Book Reviews

Arthur Holly Compton's Work

The Compton Effect. Turning Point in Physics. ROGER H. STUEWER. Science History Publications (Neale Watson), New York, 1975. xii, 368 pp., illus. $25.

Scientific Papers of Arthur Holly Compton. X-Ray and Other Studies. ROBERT S. SHANKLAND, Ed. University of Chicago Press, Chicago, 1974. xxxviii, 778 pp., illus. $27.50.

As Stuewer says, the Compton effect was a turning point in physics. It forced physicists, among them Bohr and Compton himself, who for years had rejected the concept of the photon, at last to take it seriously. The newly respectable light quantum helped stimulate researches which in one direction led to wave and in another to matrix mechanics. The perplexing simultaneity of the discovery of the alternative forms of quantum mechanics may best be explained by their common concern with problems pointed to by the Compton effect.

The familiar picture of x-ray scattering as relativistic billiards was suggested independently in 1922 by Debye and by Compton. Debye, an early practitioner of quantum theory, had conceived, perhaps as early as 1920, that the light quantum might save the phenomena of x-ray scattering; but he did not publish until encouraged by Compton's report to the National Research Council (1922), which emphasized four experimental results irreconciliable, in Debye's opinion, with electromagnetic theory: (i) the intensity of scattered x-radiation was far stronger in the forward than in the backward direction; (ii) the same asymmetry afflicted electrons set free during the scattering process; (iii) the scattered radiation appeared to be softened, likewise asymmetrically, but more backwards than forwards; (iv) the total scattered intensity could fall well below the minimum calculated by J. J. Thomson on the electromagnetic theory.

Compton came to his discovery not via the brilliant and lucky insight of the practiced quantum theoretician, but through the failure of a dogged and resourceful effort to describe the scattering of high-frequency radiations by the ordinary electrodynamics alone. By 1920 Compton knew all the facts—with respect to γ- and x-rays—which Debye was to regard as intractable difficulties. But Compton then still hoped, as he had for several years, to refer item (i) to the interference of secondary wavelets scattered from a fat, flexible electron, either a shell or a ring, the diameter of which he fixed, after laborious calculations, at about 4×10^{-10} centimeter. Ultimately (iv) also came under this program. As for (iii), Compton explained that it concerned not a truly scattered radiation, in which there is no frequency change, but a new "fluorescent" radiation, which he thought was emitted by electrons ejected by the incident beam and broadcasting at diverse frequencies in accordance with Doppler's principle. Compton then came to worry about (ii), which defeated his ingenuity. He retained the Doppler interpretation of the softening, but now (1921) tentatively employed the detestable quantum hypothesis to calculate the kinetic energy of the "oscillating" electron. A stronger form of the same proposal appeared in his National Research Council report: the electron comes away with velocity $h\nu/mc$ and radiates a Doppler-shifted secondary x-ray. Finally Compton gave up the last scrap of electromagnetic theory, cut out the Doppler stage, and introduced the billiard ball collision. As Stuewer points out, the available x-ray data could not distinguish between the final and penultimate theories; the last step was recommended not by Compton's experiments, but by the force of the quantum theory to which he had surrendered.

Stuewer traces in detail the complicated itinerary that brought Compton to his discovery. He has mercilessly limited himself to what historians of science call "internal history": an account of ideas, not of men and institutions. His purview does not even include instrumental improvements; for although he follows others in crediting Compton's success partly to the excellence of his apparatus, he gives no data to substantiate the claim. Within its severe limits, however, Stuewer's book is quite valuable for its courageous grappling with the often difficult physics, for its firm organization of the myriad details of the papers considered, for its occasional use of Compton's research notebooks and other archival material, and for its many illustrations, graphs, and tables.

Shankland's book consists primarily of reprints of selected papers on x-rays; cosmic rays are put off for another occasion (*1*). All Compton's papers analyzed by Stuewer are present; as Shankland observes, they constitute an inspiring achievement, from which one can learn not only physics, but how to do physics. Shankland also contributes a brief introduction and appendices outlining Compton's x-ray work and the research it directly inspired.

Obiter dicta in Stuewer's analysis suggest that Compton's tenacity owed something to his Midwestern religious upbringing and to a felt need to justify his choice of a scientific over a clerical career. It is curious that Compton thought his education typical of the training of American physicists of his generation. Further undeveloped data in Stuewer's and Shankland's books suggest that American mathematical physics was far stronger before 1925 than is usually conceded. A good intellectual biography of the third American Nobel laureate in physics would be most welcome and instructive (*2*).

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References and Notes

1. There exists an anthology of Compton's nontechnical writings: M. Johnston, Ed., *The Cosmos of Arthur Holly Compton* (Knopf, New York, 1967).
2. A start has been made by J. R. Blackwood [*The House on College Avenue: The Comptons at Wooster 1891–1913* (MIT Press, Cambridge, Mass., 1968)].

An Attempt to Limit Research

Antivivisection and Medical Science in Victorian Society. RICHARD D. FRENCH. Princeton University Press, Princeton, N.J., 1975. xiv, 426 pp. Cloth, $20; paper, $9.95.

What role can historians play in the attempt to understand the complex relationships between science, technology, and society in the present world? Richard D. French, the author of this substantial book on the antivivisection movement in Victorian England, has proceeded upon the explicit premise that his historical analysis can elucidate current issues.

The book has two parts. The first is a narrative account of the antivivisection movement in England from 1870 to the early 1880's. In 1876 the antivivisectionists wrote a bill severely limiting research involving vivisection and brought it to Parliament. Scientists and medical people quickly mobilized opposition that induced government officials to amend the bill in their favor, and it was passed in the