Alex Zucker: A scientific & managerial pillar at ORNL

(As published in *The Oak Ridger's Historically Speaking* column on March 3, 2014)

Carolyn Krause uses the oral histories from the Oak Ridge National Laboratory collection also available through the Center for Oak Ridge Oral History at the Oak Ridge Public Library to bring insights into another of Oak Ridge's pioneer scientists and laboratory managers. Alex Zucker, a good friend and fellow Rotarian has made a huge difference in our community. From his first job where he proved that the hydrogen bomb would NOT burn up the earth's atmosphere and thereby destroy the world to his love for music. He is truly a person we can be proud that came our way and stayed.

Enjoy Carolyn's review of Alex's oral history:
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As a U.S. Army guard standing atop a building on the Rhine River as World War II was winding down, Alex Zucker decided he would become a physicist. "I had been in college before studying chemical engineering, and I was pretty sure I didn't want to be a chemical engineer," Zucker told Steve Stow in a 2003 oral history interview.

Zucker's decision came before he knew about nuclear fission and the U.S. development of the atomic bomb. But the detonation of two atomic bombs in August 1945 "reinforced my interest in physics," he recalled.

Zucker started out as a nuclear physicist in 1950 at Oak Ridge National Laboratory, verified that explosions of hydrogen bombs would not set the atmosphere on fire, built a cyclotron that opened up a new field of physics and headed two different directorates. In 1988 he served as acting director of ORNL after Herman Postma retired and before Alvin Trivelpiece was hired.

A native of Croatia, Zucker migrated to the United States with his parents, earned a B.S. degree from the University of Vermont, served in the U.S. Army and earned a Ph.D. degree in nuclear physics from Yale University. Then he came to Oak Ridge.

He was attracted to ORNL by its nuclear reactor reputation, scientists such as Art Snell and P. R. Bell and the promise of a new cyclotron, a device that uses an alternating electric field to accelerate atomic and subatomic particles flowing in a circle in a magnetic field.

Zucker did not plan initially to work in Oak Ridge more than five years. "I really stayed because I thought the opportunities for research were wonderful," he said. "You had a lot of freedom. You could do things you wanted to do. You had great equipment. I didn't know of any better place."

And he later met his future wife, Joan-Ellen, whose parents moved in 1944 from the Northeast to Oak Ridge. She was 12 at the time and attended Oak Ridge schools. The two became leaders of the Oak Ridge Civic Music Association.

When Zucker first went to work on the 86-inch cyclotron, it was not yet running, so he was told to read books. He was ready to quit when he was asked to do research to address a question of concern to Edward Teller, Robert Oppenheimer, Arthur Compton and Hans Bethe: Could detonation of a powerful hydrogen bomb ignite the atmosphere?

"A possible atmosphere ignition might result from a nuclear reaction in which two nitrogen nuclei fuse and transmute into a carbon nucleus and an oxygen nucleus," he explained. (The nitrogen nucleus has 14 protons, carbon has 12 and oxygen has 16.) "That reaction liberates 10 million electron volts – an awful lot of heat. If the atomic bomb is hot enough, the chain reaction might heat up other nitrogen nuclei in the air, causing the whole atmosphere to blow up!"

Zucker's first job was to develop an ion source – a source of nitrogen ions that each had three positive charges through removal of three electrons. He used a Y-12 calutron as a mass spectrometer and built a graphite ion source. Then Alvin Weinberg, ORNL research director,

challenged the electronuclear division to build a cyclotron to accelerate the nitrogen ions from Zucker's source to about 25 million electron volts.

Bob Livingston asked Zucker to build what became the 63-inch cyclotron because he had worked on a cyclotron at Yale and understood the workings of its parts. So, Zucker assembled a team that scrounged parts from a calutron and together they accomplished this mission.

"It was the first cyclotron built to accelerate heavy ions," he told Stow. "It was the world's first heavy-ion machine. Harry Reynolds and I measured the nitrogen-nitrogen cross-section and proved that the atmospheric fire was not going to happen (confirming the results of Bethe's calculations). Then we were on our own, so we used the nitrogen beam accelerated to 25 MeV to do nuclear physics, to see what happens when two heavy nuclei collide."

In 1971 Zucker was appointed director of the Environmental Science Studies Board in the environmental program of the National Academy of Sciences. While in Washington, D.C., he won funding for construction of a large tandem accelerator at ORNL.

In 1972 the Zuckers returned to Oak Ridge, and he was named director of the ORNL National Heavy Ion Laboratory, which underwent construction in 1974 and was later named the Holifield Heavy Ion Research Facility. During the year Alvin Weinberg left ORNL as director, and Art Snell retired from his position as associate laboratory director for the physical sciences, a job that Zucker was given.

"After about a year, I decided I couldn't do both jobs," he said. So, Jim Ball was named director of the accelerator project. A few years later, Zucker became associate lab director of engineering technology sciences. He later counted 400 bright, active ORNL employees that he knew from his work in research and management.

"I found that being a manager is a lot easier than being a physicist," Zucker said. "The laws of physics don't change, but the frontier of your science changes obviously because you're pushing on it, too."

He suggested the idea for the High Temperature Materials Laboratory in 1975 after the first energy crisis when low-temperature materials labs were being built. Since more energy is used from fuel in engines operating at higher temperatures, it made sense to identify or modify materials to enable these engines to run longer.

