

The final volume of a "herculean effort"

Electronic and Ionic Impact Phenomena, Vol. 5: Slow Positron and Muon Collisions and Notes on Recent Advances

H. S. W. Massey, E. H. S. Burhop, H. B. Gilbody
567 pp. Oxford U. P., New York, 1975.
\$52.50

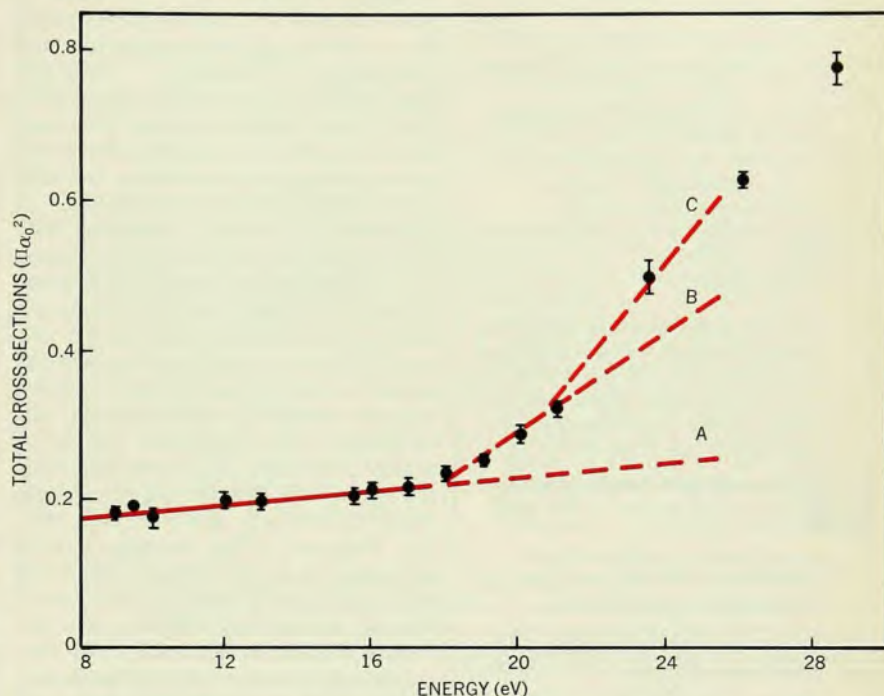
This book is the final volume in the monumental work on atomic collisions by Sir Harrie Massey, Eric Burhop and Brian Gilbody. The term "atomic collisions" is now taken to mean collisions between atoms, simple molecules, ions, electrons, positrons, muons and photons at sufficiently low energies that nuclear interactions are unimportant. A brief description of the first four volumes and references to their reviews in *PHYSICS TODAY* is included in the accompanying box.

Volume 5 deals with positrons, positronium, muons, muonium and mesic atoms, and it also contains extensive notes on recent advances in the entire field of atomic collisions. The title *Electronic and Ionic Impact Phenomena* does not do justice to the broad scope of this work.

Quantitative studies of atomic collisions date back to the discovery of x rays in 1895 and have been coupled with basic advances in modern physics since that time. In the 1950's, the field began to experience an explosive

The first four volumes

Volume 1 (1969) deals with elastic and inelastic collisions of electrons and atoms, and volume 2 (1969) covers electron collisions with molecules, photoionization, photodetachment of electrons from negative ions, radiative recombination and bremsstrahlung. They were reviewed together in the January 1971 issue, page 65. Volume 3 (1971) is concerned with thermal-energy collisions involving neutral and ionized atoms and molecules, diffusion and ionic mobilities (reviewed in January 1973, page 77). Volume 4 (1974), reviewed in the January 1975 issue, page 91, covers higher energy collisions involving neutral and ionized atoms and molecules, electron-ion recombination, and ion-ion recombination.



Positron total cross sections in helium: A is the elastic-scattering cross section, B the positronium formation cross section and C the electronic excitation cross section. This work, by K.F. Canter, P.G. Coleman, T.C. Griffith and G.R. Heyland in Sir Harrie Massey's lab at University College London, represents some of the current work on positronium referred to in the review of Massey's book. (Graph reproduced from *Journal of Physics B* 8, L185, 1975).

growth, in large part because of its importance in upper-atmospheric phenomena, space physics and controlled thermonuclear research. More recently, the need for atomic cross-section data to improve our understanding of our lower atmosphere, the atmospheres of other planets and gas lasers has provided additional impetus for the field. By this time, 20 000 papers have been written on atomic collisions, and one must marvel at the accomplishment of the authors in covering this subject. The five volumes contain more than 3700 pages, 27 chapters—and 1500 sections and subsections. (George Orwell, who described his background as "lower upper-middle class," might have liked this fine-grained categorization of the material.)

