A Phase of American Physics

Radioactivity in America. Growth and Decay of a Science. LAWRENCE BADASH. Johns Hopkins University Press, Baltimore, 1979. xx, 328 pp., illus. $18.95.

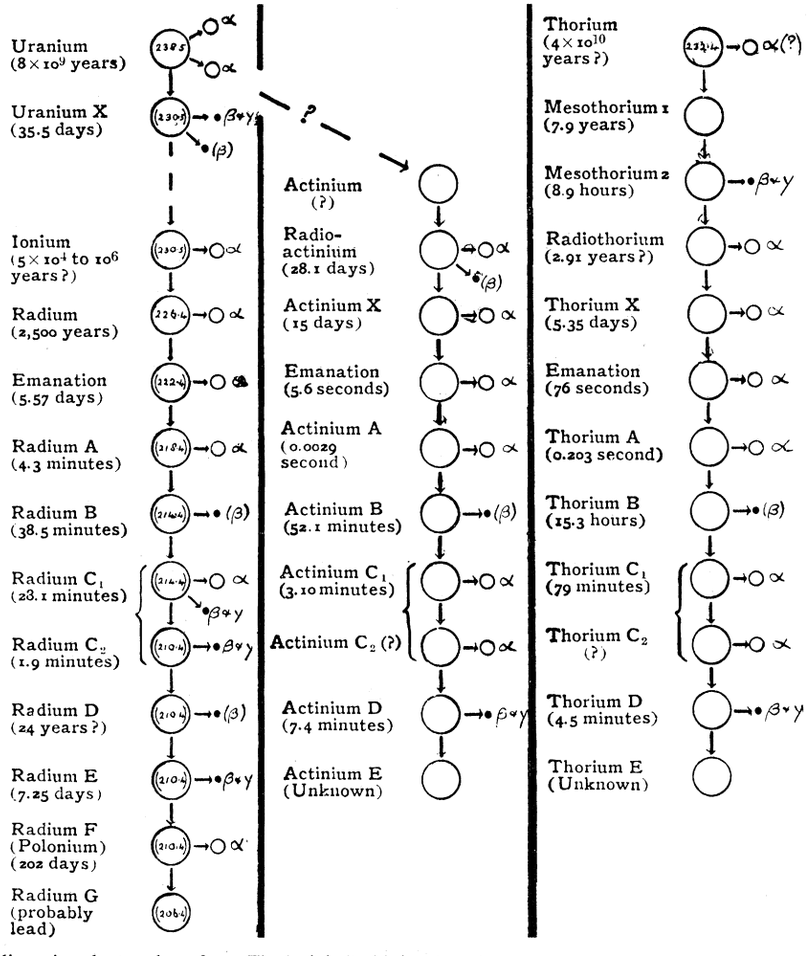
The closing years of the 19th century saw two striking experimental discoveries, x-rays and radioactivity, not to mention the electron, that shattered whatever sense of completeness that existed in physics at the time. Each opened up avenues of research that fundamentally transformed our understanding of the structure of radiation and matter. Their initial receptions, however, were markedly different. Henri Becquerel's 1896 discovery of radioactivity excited a minuscule amount of interest compared to W. C. Röntgen's discovery of x-rays the preceding year. Not until 1898, when Marie Curie and G. C. Schmidt proved that thorium was also radioactive and when the former, assisted by her husband, Pierre, discovered polonium and radium, was a significant amount of interest generated in the new phenomenon. When in the same year Ernest Rutherford isolated uranium's α and β radiations (Paul Villard discovered the γ radiations in 1900), the field opened up, and the stage was set for discerning fundamental governing principles.

These proved to be the transformation theory of Rutherford and Frederick Soddy of 1902–1903 and the radioactive displacement laws, together with the associated concept of isotopes, which emerged through the studies of Soddy, Kasimir Fajans, and others in the period 1911–1913. By the time the devastating effects of World War I had been overcome, the study of radioactivity had lost its coherence as a separate area of research and had become but one aspect, though an important one, of the larger and emerging field of nuclear physics.