"I met with Don Stevens, the head of the government's materials program in basic energy sciences, on a park bench at the Wardman Park Hotel, where the American Physical Society had its April meeting," Zucker said. Stevens suggested that Zucker and his colleagues write a proposal. HTML was conceived, and in the 1990s the new building gave ORNL's materials science program new visibility and attracted many sponsors and customers.

As acting director of ORNL in 1988, Zucker's biggest challenge was keeping open the High Flux Isotope Reactor, which started up in 1966. "I spent a lot of my time keeping the wolves away from the door," he said. "There were many people in various parts of the Department of Energy who wanted to shut it down for reasons I never learned."

Today HFIR remains ORNL's permanent research reactor, medical isotope production center and reactor-based neutron science research tool, as well as a key part of the lab's materials research program.

"I think we all do science because we think it's going to benefit humanity by enhancing our knowledge of the world around us," Zucker said. "And then, there are other benefits that have to do with the economy, health and so on. Science is hard to do."

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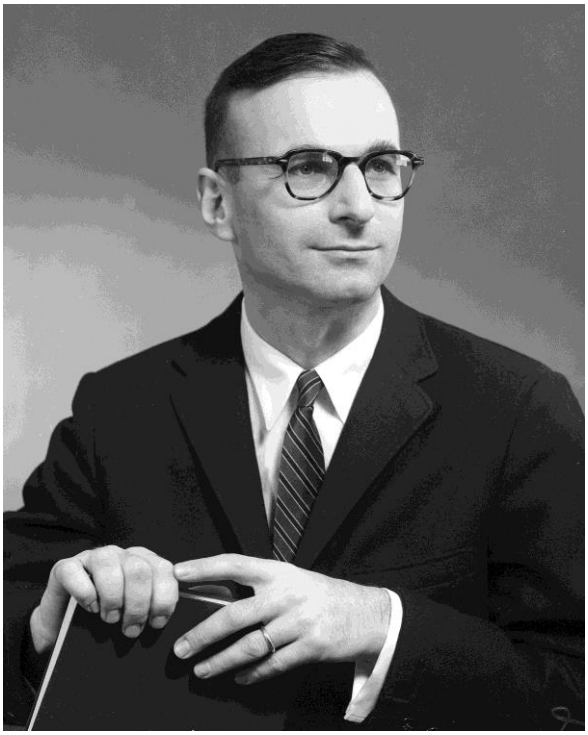
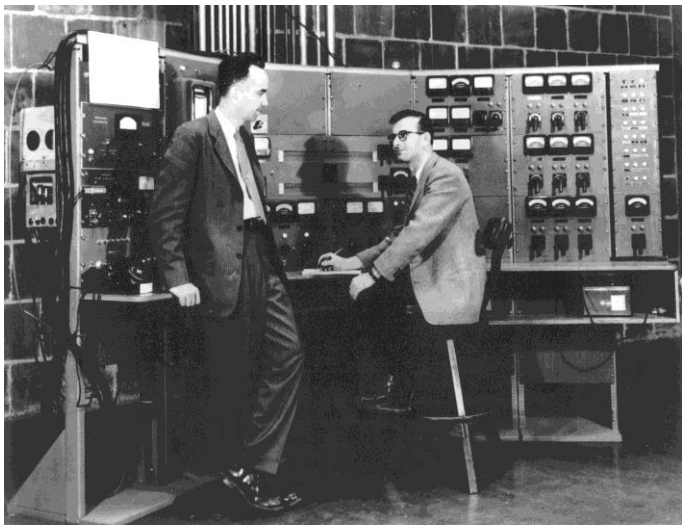
But for an American soldier in Germany near the end of World War II, science seemed exciting, too.



A young Alex Zucker who came to Oak Ridge in 1950



Bob Livingston and Alex Zucker who worked together in the early years

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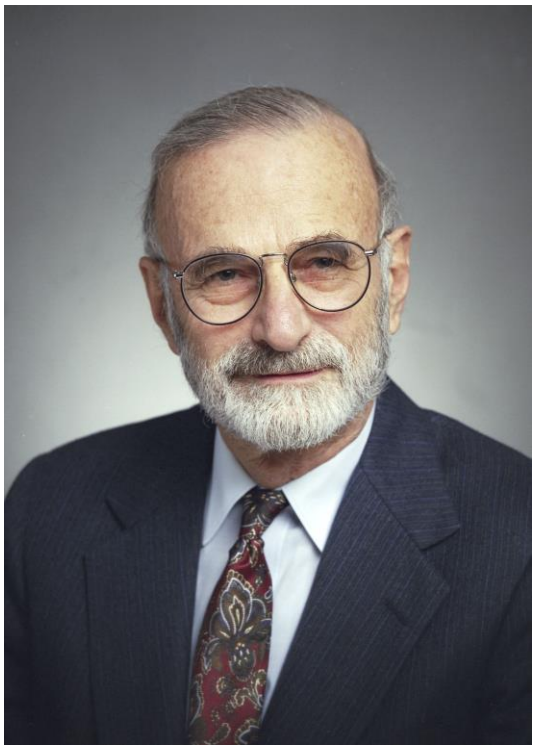
Standing left to right, Bill Madia, Alvin Weinberg, Alex Zucker and seated, Al Trivelpiece, Herman Postma



Alex Zucker in 1992