Toy engine, radiation, electricity: shocking facts from the early days

(As published in The Oak Ridger's Historically Speaking column on January 28, 2013)

There are a couple of small and unusual artifacts in Oak Ridge that intrigue me. One is the small steam engine featured by Carolyn Krause in this week's *Historically Speaking* column. The other is the *Original U235 Gas Diffusion Model* located in the American Museum of Science and Energy.

Let me say just a bit about that last model as the small steam engine will be covered in Carolyn's discussion of the first electricity produced by a nuclear reactor. This *U-235 Gas Diffusion Model* consists of a small motor, a pump and a small cylindrical apparatus with small copper tubes and a vacuum/pressure gage.

The model is located in the Oak Ridge Room of AMSE, very near a third small intriguing artifact…the "Short Snorter" – a one-dollar bill with autographs on both sides, but that is another story.

A sign placed in the plastic container with the *U-235 Gas Diffusion Model* apparatus tells of its history.

The sign reads, "This original pilot model developed at Columbia University Laboratory was the first device demonstrating the gaseous diffusion method for separating Uranium 235 from U-238. A full scale gaseous diffusion plant (K-25) constructed in Oak Ridge utilized this principle. K-25 was the longest and largest continuous physicochemical process (under one room) in the world."

It is significant to note that as I write this about gaseous diffusion, the last remnant of the actual K-25 Building's North Tower was demolished just days ago, on Wednesday, January 23, 2013. This 44 acre building's footprint will remain, a replica of a small section will be reconstructed and a *K-25 History Center* will be created on the site. This historical K-25 building location will eventually become a part of the Oak Ridge portion of the Manhattan Project National Historical Park.

I think it is important to retain these earliest examples of scientific discovery and to display them and their story for future generations. While not small, the Building 9731 Calutron Magnets are in the same category of being "firsts" and serving as a pilot operation. They exist and are in an excellent preserved state. That building will also eventually become a part of the Manhattan Project National Historical Park at Y-12.

Then there is the Graphite Reactor at the Oak Ridge National Laboratory that is already a National Historical Landmark and too will be eventually included in the Manhattan Project National Historical Park. It is at this Graphite Reactor that Carolyn will bring us another of her intriguing historical articles based on Oral Histories.

Let's enjoy Carolyn's latest unusual historical account featuring the Graphite Reactor.
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Like Rodney Dangerfield, sometimes Oak Ridge doesn't get the respect it deserves.

For example, the age of nuclear-generated electricity really started in Oak Ridge. But most historians don't see it that way.

The Graphite Reactor at Oak Ridge National Laboratory, which was built 70 years ago, is known for many achievements. They range from the production of gram quantities of plutonium and other radioisotopes to the world's first neutron scattering experiments at a reactor.

Many have forgotten that the Graphite Reactor also produced the first nuclear electricity, said Art Rupp in a 2003 oral history interview with Steve Stow. Rupp directed the isotopes program at ORNL.

In 1948 a team of reactor operators and engineers led by Logan Emlet inserted a can containing 10 uranium fuel slugs into a long cylindrical hole in the side of the reactor. Neutrons from the reactor core irradiated the canned fuel, causing it to undergo fission and produce heat.

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The reactor core was connected to a water supply. The resulting water boiling in the can drove a toy steam engine, which in turn, generated enough electric power to illuminate a flashlight bulb.

Mansell Ramsey and Charles Cagle designed the 1/1000th horsepower toy engine on a suggestion by Emlet. The engine is still on display in the public area of the Graphite Reactor.

On December 20, 1951, the Experimental Breeder Reactor-I in Arco, Idaho, produced the first "usable nuclear electricity," according to the historians. EBR-I lit four 200-watt light bulbs. Both EBR-I and the Graphite Reactor are National Historic Landmarks.

Electricity at ORNL in those early years was not always produced on purpose. Fission byproducts separated from spent uranium fuel tend not to lie dormant in storage.

Rupp recalled incidents involving unusually large accumulations in hot cells of radioactive strontium-90 and cobalt-60 at ORNL's Fission Products Pilot Plant. He related that the radioactivity was intense enough in both cases to generate electrical discharges, effects he had never seen before.

Pellets made from chemical compounds of strontium-90 were placed in a ceramic tray. It insulated the pellets from the stainless steel floor and sides of the hot cell, which had a heavy glass window.

"The beta particles that the radioactive strontium gave off are the same as the electrons in an electric cable," Rupp said. "An electrical charge developed between the ceramic holder and the stainless steel chamber, causing bolts of electricity to flash across."

In another incident, Rupp and his colleagues placed lots of radioactive cobalt-60 in a glass cell. The cobalt's gamma rays knocked out electrons from the glass structure, creating disorder.

A colleague took a photo of the cell at night with the room lights turned off.

"When the film was developed, we saw flashes that looked like little discharges of electricity throughout the glass structure," Rupp said.

Like lightning, unintentional electricity can be scary.

Today's standards restrict the amount of a fission product that can be stored in one place. These rules are intended to eliminate shocking discoveries of spontaneous electrical discharges.

"We handled hundreds of thousands of curies of radioactivity of all kinds over 30 years," Rupp said. "As far as I know, ORNL never had a serious accident."

