

# ORNL, ORAU play role in cancer detection & treatment

(As published in The Oak Ridger's Historically Speaking column on May 3, 2017)

Carolyn Krause shares notes from a recent talk by Jim Campbell:

In the history of cancer research, diagnosis and treatment in the United States, Oak Ridge National Laboratory, and Oak Ridge Associated Universities played a significant role. So said Jim Campbell, president of East Tennessee Economic Council (ETEC) and fellow of the Howard Baker Center for Public Policy, in a recent talk to Friends of Oak Ridge National Laboratory.

A look at Oak Ridge's role over time in nuclear medicine research, said Campbell, a former editor of the Oak Ridger, is indicative of how over time federal investments in research and development, coupled with university and private sector partnerships, can make a huge impact on a local economy.

Campbell quoted Howard Baker Sr., former U.S. congressman who represented Oak Ridge at the time of the Manhattan Project, who said, "Oak Ridge is more than a city in Tennessee and more than a city in the United States. It's a world-renowned place for scientific excellence, love of freedom, and scientific genius."

Oak Ridge started on the path of creating radiopharmaceuticals when Waldo Cohn came to Oak Ridge in 1944. Cohn, a biochemist and medical doctor, had earned an MD. at Harvard University and was working at Massachusetts General Hospital when recruited into the war effort. He became interested in using ion-exchange chromatography to separate radioisotopes from spent uranium slugs at the Graphite Reactor at ORNL.

In 1945, soon after the war ended, Cohn got permission to submit an article that was published in Science magazine. Titled "Separation of Biochemically Important Substances by Ion-exchange Chromatography," the article included a catalog of radioactive materials that Cohn could make in the Graphite Reactor that might have uses in diagnosing and treating cancer.

On August 2, 1946, Eugene Wigner, Clinton's co-director, stood in front of the Graphite Reactor face and presented a small container of carbon-14 to the director of the Barnard Free Skin and Cancer Hospital of St. Louis. Wigner's presentation marked the beginning of the peacetime uses of atomic energy.

Massachusetts General Hospital, Campbell said, successfully used iodine-137 from the Graphite Reactor to treat thyroid cancers in 1946. The achievement was published in a paper in the Journal of American Medicine. The New York Post printed the news with the sensational headline "Cancer cure in the fiery canyons of death in Oak Ridge."

In the first year alone, the Graphite Reactor produced more than 1,000 shipments of radioisotopes, mostly of iodine-131, phosphorus-32 and carbon-14. Over the years, thousands of shipments left Oak Ridge, destined for use in research laboratories and medical centers.

Radioisotopes of carbon, cesium, cobalt and many other elements have been used in cancer therapy. Technetium-99 has a multitude of uses in diagnostic imaging.

In 1949, Campbell said, the Atomic Energy Commission recruited Illinois-based Abbott Laboratories to set up a lab near the Oak Ridge hospital to make radiopharmaceuticals for cancer diagnosis or treatment from the radioisotopes the company obtained from the Graphite Reactor.

Three Abbott Laboratories' photos on the web show the Graphite Reactor face, a lab with packaged radiopharmaceuticals and a man loading radiopharmaceuticals in packages labeled "FRAGILE" into the cargo section of an airplane.

The Oak Ridge Institute of Nuclear Studies (predecessor of Oak Ridge Associated Universities, 1966–present), which William G. Pollard, University of Tennessee physics professor got started in 1946, became involved in cancer research.

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Simply put, to fully realize the capabilities these new materials might have for medicinal purposes, there was a need to develop a workforce. ORINS, working with universities around the nation, helped build the nation's talent base in the subject area.

In 1948 the AEC tasked ORINS with establishing a clinical research program to study the use of radioactive materials in treating and diagnosing diseases. ORINS set up a cancer research hospital and accepted its first patient in 1950.

According to the ORAU website, "Until the hospital closed in the mid-1970s, numerous patients came to the ORINS hospital, hoping to find a cure in the new treatments offered by the newly discovered powers of radiation. The Medical Division that formed around the hospital became a nationwide resource for physicians seeking knowledge in the growing field of nuclear medicine."

UT became involved in cancer research in Oak Ridge with the formation of the UT-AEC Agricultural Research Laboratory, later known as the Comparative Animal Research Laboratory. The initial target of study was the herd of "Alamogordo cattle," which were exposed to the radiation of the Trinity blast in July 1945 in New Mexico, and their descendants.

The exposed cattle were found to be normal except for the gray hairs along their backs that were attributed to "beta burns." Alamogordo cow No. 52, the last survivor of the famous herd, had 16 calves that exhibited healthy growth with no sign of harmful radiation-induced mutations.

In the 1960s the National Institutes of Health sent representatives to Oak Ridge to encourage scientists here to try "to solve cancer." An ORNL team led by Norman Anderson developed the miniature zonal ultracentrifuge in an attempt, Campbell said, "to figure out what happens in cells to cause cancer."

The experiment failed but Anderson's team demonstrated that the zonal ultracentrifuge could purify vaccines, eliminating some negative side effects. The zonal ultracentrifuge was given to Eli Lilly Corp., which uses it to purify the vaccines it sells.

Next, he talked about Terry Douglass and Ronald Nutt, two UT-educated engineers who started working at ORNL. They were at EG&G ORTEC in 1973 when Michael Phelps, developer of positron emission tomography (PET), approached ORTEC about developing the first PET scanner.

In 1983 Douglass, Nutt, Phelps and others launched CTI Molecular Imaging in Knoxville. Douglass was the first president of the company and Nutt succeeded him. By the mid-1990s researchers demonstrated that PET scans could identify tumors much earlier than existing CT scans and determine if they were cancerous.

In 2005 Siemens acquired CTI, which employed 500, for nearly \$1 billion. By 2009, 95 percent of PET scanning focused on cancer detection and treatment planning.

Douglass used his earnings from the Siemens purchase to create the Provision Proton Therapy Center for treating prostate and other cancers, Campbell said. Then Douglass and Joe Mateo founded a company in Blount County, ProNova, to fabricate proton generators for Provision.

In recent years ORNL used its supercomputing capability to conduct data analytics on different forms of cancer using money from President Obama's "cancer moonshot" fund.

Thanks Carolyn and Jim!

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Jim Campbell speaks to Friends of Oak Ridge National Laboratory recently



Abbott Laboratories photo: Interior view of the laboratory producing crude radioisotopes

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Abbott Laboratories photo: Fast air transport and efficient local delivery enable hospitals to obtain radiopharmaceuticals from Abbott Laboratories