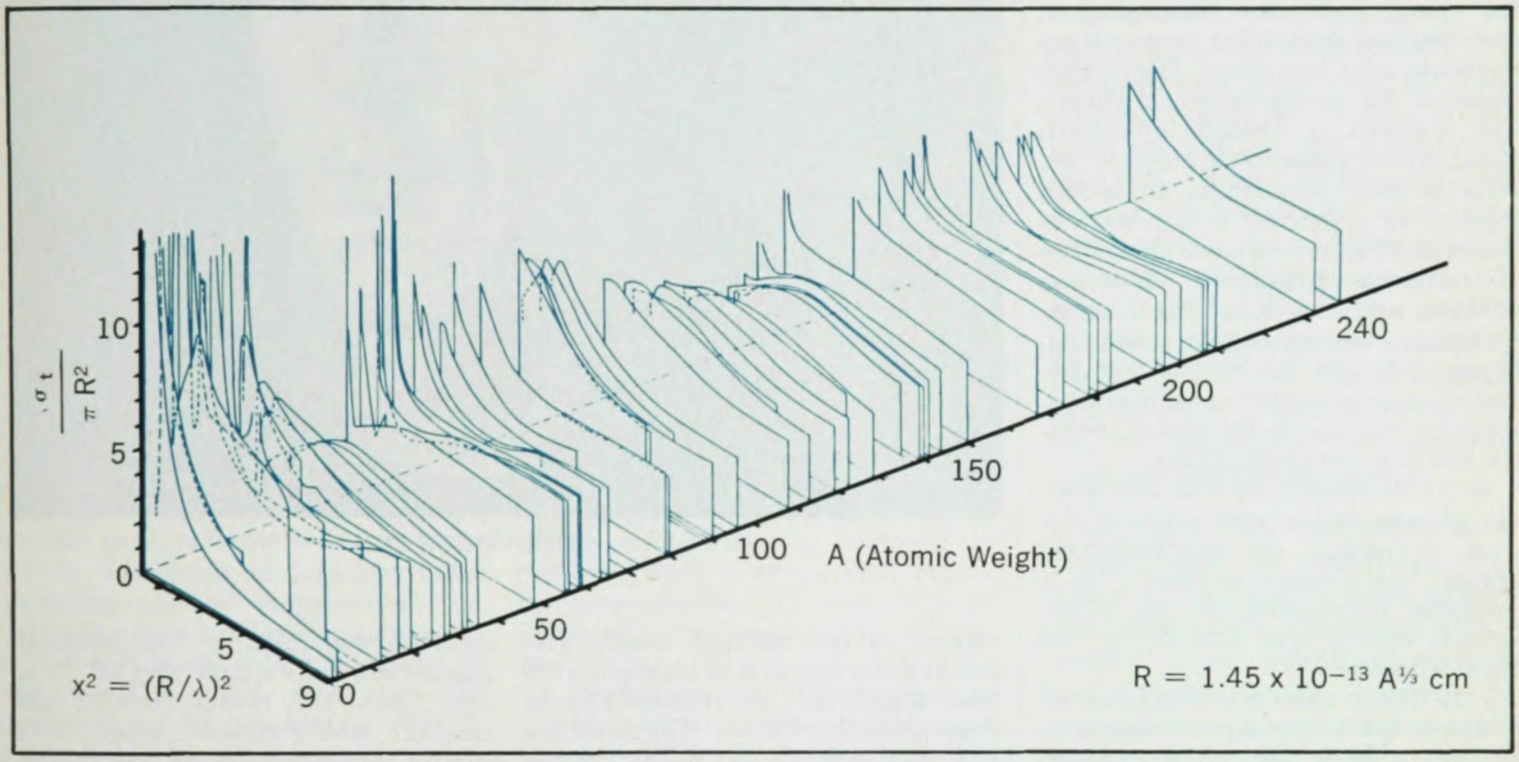
books

A valuable guide to the theory of scattering processes



Total observed cross sections for neutron–nucleus scattering as a function of energy and atomic number. Cross sections such as these are included in J. R. Taylor's book *Scattering Theory*. From H. Feshbach, C. Porter, V. Weisskopf, *Phys. Rev.* **96,** 448 (1954).

