

## **Alvin Weinberg's life was one of drama**

(As published in *The Oak Ridger's Historically Speaking* column on December 9, 2013)

Carolyn Krause brings us the second in the three-part series on Alvin Weinberg, Oak Ridge icon.

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Alvin Weinberg experienced plenty of drama in his 91 years of life in Chicago, Oak Ridge and Washington, D.C. He outlived two wives and one of his two sons. He was elected to the National Academy of Sciences, and he received two prestigious awards from the Atomic Energy Commission – the E. O. Lawrence Memorial Award and the Enrico Fermi Prize.

He worked with Nobel Prize-winning scientists in the Manhattan Project, which developed the atomic bomb that ended the world's greatest war — the leading news story of the 20<sup>th</sup> century. A nuclear reactor pioneer, Weinberg rescued a national laboratory that faced closure, and he was fired as director of Oak Ridge National Laboratory, a position he held for 18 years and used as bully pulpit for nuclear energy.

The son of Russian Jews who met on a ship while emigrating to the United States in 1905, Weinberg was born 10 years later in Chicago, where he received his education. With a Ph.D. degree in mathematical biophysics at the University of Chicago, he was drawn into the drama of the Manhattan Project's Metallurgical Laboratory there.

In an oral history interview with Steve Stow, he explained that his transition to nuclear physics was not difficult because the transport and diffusion equations he used to calculate the distances that cellular components travel could be applied to the transport of neutrons, the neutral particles in atomic nuclei that are the byproducts and instigators of nuclear fission. Weinberg learned nuclear physics from Enrico Fermi, Eugene Wigner and Leo Szilard, who held a secret patent on the chain reaction.

Weinberg's badge number was too high, so he couldn't be present on Dec. 2, 1942, when the world's first man-made nuclear chain reaction was sustained at the uranium pile on the squash court at Stagg Field at the University of Chicago. But Weinberg had gone bowling with Fermi and Walter Zinn hours before the momentous event. The next day Zinn, Fermi's chief assistant, invited him to see the history-making nuclear "pile."

Weinberg contributed important calculations to the design of the X-10 Graphite Reactor at ORNL, the world's first continuously operated reactor. Its wartime role was to demonstrate the production of small amounts of plutonium from uranium, one of the many key developments that led to the end of World War II.

When Weinberg's mentor Eugene Wigner left his job as research director in 1948, Weinberg worked 26 years as research director and, starting in 1955, as director of ORNL. In 1959 he was elected president of the American Nuclear Society.

At the end of the war, there were hints and concerns that Clinton Laboratories, the predecessor of Oak Ridge National Laboratory, would be shut down and all nuclear reactor work would be located at Argonne National Laboratory. But Weinberg came up with a successful plan to save the Oak Ridge lab from closure and keep its reactor experts onsite. (NOTE: This action alone makes Alvin Weinberg a hero for Oak Ridge...just think what we would be missing if there were no ORNL in Oak Ridge! Ray)

In his book *The First Nuclear Era: The Life and Times of a Technological Fixer*, Weinberg wrote that, as a member of Wigner's theoretical reactor group, "I naturally saw the laboratory's main long-term goal to be the development of breeder reactors based on liquid fuels — that is, solutions or slurries of uranium and plutonium. . . I had faith that if Clinton (ORNL) pushed the case for breeder-reactor development, the Atomic Energy Commission's decision to move all reactor development to Argonne would never be implemented — and this is what actually happened."

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A major drama in Weinberg's life was his clash with Milton Shaw, director of the AEC's reactor division. Shaw was a graduate of the University of Tennessee and the Oak Ridge School of Reactor Technology at ORNL; his sister Genevieve was married to Homer Kramer, a merchant in Oak Ridge. Shaw pushed for the development and demonstration of the liquid metal fast breeder reactor (LMFBR), whereas Weinberg advocated support for the molten-salt breeder reactor, an ORNL invention based on the thorium-232–uranium-233 cycle.

"I found myself increasingly at odds with the reactor division of the AEC," Weinberg wrote. Calling Shaw a dedicated engineer who managed the Shippingport (Pa.) reactor project, Weinberg wrote that Shaw had "a singleness of purpose and was prepared to bend rules and regulations in achievement of his goal...Milt tackled the LMFBR project with Rickoverian dedication: woe unto any who stood in his way.

This caused problems for me since I was still espousing the molten-salt breeder...More than that we were being troublesome over the question of reactor safety." In 1973 Weinberg was told by his friend John Swartout that his time was up, and he was fired.

In Louis Guzzy's book on AEC Chairman Dixy Lee Ray, "*Is It True What They Say about Dixy?*" Ray said that one of the notions Shaw held "that I had to fight was his stated desire to destroy the Oak Ridge National Laboratory. I never really knew exactly why but I was equally determined that that fine American institution should live forever."

In the Navy's experiments with nuclear submarines, the "Nautilus" had a light-water reactor, and the "Sea Wolf," which Shaw managed for his mentor Admiral Hyman Rickover, had a liquid-metal, or sodium, reactor in the *Sea Wolf*. Although Rickover discontinued use of the sodium reactor because of possible explosions from accidental sodium-water contact, Ray suspected that Shaw's actions were based on his desire to prove to Rickover that the LMR and LMFBR were the best reactor and breeder candidates.