The principal chronological focus of the present book, therefore, is on the first quarter-century of radioactivity's history. Its principal national focus, as its title indicates, is on research in America. The latter focus seems curious at first sight, since none of the fundamental principles cited above bear American names. Yet, this is precisely the point: physics in America was inching its way toward maturity during the period under study, and the level of American contributions to research in radioactivity was one measure of its stage of development.

This book, therefore, portrays quite a different picture of science in America from what one might expect. It is not a story of the Rowlands, Michelsons, Millikans, and Comptons; it is a story of the Baskervilles, Boltwoods, McCoys, Moores, Schlundts, Allens, and Kovaricks. Altogether, it is a first-rate achievement, ranking as one of the finest pieces of historical scholarship in recent years.

Its author, Lawrence Badash, is professor of history of science at the University of California, Santa Barbara, and editor of the *Rutherford and Boltwood Letters on Radioactivity* (Yale University Press, 1969). The present work constitutes a panorama of radioactivity in America, placing inter alia Boltwood's contributions within their proper national and international perspectives. To accomplish his purpose, Badash has analyzed all of the original research papers, has tracked down private correspondence in American, Canadian, and British depositories, has interviewed and corresponded with surviving



Radioactive decay chart from Frederick Soddy's *The Chemistry of the Radio-Elements* (Longmans, Green, London, 1911). Soddy's book "was more an encyclopedia than a conventional textbook, for it listed all the radioelements and, in sequence, gave their known physical and chemical properties. The value of this exercise lay in the completeness of the information, in Soddy's analysis, and in the direction in which it pointed. Even more than his predecessors, Soddy was struck by the analogies between the three decay series. The thorium and actinium lines were almost exactly alike in their succession of products, except that there was no counterpart in the actinium series for the two mesothoriums between thorium and radiothorium. The uranium series likewise contained an 'extra' product, uranium X, between uranium and ionium . . . and had three more radioelements than the other series at its very end. But in both chemical nature and type of emission the matched properties were striking. . . . To Soddy [the] patterns suggested the 'successive transit of matter from group to group of the Periodic Table.' " [From *Radioactivity in America*]

contributors and their relatives, and has read numerous contemporary newspaper articles and other popular and semi-popular publications. It is difficult to believe that he might have left some stone unturned in his quest for understanding.

The contents of Badash's book reflect its diversity of source materials. Its main thread, of course, is the scientific work. Badash discusses—to touch on only one or two points—the dubious evidence for the complexity of thorium reported by Charles Baskerville of the University of North Carolina; the painstaking and high-quality researches of B. B. Boltwood of Yale, H. N. McCoy of Chicago, and R. B. Moore and H. Schlundt of Missouri to unravel, especially, the decay chain of the uranium series; and the pre-World War I ionization and absorption studies on α and β particles by S. J. Allen of Cincinnati and A. F. Kovarick of Minnesota. Badash regards Boltwood's 1907 discovery of the parent of radium, "ionium" (now $^{230}_{90}$Th), as representing the mark of maturity of the American efforts. At each stage of his discussion, however, he is careful to place these efforts within a broad international context, and thus he avoids elevating American contributions above their actual contemporary importance. His deft biographical sketches throughout are a delight to read.

Interwoven with the main scientific narrative are accounts, for example, of W. J. Hammer's popular lectures on radioactivity; the radium dances of Miss Loie Fuller, America's "serpentine lady"; the only-in-America scheme to produce ready-made hard-boiled eggs by lacing chicken feed with radium; G. F. Kunz's careful radium-ray bombardment of gemstones in the priceless Morgan-Tiffany collection; the transition of radium therapy efforts from optimistic to pessimistic to realistic; the ill-fated use of radium on watch dials; attempts to exploit and control Colorado's uranium deposits; researches on radioactive dating and atmospheric radioactivity; the quest for instrumentation of increasing precision; and the definition and preparation of the first International Radium Standard in the period 1910–1912.