Scattering Theory: The Quantum Theory of Nonrelativistic Collisions

J. R. Taylor
477 pp. Wiley, New York, 1972. $14.95

Reviewed by Herbert Überall

The bulk of our knowledge about atoms, nuclei and elementary particles has been acquired by performing scattering experiments. Accordingly, quantum mechanical scattering theory, which was developed to interpret such experiments, represents one of the most important subjects of quantum theory itself, and in its corresponding aspects constitutes an essential part of atomic, nuclear and elementary-particle physics as well. The early monograph of Nevill F. Mott and Harrie S. W. Massey (1933; latest edition 1965) covering the theory of atomic collisions, had thus become an unchallenged classic of mid-20th-century physics, offering for many years its services to researchers as a handbook, and as a pedagogical work, educating a generation of students. In 1962, an updated monograph on the same field was written by Ta-You Wu and T. Ohmura. In the 1960's, important new developments spawned the appearance of further books on scattering theory. Thus, the time-dependent formal theory of scattering and of the S matrix was first comprehensively presented as part of a monumental work by M. L. Goldberger and K. M. Watson in 1964; and the theory of complex angular momenta is contained in Roger G. Newton's also sizable book of 1966. Whereas the former work encompasses both nonrelativistic and relativistic scattering (and even part of field theory), the latter is restricted mainly to nonrelativistic theory but contains a good deal of classical (electromagnetic) scattering as well.

Against this formidable background, John R. Taylor's new book on scattering theory, although of more modest size, can very well hold its own. Unlike the recent works just mentioned, which on account of their vast scope can be used mostly for handbook purposes only, Taylor's book is written strictly from the pedagogical standpoint. This does not necessarily make it a graduate textbook: In the standard university curriculum, scattering theory is being taught as part of quantum mechanics, in nuclear and particle-physics courses at a place where the need for it arises, rather than as a self-contained special course (especially the nonrelativistic theory to which Taylor restricts himself). However, the very clear and systematic outlay, the carefully prepared problems, and also a number of original graphs that clarify the physical aspects of scattering in an enlightening fashion, make this book a valuable guide to the subject for students who want to understand and master scattering theory from a considerably more fundamental level than what is presented in the usual quantum mechanics texts. In fact, Taylor's book not only uses the bra–ket notation of P.A.M. Dirac's *Principles of Quantum Mechanics,* but very much resembles this work in style, rigor, and profundity.

A further feature of the book that stamps it a pedagogical work is the absence of a great deal of applications; instead, it illustrates each step of theoretical development by one simple example. The presentation is deductive rather than historical, starting with time-dependent scattering and S matrix theory (for the single-channel problem) and proceeding to stationary scattering at a later stage; this is then repeated for multichannel problems. The material is divided into short, manageable chapters and contains, besides the standard material, all modern subjects of scattering theory such as Feynman diagrams, analytic properties of scattering amplitudes, dispersion relations and the Mandelstam representation, complex angular momenta, Regge poles and the Watson transformation; and in multichannel reactions, there are sections on the optical potential and final state interactions.

As a side remark, we note that present physics jargon now contains (for good, it seems) the ungrammatical phrase "the Green's function." It is somewhat unfortunate that the author extends this by also introducing "the Green's operator."

J. R. Taylor came from England and is now at the University of Colorado in Boulder. He is not to be confused with his two English namesakes, J. C. Taylor (Oxford) and J. G. Taylor (Southampton); all three work on related subjects in S matrix, field, and elementary-particle theory.