That's another reason why Oak Ridge merits more respect.
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Thanks Carolyn. So again we see an example of Oak Ridge doing something "first" without getting due credit. The difference in lighting a flashlight bulb and four 200 watt light bulbs is merely a function of size and power. Electricity was required to light even the smallest bulb!

I am afraid Oak Ridge's achievements are not always recognized and sometimes fall by the wayside because we don't seem to want to "promote ourselves." A saying that rings true here is, "if it is to be, it is up to me." This might be worth considering when opportunities come our way to point out Oak Ridge's strengths and technological achievements.

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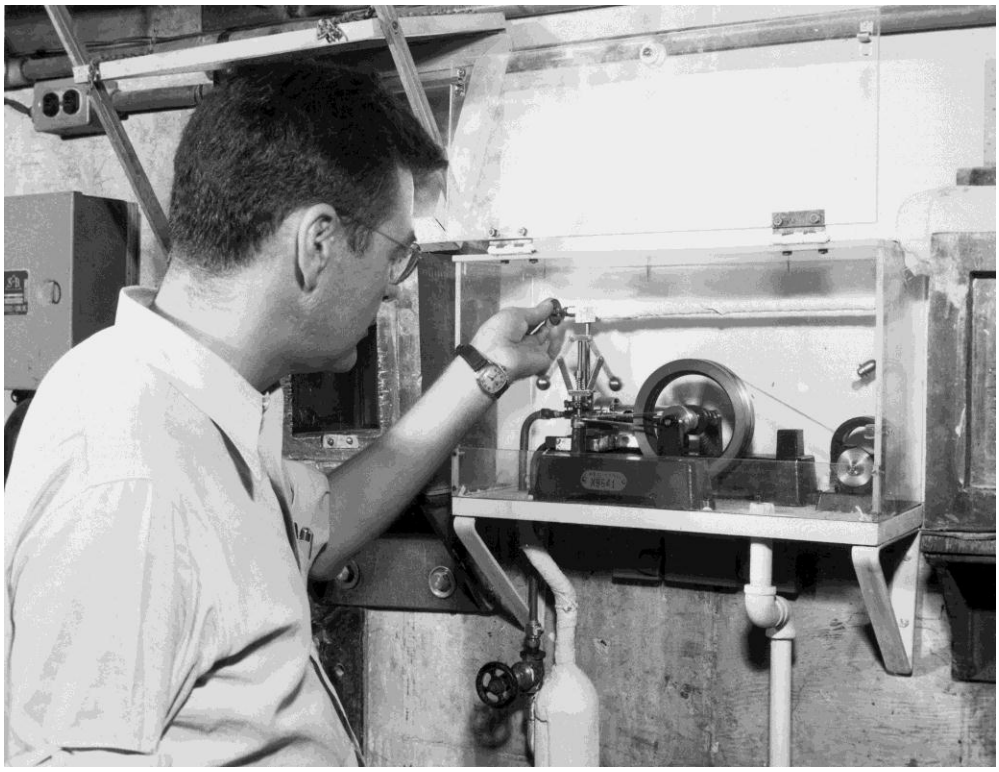
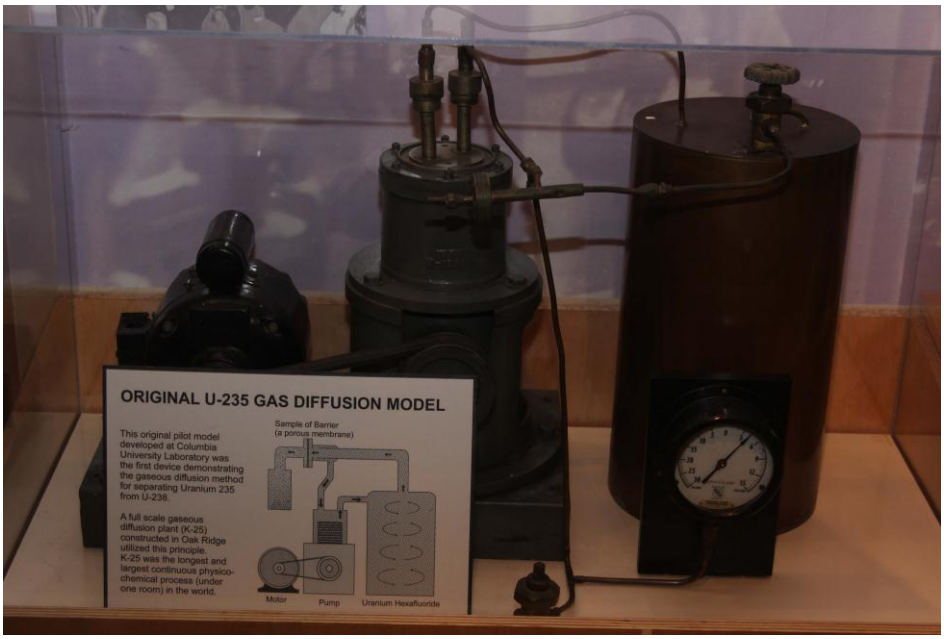


Logan Emlet with toy steam engine which using steam produced by the Graphite Reactor turned a generator to produce the world's first electricity from a nuclear reactor



The world's first gaseous diffusion demonstration model, a unique historical artifact on display at the American Museum of Science and Energy