Throughout the five volumes, the emphasis is on the phenomenological aspects of the collision phenomena, the experimental techniques whereby they are studied and experimental data. However, there is much useful information on the theory of the collisions.

The authors are unusually well quali-

fied to write the books described here. Massey's research in atomic collisions dates to 1929 and involved some experimental work, although he is, of course, best known for his theoretical research on collisions, for his definitive books in this area and for his world-renowned school at University College London. Burhop has also achieved distinction for his extensive research in collision theory, and Gilbody has made important contributions over the last twenty years on the experimental side.

The Massey-Burhop-Gilbody work will be a standard reference for years to come and will be of great use not only to researchers in atomic collisions, but also to chemists, plasma physicists, atmospheric scientists, astrophysicists and engineers who will use it as a source of data on collision phenomena. In this connection, however, the reader might be warned that the collection of data is comprehensive rather than critical. Another minor criticism that might be offered is that practically no references are made to the approximately 200 review articles on various aspects of atom-

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ic collisions now in the literature. Many of these reviews contain critical evaluations of experimental techniques and data as well as detailed discussions of theoretical methods. The user of the Massey-Burhop-Gilbody volumes should be aware of these reviews.

In volume 5, 107 pages are devoted to the annihilation of free positrons, the life-history of a positron in a gas, positronium formation, slow collisions of positrons and of positronium in gases, the quenching of orthopositronium and positronium chemistry. Forty-five pages are spent on the passage of positive muons through matter, muonium formation, the measurement of electron spin-exchange cross sections for muonium and muonium chemistry. A chapter of 76 pages is concerned with processes leading to mesic atom formation, de-excitation processes of mesic atoms and muonic atom collision processes. The remaining 330 pages of volume 5 deal with recent advances in all areas of atomic collisions, with a cut-off date of mid-1972. Unfortunately, the techniques for accurately measuring positron collision cross sections were developed too late for inclusion here, except in the form of a brief note without diagrams. This volume, like its predecessors, is well written and loaded with useful and interesting information. Massey, Burhop and Gilbody have performed a great service to all those concerned with atomic collisions processes, and we shall profit from their herculean effort for a long time in the future.

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The Religion of Isaac Newton

F. E. Manuel

141 pp. Oxford U. P., New York, 1974.
\$11.25

Until relatively recently, the prevailing image of Newton was that of the cold, rational, epitome of a scientist. When the million words Newton wrote on the Bible were made public, his image swung from cold rationalist to impassioned mystic. Perhaps Frank E. Manuel's *The Religion of Isaac Newton* will damp the pendulum and bring it to a reasonable equilibrium point.

Separation of church and science has rendered scientists, despite their great interest in Newton, not very capable of analysing his religious works, and historians of theology evidently could not care less about the work of this amateur. But to historians of ideas, even Newton's garbage is important.

Manuel, Kenan Professor of History



Isaac Newton as he might have appeared at the age of twelve in this conjectural portrait for *Harper's Young People*, 11 October 1881.

at New York University, author of *Isaac Newton, Historian*, and *A Portrait of Isaac Newton*, is eminently qualified for commentary on Newton's religion. His studies of utopias have familiarized him with religions and mysticism. He is well grounded in the Bible, biblical commentary, Hebrew, Latin and Greek, enabling him to follow Newton's peregrinations and even indicate his misspelling in Hebrew. Manuel employs his formidable erudition to place Newton's religious work in historical perspective and yet show the workings of a great mind.

Some of the manuscripts Manuel draws upon, the Yahuda collection in Jerusalem, have only recently become available. Several points emerge from the study. First, Newton did not turn to religion in his dotage or even in life's autumn when a middle-aged physicist's fancy often turns to thoughts of administration. His religious writings go back to his youth. Second, he was not alone in his zeal, but was very much a man of his time and space (17th-century England) where the use of science as a form of praise to God was traditional and the scientist-theologian was common. Third, Newton approached the scriptures, not as a mystic, but in the same way he approached science. "To choose those constructions which without straining reduce things to their greatest simplicity" of the Yahuda manuscripts echoes a passage from the *Principia*: "We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances." To quote Manuel:

"Newton's statement of fundamental religious principles, his interpretation of prophecy, his textual criticism of the historical works of Scripture, his system of world chronology, his cosmological theories . . . all bespeak the