A PERSONAL VIEW OF A LIFE REVISITED

A Mind Always in Motion: The Autobiography of Emilio Segrè

Emilio Segrè
with Rosa Segrè
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Reviewed by Glenn T. Seaborg

Throughout his life, Emilio Segrè made extensive notes to record the high points of his activities. These made it possible for him, during his last years, to write this readable, absorbing, interesting autobiography, which he, with the help of his wife Rosa, reserved deliberately for posthumous publication.

This book is a valuable contribution by a person who witnessed the development of much of modern nuclear physics. Segrè's description of the historic neutron experiments performed in Rome during the mid-1930s by Enrico Fermi's group, of which Segrè was a member, is of inestimable worth. I recall the excitement of deciphering these publications, written in Italian, as a beginning graduate student at Berkeley.

Segrè begins with a description of his childhood in Tivoli and describes his schooling in Rome, followed by his turn toward physics at the University of Rome, where the great Enrico Fermi served as his private tutor. His reverence for Fermi and their close relationship from this point until Fermi's untimely death in 1954 are central elements of the book.

After obtaining his doctorate in physics in 1928 at the age of 23, Segrè did important research in atomic spectroscopy and met many of the major physicists then working in Europe. In 1933 he turned, with Fermi and his group, to nuclear physics. During 1934 and 1935 the group (which also included Edoardo Amaldi, Oscar D'Agostino, Bruno Pontecorvo and Franco Rasetti) performed their famous neutron bombardments of uranium (leading to the "false" transuranium elements) and discovered the slow neutron.

From 1936 to 1938 Segrè served as a professor at the University of Palermo, where he identified, with Carlos Perrier, the induced radioactivity of element 43, for which he later suggested the name technetium.

Driven from Fascist Italy in 1938, he moved to the University of California, Berkeley, where I joined with him to perform his first experiment there: the demonstration of nuclear isomerism in element 43. His discoveries with his coworkers at the Radiation Laboratory in Berkeley are impressive: the chemical separation of nuclear isomers, the effort (unsuccessful) to identify element 93, the discovery of the artificial element 85 (later named astatine), the demonstration of the slow-neutron fissionability of plutonium-239 and the discovery of the antiproton, for which he and Owen Chamberlain in 1959 received the Nobel Prize in Physics. His wartime contributions at Los Alamos included the important demonstration of the spontaneous fission of plutonium-240.

Included in the book are curious, in fact unprecedented, posthumous attacks on a number of his Berkeley colleagues. (Oddly, they are confined to his Berkeley colleagues.) For example, according to Segrè, Ernest O. Lawrence was "no more than a mediocre scientist," and Segrè doubted that, following the demonstration of the fissionability of plutonium-239, "Lawrence appreciated the weight of [its] implications." (I do not agree with either statement.) Luis Alvarez is characterized as "a little fascist leader, fawning to the Duce [a reference to Lawrence], but mean to his equals or inferiors." (This is an unfair description of the

Glenn T. Seaborg (left) and **Emilio Segrè** in 1966.

Glenn T. Seaborg, associate director-at-large at the Lawrence Berkeley Laboratory and the codiscoverer of ten transuranium elements, including plutonium, was a colleague of Emilio Segrè over a period of 50 years.

most versatile scientist I have known.) Edwin M. McMillan is depicted as "very clever, but lazy." (He was one of the most industrious scientists I have known.) "[J. Robert] Oppenheimer and most of his acolytes followed the political line of the Communist Party of the United States." (This is an unfair characterization of Oppenheimer's devotion to the correction of social injustice.) Philip Abelson didn't "hide his feelings about foreign interlopers." (Abelson made the successful chemical identification of element 93, following Segrè's abortive attempt.) And so on.

Segrè is even critical of his coworkers on the antiproton, and he makes disparaging remarks about his own brothers. He seems to recognize this side of his character when he says at one point: "I know how unpleasant I can be." But he justifies his stance as an attempt "to tell the unvarnished truth (as I see it)."

Ironically, just as I was his first collaborator at Berkeley in 1938, I was his last collaborator, more than 50 years later in 1989, when we served as cochairmen of the American Nuclear Society's conference commemorating "50 Years with Nuclear Fission," held in Washington, DC and Bethesda, Maryland.

The book contains a number of errors that may be ascribed to its posthumous production. Overall, this is an engaging autobiography written by a key participant in the development of 20th-century nuclear physics.

To A Rocky Moon

Don E. Wilhelms
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Between 1961 and 1972, the US Apollo Program developed systems to land human beings on the Moon and return them safely to Earth, and performed the feat six times. Simultaneously with this technological achievement, the science of comparative planetology was being born. For the first time, the Moon became a place where telescopic or remotely sensed data could be tested and extended through direct observations and the collection of samples *in situ*. Don Wilhelms, who was a leader in the lunar mapping program that supported Apollo, has done a splendid job of documenting the development of lunar science through the Apollo era, weaving it together with the missions that caught the world's attention. *To A Rocky Moon* is a personal history, filled with the people who developed the science and including their accomplishments, idiosyncrasies and disputes.

Starting his account before Apollo, Wilhelms traces the history of thought about the Moon and its origin, highlighting diverse opinions held by, among others, Harold Urey (the Moon was a primitive, unaltered remnant of the early solar system), Gerard Kuiper (the Moon had totally melted), Ralph Baldwin (the Moon's craters were produced by meteorite impacts) and Jack Green (most of the Moon's craters were formed by volcanic explosions). In the early 1960s, close inspection of lunar photographs and studies of Meteor Crater in Arizona by Eugene Shoemaker began to confirm meteorite impact as the dominant shaper of the Moon's surface. It remained for the Surveyor missions' automated landers and the Apollo samples to demonstrate that basalt, a common terrestrial volcanic rock, was the main constituent of the lunar maria and that the Moon had had active volcanoes until perhaps a billion years ago. Some of the proponents of the earlier models were gracious in the face of new information; others never abandoned their models.

In 1960 the US Geological Survey, in support of the lunar program of the National Aeronautics and Space Administration, created the astrogeologic studies group, which became its branch of astrogeology. Under Shoemaker's leadership, its members became the principal lunar mappers, making important contributions to the development of scientific thought and playing a major role in training astronauts to make scientific observations on the Moon; one member of the branch, Harrison "Jack" Schmitt, became the only scientist–astronaut to explore the Moon. Wilhelms describes the give-and-take environment of this USGS team, in which everyone contributed and debate was furious. Their work led to the selection of target sites for the Apollo landings and detailed plans for astronaut activities, and it became the basis for interpretation of the samples.

Even before crews reached the lunar surface, their excursions were planned in detail to extract the most scientific information possible about the sites. Wilhelms describes the triumphs and failures of the planning, as well as the scientific results from each mission. In the end, he finds, the astronauts, trained as test pilots, proved to be excellent observers and made important contributions to our understanding of the Moon: Their efforts were the key to turning the Moon from a remote celestial object