Emilio Segrè

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Francesco Iachello

introduced models of molecules that were based, like those used to describe nuclei, on group theory.

Iachello received one doctorate in nuclear engineering from the Turin Polytechnic in 1964 and a second doctorate in physics from MIT in 1969. He has been a professor at Yale since 1978.

IN BRIEF

Michael Knotek, formerly chairman of the National Synchrotron Light Source at Brookhaven National Laboratory in Upton, New York, has become senior science director for Batelle Memorial Institute's Pacific Northwest division in Richland, Washington.

Shobo Bhattacharya, formerly a senior staff physicist at Exxon's Corporate Research Laboratories, has become a senior research scientist in the physical sciences research division of the NEC Research Institute in Princeton, New Jersey.

This month **Gordon P. Eaton** will leave his position as president of Iowa State University to become the new director of Columbia University's Lamont–Doherty Geological Observatory in Palisades, New York. Eaton is a geologist by training who has been in university administration for about nine years.

Herbert Goldstein, a professor of applied physics and nuclear engineering at Columbia University, has been chosen to receive the Arthur Holly Compton Award of the American Nuclear Society. According to the award citation, Goldstein is recognized for "his pioneering research and teaching in radiation transport and shielding, and for his selfless effort to promote public understanding of nuclear power."

OBITUARIES

Emilio Segrè

Emilio Gino Segrè, Nobel laureate and a pioneering figure in nuclear physics, died suddenly of a heart attack on 22 April 1989, at the age of 84. Segrè became a research associate at Lawrence Berkeley Laboratory (then the University of California Radiation Laboratory) in 1938, and joined the physics department of the University of California, Berkeley, two years later. He and I shared the Nobel Prize in Physics in 1959 for the discovery of the antiproton.

Segrè was a polished writer, so I shall take the liberty of frequently quoting his own description of his life and work in his Faculty Research Lecture, "From Atoms to Antiprotons," given in March 1960.

Emilio was born into an influential and affluent Italian family that had strong intellectual traditions. His father was an industrialist—the owner of a paper mill—and his mother was the daughter of a well-known Florentine architect. He recalled:

> I passed my youth in Tivoli, where I received extraordinarily good instruction in the elementary grades. . . .
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> At the University [in Rome] I came immediately into contact with scientists and mathematicians of outstanding merit, such as Castelnuovo, Severi, Levi-Civita and Corbino. However, I studied engineering and not physics. . . . It was only in my fourth university year that I became acquainted with first [Franco] Rasetti and then with [Enrico] Fermi. . . .
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> Fermi had just arrived in Rome as a young professor. . . . He gave us, that is, [Edoardo] Amaldi, Rasetti, [Ettore] Majorana and myself [his first students], and later [Giulio] Racah, [Gian Carlo] Wick and others, private and informal lessons, out of which we learned physics. . . .
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> [In those lessons] I was deeply influenced in my scientific taste of what is important in physics and in my conception of the indissoluble connection between theory and experiment.
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> Although my own work has been mostly experimental, it was motivated much more by theory than by a desire to develop a technique or an instrument.
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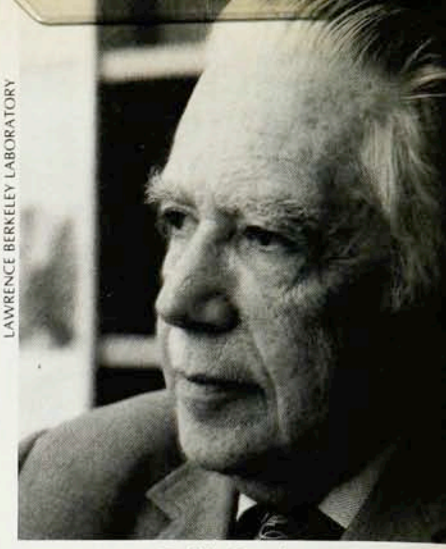
> Experimental complication to me is more an unavoidable evil to be tolerated in order to obtain the results than a stimulating challenge, as it is to many physicists. The simple experiment has been always the one I admired most.