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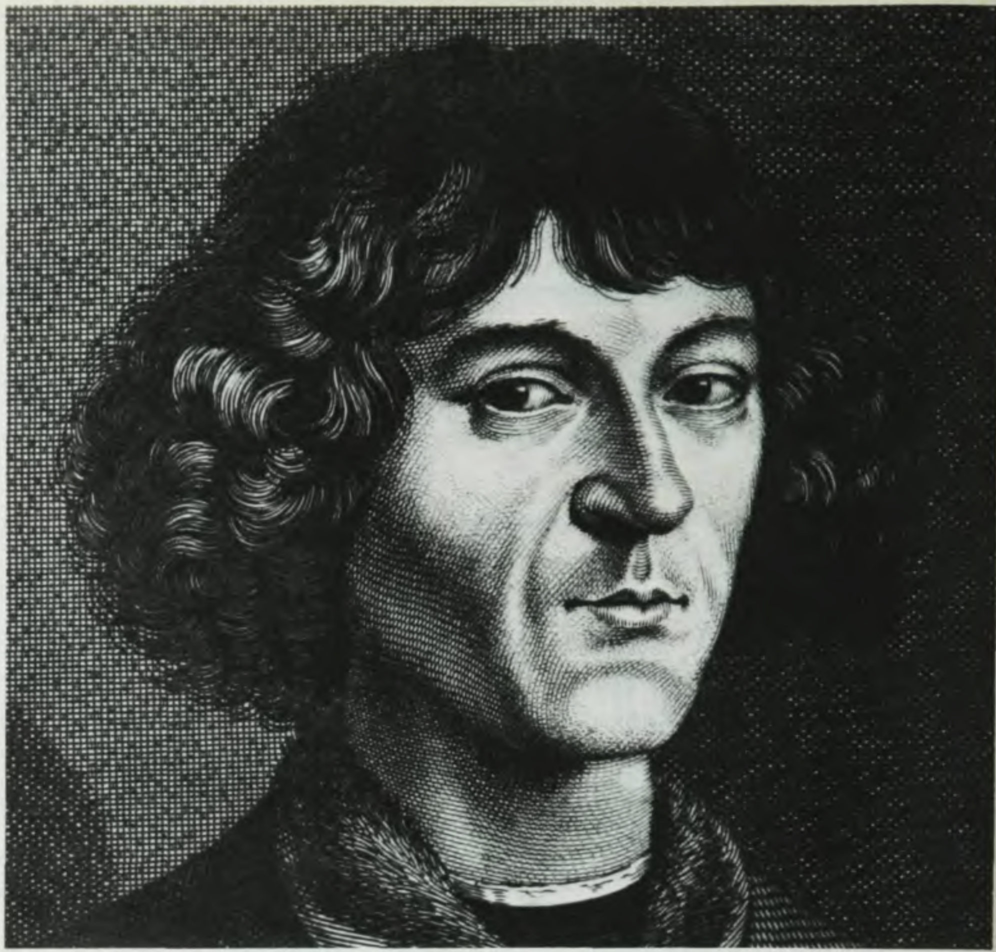

COPERNICUS

Physical Science in the Middle Ages

E. Grant
128 pp. Wiley, New York, 1971. $7.50

This book is brief in compass, deceptive in its apparent simplicity, and original in its underlying philosophy. The outgrowth of Edward Grant's years of teaching experience and research in medieval science, it performs drastic surgery on the material usually presented under this title to highlight a few basic themes that led ultimately to the Copernican Revolution. The result has a twofold audience and utility: it will serve well as a textbook for a one-semester course in the history of science, and it will quickly acquaint the educated reader with the essential contribution of the Latin West to the rise of modern science.

The heart of the work is a chapter on "the physics of motion," wherein Grant treats expertely of the adumbrations of dynamics and kinematics in the context of medieval discussions of Aristotle's two major physical works, his *Physics* and his *On the Heavens*. This is followed by a substantial chapter on "earth, heavens, and beyond," which details the transition to celestial mechanics and astronomy in the light of Aristotelian physical principles. Both of these chapters represent the distillation of Grant's scholarly book on Nicole Oresme and his many articles on medieval mechanics. Three preparatory chapters set the stage for this exposition, describing the state of science in the so-called Dark Ages from 500 to 1000 AD, the period of translation from 1000 to 1200 AD, and the impact of Aristotelian thought on the medieval universities in the 13th and 14th centuries.

Grant presents his subject well, writing with such clarity that one might be deceived into thinking that medieval physics was quite simple after all. It is only when the reader consults the lengthy bibliographical essay with which Grant concludes the book that he will appreciate the maze of detail through which the author has waded and the depth of erudition on which his work is based.

The chapter entitled simply "Conclusion" is the vehicle for Grant's own middle-of-the-road view of the bearing of medieval physics on the origins of modern science. Here he focusses attention on Copernicus and his conviction that "science and its hypotheses must treat of realities, not fictions," as an essential characteristic of the changed viewpoint "that came to prevail with Galileo, Kepler, Descartes, and Newton." The thesis is novel and debatable, but basically in accord with my own sentiments.

This book is part of a new Wiley History of Science Series edited by George Basalla and William Coleman. It is cheaply produced, considering its price, with only a few small diagrams dispersed throughout the text. But the content of this work makes up for such defects and speaks well for the future of the series as well as the wisdom of its editors in entrusting to Grant the volume on medieval science.

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