Not content to stop there, Badash also discusses the dynamics of scientific research from the perspective of his study of radioactivity in America. He sees personal contacts and correspondence on an international level, and the extraordinary influence of Rutherford especially, as dominating over national or local scientific traditions in America at the time. He notes the refusal of chemistry departments to embrace the pioneers in the new field of radioactivity. He identifies Yale, Chicago, and Minnesota as the only universities in the country where research traditions in radioactivity, albeit weak ones, were established in the period under study. Finally, he finds that his study more or less supports Derek J. de Solla Price's growth curve of scientific activity, Thomas S. Kuhn's theory of scientific change, and Gerald Holton's model of internationalism in science, involving communication through travel, congresses, publication in foreign journals, and the like.

(Perhaps I should note for the record that Badash has missed a key link in the close intellectual and personal ties of the period between Yale and Minnesota—the appointment in 1885 of Frederick S. Jones, B.A. Yale 1884, as Minnesota's first full-time physics teacher and Jones's subsequent return to Yale in 1909 as dean. And on p. 270 he states, incorrectly, that Henry A. Erikson never studied abroad—Erikson actually went to Cambridge in 1908–1909.)

Badash's book is exceptionally well written, though the inherent difficulty of some of the concepts treated, the paucity of figures, and the unavoidable use of some outmoded terminology and symbols do not always make reading easy. This masterly study, nonetheless, will be prized by scholars from a broad range of disciplines for many years to come.

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Ostwald as Philosopher

Forschen und Nutzen. Wilhelm Ostwald zur wissenschaftlichen Arbeit. GÜNTHER LOTZ, LOTHAR DUNSCH, and UTA KRING, Eds. Akademie-Verlag, Berlin, 1978. xlviii, 278 pp., illus. + plates. 38 M. Beiträge zur Forschungstechnologie, Sonderband 1.

Best known today as one of the founders of modern physical chemistry, Wilhelm Ostwald (1853–1932) was a scientist of exceptionally broad ambition and far-ranging interests. During a career that took him from Germany's Baltic provinces to a chair at the University of Leipzig and then to a free-lance existence as a scientist and philosopher, Ostwald was obsessed with the desire to reform ever widening circles of knowledge. Initially he confined his ambition to chemistry, where he sought to rekindle interest in the problem of chemical affinity. In the 1870's and 1880's, Ostwald wrote his monumental *Lehrbuch der allgemeinen Chemie*, cofounded the *Zeitschrift für physikalische Chemie*, and organized an extremely productive and influential research school in physical chemistry. During the next decade, he enlarged his horizons, both by writing significant texts on analytical, inorganic, and electrochemistry and by launching a campaign to set the physical sciences on a new foundation that would eliminate unproven hypotheses, such as the atomic theory, and instead be based on the principles of thermodynamics. Finally, following his retirement from teaching in 1906, Ostwald devoted himself to philosophy and a variety of social causes, believing that the entire theory of knowledge was in need of reform and that social institutions and conventions as diverse as language, coinage, the printing industry, education, and our way of measuring time were in need of rationalization.

Ostwald was an enormously prolific writer. Apart from his editorial labors and translations, Ostwald wrote over 20 books, hundreds of scientific papers, and nearly 5000 reviews. The problem of selecting a representative sample from this large corpus is formidable. *Forschen und Nutzen*, a volume published to commemorate the 125th anniversary of Ostwald's birth, consists of three dozen selections drawn from Ostwald's published works together with two brief essays taken from his unpublished papers. The three East German editors chose to include extracts from Ostwald's writings that they thought would be of relevance today. This criterion results in a rather odd collection when applied by dialectical materialists to Ostwald, a figure well known as a monist and antimaterialist. Included are Ostwald's Nobel lecture of 1909, several earlier papers on scientific instruments, articles and portions of larger works dealing with education, scientific organization, scientific creativity, and the history of chemistry, and, inevitably, selections treating the relationship between theory and practice. Inclusion of Ostwald's lecture of 1895, "The Conquest of Scientific Materialism," would have made this a far more interesting collection, but the editors apparently wish to rehabilitate Ostwald and not to bury him.

Although the editors' standards of selection are wanting, the volume possesses several redeeming features. The index is meticulous and contains biographical facts about people mentioned