Elizabeth Rona

(1891?–1981)

The radioactive tracer, now raw material in most branches of science, was the discovery of at least four persons. The last of these four, Elizabeth Rona, died in Oak Ridge on July 27, 1981.

She was with Kasimir Fajans during the discovery of isotopes, and changed the Hevesy-Paneth term "indicators" to "tracers." She measured the first radioactivity in oceanography; made many of the polonium sources that smashed atoms in pre-accelerator days; and was one of the first to learn of the new "artificial" radioisotopes and of the discovery of fission. For almost sixty years she taught other scientists how to measure radioactivity in any substance, and for over fifty years her scientific specialty was the study of radioactivity in sea water. Although she felt her students' work was more important than her own, none of us has yet matched her contribution to science.

At the age of 21 Elizabeth Rona received her Ph.D in chemistry, physics, and geophysics from the University of Budapest (about 1912). For postdoctoral training she went to Karlsruhe to study under Kasimir Fajans, who had just announced his discovery of "pliades" (the term was changed to "isotopes" by F. Soddy a year later). After an eight-month introduction to the new radiochemistry, Elizabeth returned to the Chemical Institute of Budapest, where she completed her first scientific paper on the diffusion constant of radon in water.

At this time George Hevesy also returned to Budapest, but from Vienna, where he and Fritz Paneth had just finished reporting their studies of the diffusion of lead solutions in lead solutions. They had used ThB, which we now term Pb-212, and stated that except for the radioactivity it was identical to lead presently known as Pb-206-7-8. Thus a radioactive "isotope" could be an "indicator" of the behavior of its stable sibling. In Budapest, Hevesy was delighted to find a young girl using the new radiochemical techniques to measure radon diffusion. He and Fajans had learned the technique from Hans Geiger at Manchester two years earlier. Hevesy asked Elizabeth to check a small detail in a current radiochemical argument. G. N. Antonoff in Rutherford's Manchester laboratory had discovered UY, now termed Th-231, but F. Soddy and A. Flecks in Glasgow could not confirm the new "element." (New radioactive substances were still "elements" in 1912 but orphans in the periodic table—hence automatic arguments.) Elizabeth followed Hevesy's suggestion and verified the existence of UY. After the Hungarian Academy of Science published her successful study, Otto Hahn and then F. Soddy reverified Elizabeth's work, and she was no longer "just a young girl chemist."

During discussions with Hevesy, Rona coined the words "isotope labels" and "tracers." A tracer was termed a radioactive substance identical to its nonradioactive sibling, but the word "identical" troubled both of them. Atomic diffusion is a property of atomic mass, hence there must be a difference in the diffusion velocity of isotopes. Rona measured the diffusion velocity of radioactive tracers from molecular thin layers of their "identical" siblings. The differences were imperceptible, but Hevesy pointed out that the mass difference between UY (Th-231) and UX_1 (Th-234) was small. If it were large, there must be a difference. Unfortunately, there were no such nuclides in 1914, and so they put their caveat on isotope identity into a footnote:

> "These ideas do not apply strictly to diffusion processes or, therefore, to the exchange of atoms in the same phase, because the velocity of diffusion is dependent on the mass; this dependence is very slight [in lead and thorium]."

The footnote was not "just a footnote" in Aston's mind when he set up his mass spectrograph five years later; nor in Urey's mind when he looked for heavy water fifteen years later. It was not a footnote when U-235 was separated from U-238 25 yr later. If anything, it was the fattest, heaviest footnote in isotope history.

After World War I, at his invitation, Elizabeth Rona joined Otto Hahn's staff in Berlin to separate ionium (now Th-230) from uranium ores, and about 1928, Stefan Meyer asked her to join the staff of the Vienna Radium Institute. Transmutation, in the days before accelerators, was done with alpha particles. Po-210 was the best source and could be obtained cheaply from spent medical radium needles. Rona joined the staff of the Curie Institute in Paris to learn polonium separation from Irene Curie. In 1934, Irene told her the story of the discovery of P-30 a few weeks after it happened. Rona's retelling is the closest we will ever get to a first-hand account of the 1934 beginning of the "artificial radiotracer" technique to supplement Rona's first-hand account of the beginning of the "natural radiotracer" technique.

In 1928 Hans Pettersson, the Swedish oceanographer, had visited the Vienna Institute with samples of sea bottom sediments that he wanted to have analyzed for radium content. Stefan Meyer assigned Rona to the task, but the radium background at the Institute was too high; so she packed up the equipment and moved it to the oceanographic station at Bornö, Sweden. For the next twelve years she spent her summers investigating the selective dissolution of the uranium, thorium, and actinium decay chains in oceanographic environments. The gigayear half-lives led her directly to radiogeochronology.

In 1939, while she and Otto Hahn were visiting the University of Oslo, Hahn confessed to her a mistake: his transuranium atoms were really something that Lisa Meitner called fission products.

In 1941, with the Russians on the right bank of the Danube and the Germans on the left bank, geochronology was finished in Hungary. (To Elizabeth, Vienna was a suburb of Hungary.) Rona then immigrated to the United States, and her first job was to analyze sea water and ocean sediment for uranium at the Geophysical Laboratory of the Carnegie Institute in Washington, D.C. There was a brief stint on preparing Po-210 and Pb-210 samples at Rochester, N.Y., but the purpose was "restricted" in war time.

In 1950 she joined the teaching staff of a new school at the Oak Ridge Institute of Nuclear Studies. Her facility with languages, especially scientific translations, was invaluable when foreign students were admitted. For her, English, French, German, etc. were simplistic dialects of Hungarian. After fifteen years she retired, but then spent another decade on the staff of the Institute of Marine Sciences of the University of Miami, performing the science she had introduced fifty years earlier.

On her second retirement, Elizabeth Rona returned to Oak Ridge where friends insisted she overcome her passion for anonymity and write about her career. The 75-page booklet printed in 1978* was a short history of the radioactive tracer method. No references to the literature were needed, for most of the great events happened because either she or one of her close personal friends was there.

Her death marks the end of the first chapter in radioactive tracer methodology. She specifically requested that no fuss be made, so her scientific colleagues merely express thanks for having had the opportunity to know Elizabeth Rona.

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* *Elizabeth Rona; How It Came About.* ORAU-137, Oak Ridge, TN, June 1978