"Shaw ran the reactor program as if breeders were the only program on the AEC agenda," Ray told Guzzy. "Other programs were neglected," including ORNL's molten-salt reactor and breeder program and the nation's nuclear fusion program. Shaw resigned when Ray ordered an audit review of the reactor development budget that Shaw had never before been required to report on. The reason: he enjoyed the confidence of AEC Commissioner Jim Ramey and of Rep. Chet Holifield, chair of the Joint Atomic Energy Committee of Congress.

In 1974 Weinberg was named the director of the Energy Research and Development Office, first in the White House and then as part of the Federal Energy Administration. He had been on the President's Science Advisory Committee during the Kennedy and Johnson administration. After President Nixon fired his science advisors, he asked Bill Simon to invite Weinberg to take the ERDO job and help address the energy crisis.

In his book, Weinberg described 1974 as the worst year of his life. "I was lonesome," he told Steve Stow in an interview. "I just couldn't mesh with the Washington milieu very well. I guess the main thing I got to understand was that in Washington everything is politics. It's not so much what you know, as who you know."

But Weinberg's year in Washington was productive. His office recommended the establishment of a solar energy research institute that led to the creation of a Department of Energy national lab in Colorado, now the National Renewable Energy Laboratory. Later through the Institute for Energy Analysis that he founded, Weinberg convinced DOE to start funding studies of carbon dioxide emissions from fossil fuel plants and climate change.

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Weinberg died in October 2006, but since then private companies from Japan, Australia, Russia and the U.S. have expressed interest in developing liquid fluoride thorium reactors, which contain molten thorium salt. On Sept. 8, 2011, the British House of Lords launched the Weinberg Foundation, a nonprofit organization dedicated to raising awareness about the potential of thorium energy and LFTR. The Weinberg drama continues.

**What is a molten salt reactor?** A molten salt reactor, which uses a molten salt mixture as the coolant and fuel, runs at higher temperatures and lower pressures than the pressurized water-cooled reactor at the heart of most nuclear power plants. It reduces mechanical stress on reactor system parts, simplifying reactor design and improving safety.

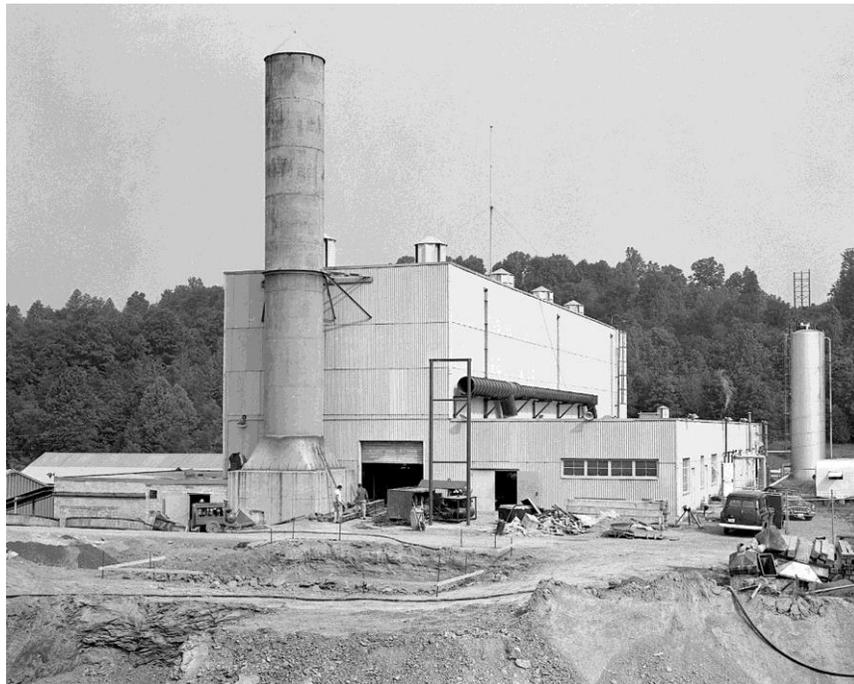
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Thanks Carolyn, for bringing us a most candid look at an Oak Ridge Icon, Alvin Weinberg. Not only was he a key factor at ORNL at a number of junctures when the lab might have taken a more limited role had he not been such a staunch supporter of "big science" and nuclear reactor technology, he was a key factor in resolving the energy crisis of the 1970's for the nation.

Often I think about Alvin and wonder why Oak Ridge does not promote him more, why we do not hold him up as a hero more prominently, why is it that we are reluctant to brag on our own. I think we need to get over that and focus attention on the Oak Ridgers who have achieved great accomplishments internationally or even locally and hold them up for praise.

As I mentioned at the end of the first article Carolyn wrote about Alvin Weinberg, there is a group of folks who are attempting to do just what I suggest above. They can use your help to complete a film about Alvin's life. If you want to help fund that effort, please see Tom Row or Steve Stow.

If you can't reach them, contact me and I will help. 865-482-4224 or draysmith@comcast.net.



Construction of the Molten Salt Reactor (MSRE), May 23, 1962 (Photo courtesy of ORNL)

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Construction of the Molten Salt Reactor Experiment (MSRE), November 1962  
(Photo courtesy of ORNL)



Molten Salt Reactor Experiment - Man working on graphite assembly for the MSRE, January 1964 (Photo courtesy of ORNL)

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Molten Salt Reactor Experiment - Men working on a MSRE core assembly, March 1964  
(Photo courtesy of ORNL)



Molten Salt Reactor Experiment - MSRE reactor vessel in a shipping jig, July 1964 (Photo courtesy of ORNL)