The second volume will be of greater interest to a reader trained in mathematical physics. For here in English translation are two classics, in which the science of hydrodynamics was founded. Putting the two works together has greatly enhanced their value; for in this pair, there is a scientific and a personal drama. Daniel Bernoulli's book (of 1738) explores a variety of problems of practical and theoretical interest, including the motion of waters inside and on leaving vessels, hydraulic machines, and "elastic fluids". His basic conceptual tool was not Newtonian mechanics, but what can be called the pendulum principle, derived from Galileo through Huygens. (The reader who wants to browse this work should first study the brief section at the beginning of chapter three where the fundamental ideas are developed; almost any subsequent argument can then be followed easily.) Application of this principle enabled him to make a first investigation on the problem of the pressure of a moving fluid on the walls of the pipe; and he did direct experiments to test his results, as was his practice.

Daniel's aged father John immediately attacked this last problem; and by improving its conception (and using Newtonian mechanics) he was able to derive its solution in the classic form of "Bernoulli's Theorem". On this special topic he produced a masterpiece; but, not content with the credit for improvement, he tried, by various devices, to arrogate full credit to himself. Euler was a friend of both father and son; and whether he avoided compromising himself in this nasty business is a question of historical interpretation. The preface by Hunter Rouse tells the story well; he could have pointed out that the first paragraph of Euler's letter to John, printed with the book, did give basic priority to Daniel.

In fact, the two books give a good sample of the distinctive styles of father and son: Daniel was a man of wide interests (he taught medicine at Basle !), concerned with experiment and with technical applications, but lacking the deep mastery of physical concept and mathematical technique that brought immortality to his father and uncle. In the translation, notation is slightly modernized but the words stay close to the original; this is fortunate, because a modernization of Daniel's mechanics would have made it unintelligible. It is a pleasure to see that Dover Books, who in the past have served the history of science so well by providing inexpensive editions of classics in translation, are back in the field, even if at a "library" price.

J. R. RAVETZ

COMPUTER ECONOMICS

The Economics of Computers

By William F. Sharpe. Pp. x+571. (Columbia University Press: New York and London, October 1969.) $10; 90*s*.

THIS is a report of a study made by the Rand Corporation. It is in two main sections: the first, of 180 pages, is on economic theory generally while the second deals specifically with the computer world and has chapters on the computer industry generally, on the marketing and pricing of computers and associated services, and on the costs and effectiveness of complete computer systems and of major components such as central processors and stores ("memories" here).

The first section gives a lot of useful background material which it is handy to have by one, but the real interest is in the second. The chapter on "The Computer Industry" gives a fascinating account of the history, development and present (meaning 1968) structure of this remarkable enterprise, whose growth from zero in 1950 to its present status of a truly major industry is one of the phenomena of our time.

The author emphasizes the importance of the part played by government in this development; on p. 186 he says ". . . it can plausibly be argued that without government (and particularly military) backing there might be no computer industry today". The whole book is concerned almost exclusively with the American scene and the author make no bones about it—IBM dominates, and has done since 1956, just as it dominated the punched card and tabulating machine market in the pre-computer era. The rest of the world gets two pages at the very end, in a section headed "Computers Abroad"—but, ironically enough, the author says (p. 204) that "perhaps the most analysed group of computer manufacturers is that in the United Kingdom". This chapter is chiefly a presentation of facts, as are those on sales and rental of computers, and also, though to a lesser extent, chapter twelve (the final chapter) on "Services, Markets and Costs".

The titles of two long chapters in the middle of the book hold promise of great interest—chapters nine and ten on "Cost and Effectiveness of Computer Systems" and of "Memory" respectively. Computers are expensive things to buy and to run—big systems are very expensive—and it is obviously very desirable to have some measure of cost-effectiveness to guide one's choice between rival manufacturers' offers. They are also very complicated things, so one can expect the problem of finding such a measure to be difficult. The main impact of these chapters is to show just how difficult it is. The author deals with all the types of performance measurements which are well known in the computing world; for example, simple criteria depending on the times for a very few basic operations, more complicated instruction-mixes, times for standard machine-code programs or "bench-mark" collections of programs in high-level languages and several less well known ones proposed by various individual investigators. Some of these latter seem rather odd, such as the formula on p. 313 which involves a number of constants and cook-factors whose values were determined, apparently, by a sort of public opinion poll (though among only forty-three "engineers, programmers and other knowledgeable people"). Many proposed methods involve weighting factors for various operating times, which again are very subjective. The author is quite honest about all this, and shows by quoting results of actual tests that different measures can give wildly inconsistent ratings of the relative performance of two systems. The main lesson to be learned is that one has to be very cautious in interpreting the results of any such tests. This is not altogether unknown.

The book is quite long—556 pages—and is packed with detailed factual information. Wherever possible the arguments are carried on quantitatively, so there is a fair amount of algebra but no very elaborate mathematics. It is well worth having as a stimulus to thought about the assessment of computer performance, for its surveys of the industry and for the very large number of references to relevant work, up to 1968, most of which would be very difficult for the unaided worker to track down.

J. HOWLETT

BUSINESS IS BUSINESS

Think

A Biography of the Watsons and IBM. By William Rodgers. Pp. 320+10 plates. (Weidenfeld and Nicolson: London, January 1970.) 50*s*.

How IBM with "the punched card that changed the world" is becoming the largest corporation on Earth is the subject of this new book by William Rodgers. Concentrating on the people rather than the computers, Mr Rodgers shows that these amazing machines are less fascinating than the managers who sell them, and his book has therefore apparently not gone down well with the company.

This book will be grist for many an amateur psychologist. What is to be made of Thomas J. Watson who turned