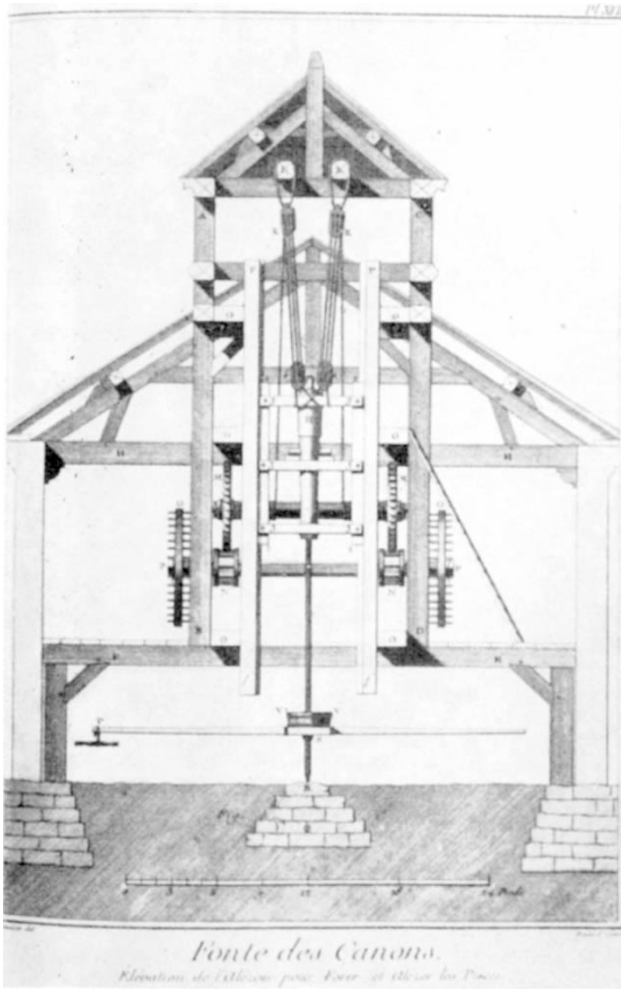
these matters. The price is fairly, but not unreasonably, high for a specialized text of this size. This book will be most useful to active workers in the field, but it can also be recommended to others seeking an introduction to the literature on various aspects of radical-ion chemistry. It will do much to stimulate interest and new work in this interesting and growing field of study. G. H. WILLIAMS

EARLY MACHINE TOOLS

A History of Machine Tools 1700–1910

By W. A. Steeds. Pp. xx + 181 + 153 plates. (Clarendon Press: Oxford; Oxford University Press: London, January 1969.) 126*s*.

MACHINE tools are almost as old as man's need to supplement his own strength. Artefacts dating back to 1500 BC appear to have been machined on a lathe, and Leonardo da Vinci (inevitably) made designs for tools to cut threads —though whether they ever operated is doubtful. But, like other triumphs of human ingenuity, it was warfare which provided the stimulus for the first effective machine tools. They were built to bore the barrels of large guns, and Steeds's survey begins in 1700, just about when gun-boring machines became important. The first were driven by animals, with the gun held vertically and moved downwards against the rotating tool. The results were good enough not only for guns but also for boring cylinders for Newcomen's engine, and no doubt the armourers of Woolwich proclaimed this archaic spin-off with as much relish as today's apologists for NASA.



Vertical gun-boring machine illustrated by Denis Diderot in his *Encyclopedie* (1762–72). It is thought to represent a machine invented in 1713 by a Swiss named Maritz (or one made to his design). The frame of the machine is made almost entirely of wood and forms part of the structure housing it. This use of the structure of a building to form part of a machine tool continued well into the second half of the nineteenth century. (Plate 6 from *A History of Machine Tools 1700–1910*, by W. Steeds.)

Later, Newcomen's engine was replaced by James Watt's, which called for another leap forward in machine tool design. This was provided by James Wilkinson, who invented a much more accurate boring mill, in which the boring bar was supported at both ends. Aesthetics also played a part in advancing design—the lathe seems first to have been used for decorative purposes. One of the very first was made for Peter the Great of Russia in 1717 by a craftsman called Andrea Konstantinovich Nartov, and is still to be seen in the Conservatoire National des Arts et Métiers in Paris. It was used for copying medals or similar decorative pieces.

By the second half of the eighteenth century, the pace had quickened. Metal took over from wood as the structural material, and Maudsley made his first screw cutting lathe, an ingenious device now in the Science Museum in South Kensington. By 1830 all basic types of machine tools had been made, except for the slotter, shaper and grinding machine.

After this, the history necessarily becomes more detailed, with fewer general principles to elucidate. Inevitably, it also becomes harder to follow (though it is never easy). The book, in fact, is something of a puzzle. It is produced with great style and elegance, set in a large and comfortable type and comprehensively illustrated—though I could have done with more line diagrams in the text and fewer plates at the back. It is sumptuous enough (and certainly heavy enough) to be a coffee-table book, though this would be to insult Steeds's detailed text. He sticks firmly to the job, with no diversions into social history, nor any attempt to relate the development of machines to the changes in society. Indeed, it would be possible to read the book without realizing that there had ever been an industrial revolution. But Steeds does provide the basis on which such a social history could be written, and that is a great deal to be grateful for. Oxford University Press also deserve praise for the beautiful presentation—to provide more than 150 full page plates for six guineas is generosity indeed.

NIGEL HAWKES

FACTS AND FUNCTIONS

Biological Membranes

Physical Fact and Function. Edited by Dennis Chapman. Pp. xi + 438. (Academic Press: London and New York, September 1968.) 100*s*; $15.

THIS book is an important addition to the literature on biological membranes. It is reasonably priced by current standards (possibly because it includes only eleven half-tone plates) and should find its way onto the book-shelves of all who have a specific interest in membrane structure and function as well as into libraries.

There are several chapters filled with facts—chemical, physical and physiological. They will be of intrinsic interest to many and generally very useful for reference purposes, but some may disappoint those whose sole interest is in membrane function. One chapter is essentially a review of models, but it is all too evident that there is a very substantial jump from the facts to the