

Lee Russell—Oak Ridge's scientific superwoman

(As published in *The Oak Ridger's Historically Speaking* column on October 14, 2013)

In my experience as a historian interviewing individuals over the past several years who have lived the history of Oak Ridge, none have been more exciting for me personally than getting to know Lee Russell. She truly is a "superwoman."

Lee is multitallented, a leader in all her chosen endeavors and yet she is a humble, kind and thoughtful individual, thinking of others always ahead of herself. I have enjoyed creating documentary films with her help and guidance that focus on the history of the Oak Ridge National Laboratory's Biology Division located in Bear Creek Valley at Y-12. I have also appreciated her steadfast efforts over the years to protect wild and scenic rivers and our wilderness areas.

I have had the pleasure to write about Lee and her achievements in the area of environmental awareness and wilderness preservation. She and I discussed her scientific career and she knew I wanted to document that part of her life and career. I am so pleased that Carolyn Krause shared my enthusiasm for documenting the achievements of Lee Russell, Oak Ridge's scientific superwoman! Please enjoy Carolyn's excellent treatment of one of our most famous Oak Ridgers – Lee Russell.

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Few people have completed a Ph.D. dissertation that led to an international rule—one that protects the human embryo in any woman who doesn't yet know she's pregnant.

On her way to becoming Dr. Liane B. Russell, Lee made a discovery at Oak Ridge National Laboratory that influenced the practice of medical doctors worldwide.

Her thesis research goal in 1950 was to compare the effects of X-rays on the genes of two types of cells in mice—the reproductive cells and the cells of the body.

"I had to find just the right number of cells to make my experiment worthwhile," Lee, now 90, said 10 years ago in an oral history interview with Steve Stow. "I irradiated mouse embryos in different stages of development, and I ended up producing baby mice with strange abnormalities, such as misshapen legs, toes fused together or kinky tails."

So, she changed her dissertation topic to the effects of X-radiation on embryos and published her definitive paper in 1952. In the earliest part of pregnancy, X-rays either kill the embryo or it survives as normal. But in the next stage, major malformations are likely to be induced.

"We ended up developing the 14-day rule for humans," Lee said. "X-rays of women capable of having babies should be scheduled 14 days after the menstrual period. The real danger of X-rays to human embryos is to an unsuspected, unknown pregnancy. The idea is to avoid irradiating the really sensitive embryonic stages before a woman knows she's pregnant."

A native of Vienna, Austria, and daughter of a chemist, Lee graduated from high school in England and from Hunter College in New York City. She met her future husband, Bill Russell, at Jackson Laboratory in Bar Harbor, Maine, which she was attending in 1943-44 as a summer school student while still in college.

"Bill's school worked on the principle of giving the students real hands-on experience in experimental work," she said. "I remember first looking down a microscope at a fertilized mouse egg. The total wonder was that this little thing is going to be a whole mouse!"

Following in Bill's footsteps (he was 13 years older), Lee did her doctorate work under Sewell Wright, the same famous genetics professor Bill had at the University of Chicago. Meanwhile, Bill decided to leave Jackson Laboratory because he and his first wife were getting divorced. Bill left the Jackson Laboratory and applied to various universities and what became the Oak Ridge National Laboratory.

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"His stipulation was that he would not accept a job unless I was hired also," she said.

"He wanted me to have a career in science, too. That ruled out quite a few places that had a nepotism rule. But ORNL did not." So, the first husband-and-wife team at ORNL came to Oak Ridge in 1947. [Note: At the time the name of the laboratory was Clinton Laboratories. The name was changed to Oak Ridge National Laboratory in March 1948, see: <http://web.ornl.gov/info/records/history.htm> – Ray]

They were hired by Alexander Hollaender, who was recruited by Clinton Laboratories Research and Development Director, 1946-1947, Eugene Wigner to set up a program to research the genetic and other biological effects of radiation on mice, which are genetically related to humans.

Health effects of radiation were a concern because the Graphite Reactor was the world's first continuous running nuclear reactor and Oak Ridge plants were involved in providing radioactive fuel for the nation's nuclear weapons.

Lee called Hollaender "a true go-getter in the scientific world" who "built up an incredible division that had young, energetic scientists in every area of genetics." He also "had a great talent for outreach. He organized symposia and started scientific societies all over the world."

When Lee was leader of the Biology Division's mammalian genetics section, she hired excellent molecular genetics researchers, preparing the lab for the next revolution in biology—the analyses of mammalian genomes.

At ORNL Lee led the research showing that the Y sex chromosome was responsible for maleness in mammals, including men. "Among the mouse stocks we kept were mice with genetic mutations that occurred spontaneously," she said. "One of those stocks had the first sex-linked mutation ever to be recorded in the mouse.

"In that stock we found that some females that didn't breed according to type had lost one of their two X sex chromosomes. So, we called these mice XO females." Normal female mammals have two X sex chromosomes (XX), but normal males have an X and a Y sex chromosome (XY).

"We found some male mice had color markings only females in that stock should have," Lee continued. "We called them XXY males because they carried two X chromosomes and a Y. It became clear to us that what made a mouse a male was the presence of a Y chromosome."

The Russells discovered that female mice that had an X sex chromosome attached to a non-sex chromosome (translocation) were marked with spots. But when only one X sex chromosome was present, as in the male and XO female mice, the animals were not mottled.

The upshot of this work is that female mammals have two X sex chromosomes but only one is active. "It simply means that maybe women aren't that different from men because both genders have only one X chromosome that's working," Lee quipped.

Interestingly, Lee and Bill both received the prestigious Enrico Fermi award from the Department of Energy and the International Roentgen Medal. Both were elected members of the National Academy of Sciences. Both were named ORNL corporate fellows.

Few scientific couples have been as influential as the Russells none so effective in protecting the health of future children.

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Thanks Carolyn for yet another exceptional document taken from the oral histories in the Oak Ridge Public Library's Center for Oak Ridge Oral Histories COROH

<http://cdm16107.contentdm.oclc.org/cdm/landingpage/collection/p15388coll1>

NEXT: Carolyn will bring us Bill Russell's contributions to genetics, as told by Lee.



Lee Russell as a young scientific researcher at the ORNL Biology Division



Lee Russell as she is recognized for her achievements at her 90th birthday party