LAWRENCE BERKELEY LABORATORY

Emilio Segrè

In 1928 Segrè completed his doctoral thesis at the University of Rome, on the anomalous dispersion of lithium vapor. Although he worked with Fermi on a number of atomic spectroscopy problems, in 1929 he made his first original discovery, on the connection of forbidden lines with quadrupole radiation using the Zeeman effect. This was the experiment that convinced him he could do something significant in physics by himself.

To bring new experimental techniques to Rome, members of the Fermi group had to learn them by working with other research teams:

> I went to Amsterdam, to [Pieter] Zeeman's laboratory to study forbidden spectral lines. . . . I later worked on molecular beams in the Otto Stern laboratory in Hamburg. . . .
>
> Around 1930 Fermi recognized . . . that one had to turn to the nucleus for new and interesting problems and riddles . . . and just in the middle of this work, lightning struck in the form of the discovery of artificial radioactivity by [Irène] Curie and [Frédéric] Joliot. . . . Fermi immediately saw the advantages of using neutrons instead of alpha particles as projectiles and started experimenting in that direction. . . . When Fermi obtained his first success he generously asked us to help him; and we dropped everything else, . . . divided our work and took responsibility for different parts of it. . . .

At that time we made a discovery practically every week. We had a hard time in writing the letters to the *Ricerca Scientifica* relating our work as fast as they were needed.

In 1936 Segrè was appointed professor of physics at the University of Palermo and director of the university's physics institute. Though reluctant to leave the Fermi group, he was attracted by the prospect of making a significant research center out of what had been essentially a nonexistent physics department.

Around that time he and his new wife, Elfriede, made a trip to Berkeley, where Segrè asked for and was given some discarded parts from the 37-inch cyclotron deflector, which had been bombarded by deuterons. These he brought back to Palermo and, convinced that they contained the so-far-unseen element 43, he persuaded the mineralogist Carlos Perrier to help him "separate chemically the radioactivities of the target." In due course they found a radioactivity that could not be anything but a new element, atomic number 43, which they called technetium.

However appreciated and praised this discovery was, on a return trip to Berkeley in 1938 Segrè learned that Mussolini's new anti-Semitic laws had removed him from his position at Palermo, and so, sensing what was to come, he decided to remain in the United States and send for his family.

While temporarily employed at the Radiation Laboratory in Berkeley, Segrè pursued an investigation of nuclear isomerism, a highlight of which was his devising and demonstrating a method for the chemical separation of isomers. Then, with Dale Corson and Kenneth Mackenzie, he found his second new element, number 85, which, because of its instability, they called astatine.

In December 1940, acutely sensitive to the threat of US involvement in the war in Europe, Segrè met with Fermi in New York, where Fermi was now a professor at Columbia, and they discussed the possibility that the plutonium isotope of mass 239 could be a slow-neutron fissioner and thus an alternative to uranium-235 for making a neutron chain reaction.

Soon a concerted effort was being made in Berkeley to find elements 93 and 94, neptunium and plutonium. Edwin McMillan and Phillip Abelson, who were irradiating uranium with neutrons, showed that two of the radioactivities were members of the same chain. Uranium-239 was decaying to neptunium-239, which in turn was believed to be decaying to plutonium-239, but the amount of plutonium was too small to be measured.

Another group composed of Joseph Kennedy, Glenn Seaborg, Arthur Wahl and Segrè, pursuing the same goal, succeeded in producing measurable amounts of plutonium, which indeed proved to be a slow-neutron fissioner.

By 1942 Segrè had made early contributions to the Manhattan Project and his remarkable knowledge and scientific genius were called upon as he led some of the pioneering work at Los Alamos. There he worked on the spontaneous fission of uranium and plutonium isotopes with his assistants, including Clyde Wiegand and me.

The history of the atomic bomb is too well known to repeat here. (For Segrè's own account of the discovery of nuclear fission, see PHYSICS TODAY, July, 1989, page 38.)

In 1947 Segrè was appointed a professor of physics at Berkeley, and within a few years he and his group, of which I was again a member, began a series of nucleon–nucleon scattering experiments on the recently completed 184-inch cyclotron.

Later we produced polarized protons and used them in numerous scattering experiments. Eventually two subgroups under Segrè worked toward the discovery of the antiproton. The success in 1955 of the subgroup that included Wiegand, Tom Ypsilantis, Herbert Steiner and me resulted in the awarding of the 1959 Nobel Prize, which Segrè and I shared.

