

# Oak Ridge National Laboratory's Miles Leverett: pioneering reactor designer

(As published in The Oak Ridger's Historically Speaking column on February 22, 2016)

Continuing with Carolyn Krause's edited version of Bill Yee's research on Miles Leverett:

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Bill Yee presents us with his second of two articles on Miles Leverett's contributions to the testing of an atomic weapon designed at Los Alamos, the design of the Materials Testing Reactor at Oak Ridge, and the design and testing of a reactor for the Air Force's futile project of developing a nuclear-powered aircraft. From this project came ORNL's molten-salt technology and other research programs.

In early 1945, J. Robert Oppenheimer, director of the Los Alamos laboratory, asked Clinton Labs in Oak Ridge to isolate radioactive barium-140 from spent uranium slugs after their removal from the Graphite Reactor. Two truck drivers drove the barium in a lead pig some 1500 miles to Los Alamos, where radioactive lanthanum (RaLa), which has a short half-life of 41 hours, was extracted.

RaLa, which emits gamma rays, was needed during and after the Manhattan Project, from 1944 to 1956, to simulate the behavior of plutonium inside a metal sphere when compressed by explosives. This study was considered the single most important experiment for determining the final implosion design for a plutonium bomb (the earlier gun-type design worked only for uranium bombs).

Within five months of the original request, the Technical Division under Miles Leverett developed the processing technology and converted an existing facility to produce the first quantities of barium-140 for Los Alamos National Laboratory.

In 1949, increased demand at Los Alamos for quantities of RaLa led to the design and construction of a larger facility at Oak Ridge to separate barium-140 from spent uranium slugs. So the Graphite Reactor was operated at higher power. A negative result was an accidental release to the environment of radioactive iodine-131 on April 29, 1954.

In 1943, when personnel from the University of Chicago were transferred to Oak Ridge, Eugene Wigner envisioned peaceful uses for atomic energy, such as the production of radioisotopes for nuclear medicine and steam for power generation. Wigner, who became research director of Clinton Laboratories in Oak Ridge in 1946-47, won a Nobel Prize in physics in 1963.

Specifically, Wigner proposed building a reactor with high neutron flux for studies of the effects of radiation on candidate reactor materials for future nuclear power plants.

From the beginning, the Technical Division under Leverett expended considerable effort to design a Materials Testing Reactor (MTR) that would have 1,000 times the neutron flux – number of neutrons per square inch (of the target) per second -- of the Graphite Reactor. The long-term effort involved up to 60 persons and lasted over six years.

According to Alvin Weinberg's "The First Nuclear Era," Leverett and Lothar Nordheim, head of the Physics Division, settled on a reactor design "fueled with highly enriched uranium-235, cooled with ordinary water, and moderated with heavy water." Wigner eliminated the heavy water, added a beryllium reflector and redesigned the fuel elements with curved aluminum plates, instead of the less stiff, flat, parallel ones. (In 1946 Leverett and Nordheim also led the first analysis of the consequences of a nuclear reactor accident.)

The MTR project that originated at ORNL was moved to the much more remote National Reactor Test Station in Idaho Falls. The MTR was approved for construction in 1954 under the direction of Argonne National Laboratory, where the Atomic Energy Commission had decided in 1948 to concentrate all reactor work. With no reactor work defined for Leverett in Oak Ridge, he returned to his previous job at Humble Oil in Houston.

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Noting that Leverett headed the MTR design team at ORNL, Weinberg wrote in 1994, "Oak Ridge's most influential contribution to reactor technology turned out to be the development and prototyping of the MTR and its many variants."

However, Leverett soon became involved in the nuclear business again. The Air Force, well aware that the Navy was building nuclear-powered ships and submarines, was pushing for nuclear-powered airplanes. In 1949, Leverett became the technical director of Fairchild Aircraft, which was managing the Air Force's nuclear energy for the propulsion of aircraft (NEPA) project, started in 1946. He returned to Oak Ridge, where Fairchild had facilities in the S-50 area, about 10 miles from ORNL.

At that point, Leverett, who was the scientific leader of the NEPA project, actively engaged Research Director Alvin Weinberg and ORNL staff in discussions that eventually led to a large, AEC-funded program. It enabled ORNL researchers to work on the Air Force's nuclear-powered aircraft project. By 1951 ORNL became responsible for the nuclear phases of the Air Force's newly designated Aircraft Nuclear Project (ANP), essentially sharing reactor responsibilities with Argonne National Laboratory.

The advantage of the ANP concept: The aircraft could fly around the world without refueling and drop bombs. The drawbacks: the reactor shielding needed to protect the flight crew from radiation might be too heavy for the aircraft to fly, and a possible crash could release unacceptable levels of radiation.

The Air Force replaced Fairchild with a number of contractors involved in two competing nuclear engine projects, one managed by General Electric and the other, by Pratt and Whitney. Leverett joined GE's program as the manager of development laboratories and relocated to Cincinnati.

During the 10-year program, the number of employees in the GE engineering section (laboratory and design) increased to about 900. Then, in 1961, President Kennedy canceled the ANP project largely because of advances in missile technology and Congressional concerns over the possibility of a hazardous plane crash.

