by M. Pareto the ophélimité of the individual considered. Under a monopoly, the prices are again mathematically determined but not to the greatest satisfaction of all engaged in the transaction, but to the advantage of the proprietors of the monopoly. If there is a maximum of "ophelimité," the cost of production is equal to services rendered in production.

Many other applications are given in the book. Among these should be mentioned Cournot's theory of exchange, the rôle of the theory of games of chance in statistics, which includes the questions of annuities and insurance.

Taken as a whole, the book is useful for the clearness of presentation as well as for the numerous applications to economic theory. While the reviewer would expect a treatise on statistics to contain more recognition of the recent work of Karl Pearson and those associated with him, the present book contains much valuable material for the student of mathematical statistics.

H. L. RIETZ.

Σώζειν τὰ Φαινόμενα. Essai sur la Notion de Théorie physique de Platon à Galilée. Par P. DUHEM. Paris, A. Hermann et Fils, 1908. 144 pp.

OFTEN, when fatigued with the perplexities of modern physics or the intricacies of modern mathematics, it is a pleasant change to take a dilettante interest in the science of the ancients, to draw an optimistic courage from the progress twenty centuries have made or a pessimistic cheer from the little that so long a time has won. Then a volume of Pliny or parts of Plutarch's works suggest themselves — in a translation, alas! despite or to spite eight years of Latin and six of Greek. There we can find a dissertation on flesh eating which reads like some of all too recent date or a disquisition on the moon and her inhabitants that seems quite modern Martian. The philosophers who live much by and with and for the Greeks have collected, collated, and translated the words of philosophic wisdom of these ancients. If such a collection should be made for science with some appropriate comments relative to our present point of view, a highly entertaining book could be printed. Perhaps Duhem will sometime get to this; his present work with its Greek title and French subtitle is merely an essay on the conception of physical theory from Plato to Galileo — and by physical theory is apparently meant only such as regards astronomy, the best developed of the Greek physical sciences.

Duhem points out that at the very outset in the days of Plato and Aristotle there were two distinct and largely contrary attitudes toward astronomical science. The first was the mathematical (or astronomical) point of view that the test of a hypothesis relative to the motion of the planets was merely whether or not that hypothesis enabled one to describe the facts — *σώζειν τὰ φαινόμενα*. The second was the metaphysical (physical) point of view which called upon a hypothesis to conform to the real nature of things — *κατὰ φύσιν* — whatever that may mean. Of course it is at once apparent to everybody that there probably always have been, surely are now, and very likely always will be these two points of view; that the scientist will incline to the first and the metaphysician to the second; that some will be content to make use of nature as best they can, while others will not be satisfied unless they make nature according to their own best ideas. Not only do the two points of view correspond to two different types of mind; they appeal to different moods of the same mind. A new theory seems naturally a convention and an old theory equally a reality. Osiander might well maintain in his preface to Copernicus's work that the Copernican view was merely a clever but unreal way to explain appearances. Yet it was not long before the adherents of the theory were willing to make martyrs of themselves for its reality and still to maintain: E pur si muove! It probably takes almost as much courage now-a-days to maintain that "the earth moves" means merely that "it is more convenient to assume that the earth moves."

Throughout the essay Duhem carefully traces the history of the conflict between the scientific and the metaphysical view. That the text is readable and entertaining may be taken for granted when it is written by the author of such a variety of well known works. It is interesting to note that during the fourteenth, fifteenth, and sixteenth centuries the masters at the Sorbonne set forth views on physical theory which were better and deeper than any heard up to the middle of the last century. The author's conclusion is also noteworthy, namely: En dépit de Kepler et de Galilée, nous croyons aujourd'hui, avec Osiander et Bellarmin, que les hypothèses de la Physique ne sont que des artifices mathématiques destinées à sauver les phénomènes; mais grace à Kepler et à Galilée, nous leur demandons de sauver à la fois tous les phénomènes de l' Univers inanimé. Perhaps there are still a number of unenlightened

physicists who can not take quite this view with respect to our more firmly fixed theories of physics; probably the majority of metaphysicians would not acquiesce. It may be that some day reality will consist merely of conventions, or it may be that the pendulum will again swing to the other side and make the conventions real. At any rate much will still be spoken and written on both sides of the question.

E. B. WILSON.

The Slide Rule. An Elementary Treatise. By J. J. CLARK. Technical Supply Company, Scranton, Pa., and New York. 62 pp.

ONE familiar with algebra and logarithms usually needs little instruction in the use of the slide rule. He needs only practice in reading results accurately and expeditiously. On the other hand a person ignorant of logarithms finds the mastery of the instrument a more difficult task. The author of this booklet directs his attention to the wants of the latter class. His aim is to give directions for the use of the slide rule, so simple and explicit that any pupil with a fair knowledge of arithmetic can understand them. In this laudable purpose the author has been eminently successful. The booklet is a model of clear exposition.

The author confines his attention to two slide rules, the Mannheim rule and the Rietz rule. The term "Mannheim rule" has become generic. The Mannheim type is now used more than any other for ordinary purposes, and is manufactured by many firms in different countries. The name Rietz is attached to a specific rule, manufactured by the firm of Albert Nestler in Lahr, Baden. The Rietz rule is one of the very numerous rules with the Mannheim arrangement of the lines A, B, C, D, to which one or more other lines are added (in this case the E line for cube root, etc.). Just why this Rietz rule should have been selected out of a very large number of similar domestic and foreign makes is not quite evident.

The author gives nothing on the history of the slide rule. It is perhaps just as well that no attempt should have been made in this line. Only very recently have I been able to settle the long-disputed question as to the inventor of the straight-edge slide rule.* Mr. Clark gives in his book just

* "History of the logarithmic slide rule," Engineering News Publ. Co., New York, 1909.