In 1952 Segrè became the editor in chief of the *Annual Review of Nuclear Science*, a position that he held until 1977. During this interval he edited *Experimental Nuclear Physics* (Wiley, 1953) and wrote *Nuclei and Particles* (Benjamin, 1953); *Enrico Fermi, Physicist* (U. Chicago P., 1970); and *From X Rays to Quarks: Modern Physicists and Their Discoveries* (Freeman, 1980). In 1984 he produced another book, *From Falling Bodies to Radio Waves: Classical Physicists and Their Discoveries* (Freeman). His retirement in 1972 was simply the beginning of a new period of writing and publishing, and of lecturing in California, Italy, Israel, England and elsewhere.

The many honors that were showered on Emilio Segrè recognized him as a world-class figure in physics and also as a humanist. Segrè was a bridge connecting the inception of nuclear physics to the present world of particle physics with its enormous accelerators. He knew almost all the great figures in 20th-century physics, and he shared that knowledge through his books and teaching. As a lecturer, Segrè made a forceful impact on his American students—on me for one, in more ways than I could have ever anticipated. I have written this obituary with a sense of humility on considering the accomplishments of so gigantic a figure in physics.

OWEN CHAMBERLAIN
University of California
Berkeley, California

Edoardo Amaldi

Edoardo Amaldi

Edoardo Amaldi died suddenly of a heart attack on 5 December 1989. With his death the world of physics has lost not only an outstanding researcher and teacher but also a great statesman of science who influenced in an extraordinary way the rebirth of physics in Europe after World War II.

Amaldi was born in Carpeneto (Piacenza) on 5 September 1908, and graduated from the University of Rome in 1929 with a thesis on the Raman effect, carried out with the guidance of Franco Rasetti. Except for some sojourns abroad, Amaldi remained in Rome for the rest of his life. During six decades of active research he moved, in succession, from molecular physics to atomic, nuclear, cosmic-ray and high-energy physics, and finally to the study of gravitational waves.

Amaldi was a member of the famous group of Enrico Fermi—probably the first "large" physics group—that made so many remarkable discoveries in neutron physics in the pre-World War II days. The group induced radioactivity in most elements up to the heaviest, first using fast neutrons and then with thermal and resonance neutrons. In 1955, simultaneously with the discovery of antiprotons in a counter experiment at the Berkeley Bevatron, nuclear emulsions were used by a Rome–Berkeley collaboration between Amaldi's group and the group of Gerson Goldhaber, Emilio Segrè and a visitor, Gösta Ekspong, to establish the antiproton annihilation process. Amaldi's scholarly knowledge of the history of physics was brilliantly exhibited in his encyclopedic reviews of the development of neutron physics, including several chronicles of the long road to the discovery of fission. His interest in history also spawned a review of magnetic monopoles and biographical sketches of his fellow student Ettore Majorana, and of Bruno Touschek, Fritz Houtermans and others.

After Fermi, Bruno Rossi, Segrè and other physicists left their country because of Mussolini's racial laws, the survival of physics research in Italy owed much to Amaldi's efforts. During the German occupation of Rome he organized resistance and sheltered both old and young colleagues. He and Gilberto Bernardini supported the famous basement experiment of Marcello Conversi, Ettore Pancini and Oreste Piccioni in which they discovered the leptonic nature of muons.

In the fall of 1945 Amaldi established the very productive Centro di Studio per la Fisica Nucleare at Rome University. Together with Bruno Ferretti, Amaldi always emphasized the importance of fundamental research, but he also helped the development of nuclear technology in Italy. He strongly supported the construction of accelerators, in particular the pioneering electron machines in Frascati. Amaldi also had a leading role in the remarkable development of experimental and theoretical physics in Italy immediately after the war. His outstanding personality kept divergent groups together and fostered national and international collaboration.

Amaldi played a vital role in the creation of CERN. He participated in its development not only because of his urge to return European physics to the forefront but also because he expected CERN to become an example of a successful collaboration between European nations. Due to Amaldi's influence, Italy was the first country to pledge financial support for the study of this project. As secretary general of a provisional organization formed in 1951 to establish a high-energy laboratory, Amaldi strongly influenced the decision to build at a site near Geneva the largest feasible proton accelerator, based on the newly invented principle of strong