However, new programs grew out of the ANP project at ORNL, including materials research, reactor controls and computing and the development of the molten-salt reactor and thermal breeder.

Leverett stayed with GE, relocated to San Francisco and retired in 1976. He is remembered as a pioneer in organizing the nuclear engineering profession. He chaired the Nuclear Engineering Committee of the American Institute of Chemical Engineers after World War II and served as the sixth president of the American Nuclear Society in 1960-61.

In 1984, Leverett was elected to the National Academy of Engineering for his "pioneering contributions to nuclear reactor designs and for a broad range of contributions to the enhancement of safety in the nuclear industry."

Miles Leverett died in 2001 at the age of 91.

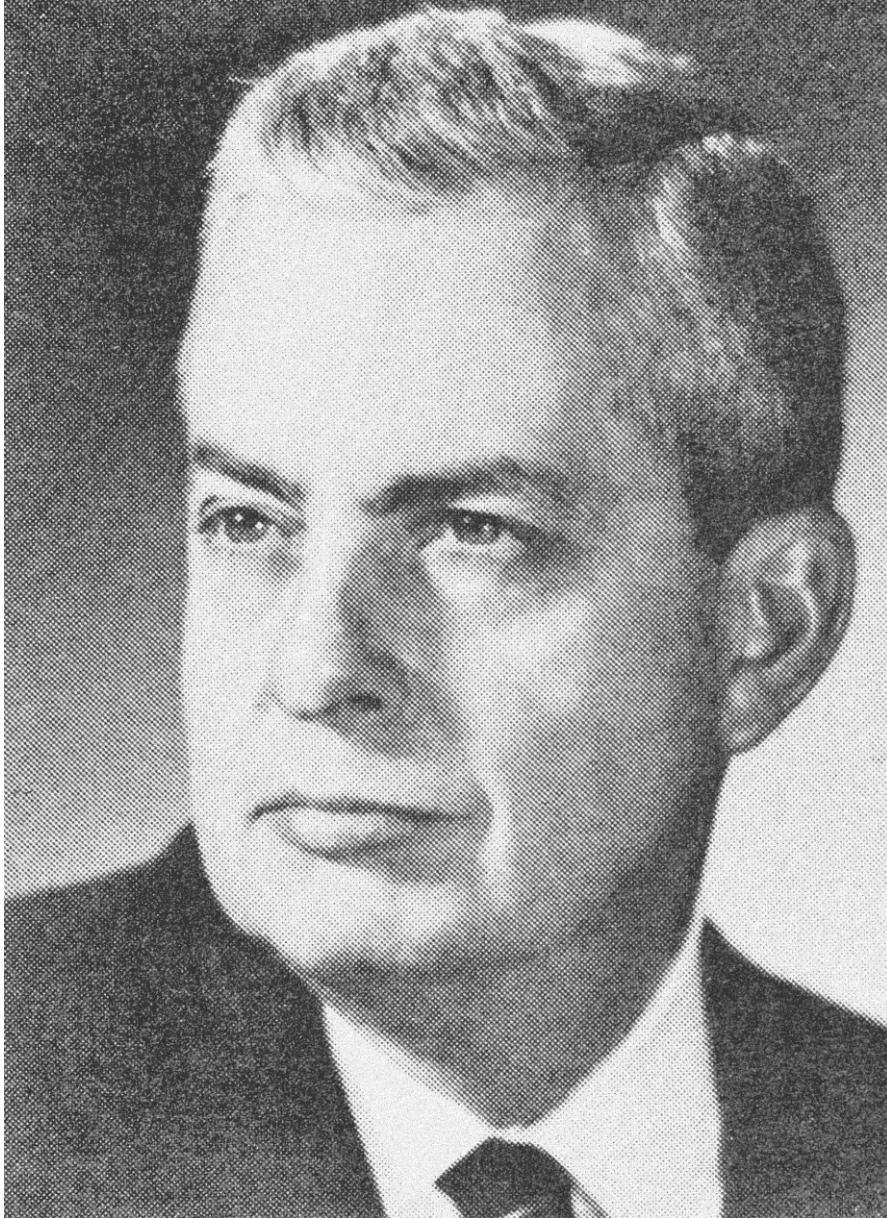
In the fall 1976 issue of the ORNL Review, Leverett recalled a memorable experience arising from an endless, heated discussion on how to design the MTR to satisfy the needs of the technical people planning to perform experiments there. A design engineer and a group of biologists tried to agree on the correct size of holes needed to study the effects of radiation on various animals, ranging from mice, rats, and rabbits to goats and swine. Finally, the exasperated engineer declared, "I have decided. We'll make the hole big enough for a donkey and call it by its rightful name."

Indeed, Leverett was a pioneer who helped shape the destiny of ORNL as a world-class energy research, science and technology institution.

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Thanks goes to Bill Yee and Carolyn Krause for an excellent Historically Speaking series. Don Miller is working on a brief history of The Graphite Reactor from his perspective as a member of the Oak Ridge National Laboratory's Instruments and Controls Division. You will enjoy that article in Historically Speaking in a couple of weeks.



Miles Leverett in his later years at the Oak Ridge National Laboratory