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today's scientists

Dr. Paul C. Aebersold

Mister Isotope

Atomic Energy Commission

Ex-track star Aebersold is now star "salesman."

ONE day in 1932, a husky young athlete in a Stanford track sweater trotted up to the physics building at the University of California at Berkeley. He strode into one of the laboratories, looked around for a minute, then approached a blond young man who was bending over a square metal box with rods and wires sticking out of it.

"Do you know where I can find Professor Ernest O. Lawrence?" asked the Stanford runner, whose name was Paul Aebersold. "I'm a physics student and I want to ask him some questions about his invention. I think he calls it a cyclotron."

"I'm Professor Lawrence," said the youthful scientist. "And if you want to see the cyclotron, this is the main part right here. I'm trying to plug up a leak in the vacuum chamber."

A few minutes later, Paul Aebersold found himself at work, helping to repair a leak in the 8-inch cyclotron—one of the earliest forerunners of the powerful "atom-smashers" which produce man-made radioactive atoms, called *radioisotopes.* He had expected to spend about ten minutes in the lab. He stayed at Berkeley for ten years—first as a graduate student, then as a teacher and research scientist. He was a member of the team of scientists that produced some of the first man-made radioisotopes. He was a pioneer in the medical uses of these isotopes.

During the 28 years since his first meeting with the inventor of the cyclotron, Dr. Aebersold has devoted most of his time to the study of man-made atoms and their uses. Now, as director of the Office of Isotopes Development of the U. S. Atomic Energy Commission, he is the commission's chief "salesman," encouraging the use of radioisotopes in hospitals, industries, agricultural experiment stations, research laboratories and schools. Every year he travels some 50,000 miles telling people about the peacetime uses of radioisotopes—from cancer research to food preservation, from insect killers to packaging gauges.

What are isotopes? They are simply atoms of an element which are like other atoms of the same element in everything but weight. The word *isotope* is made up of two Greek words—*iso* means "same"; *topos* means "place."

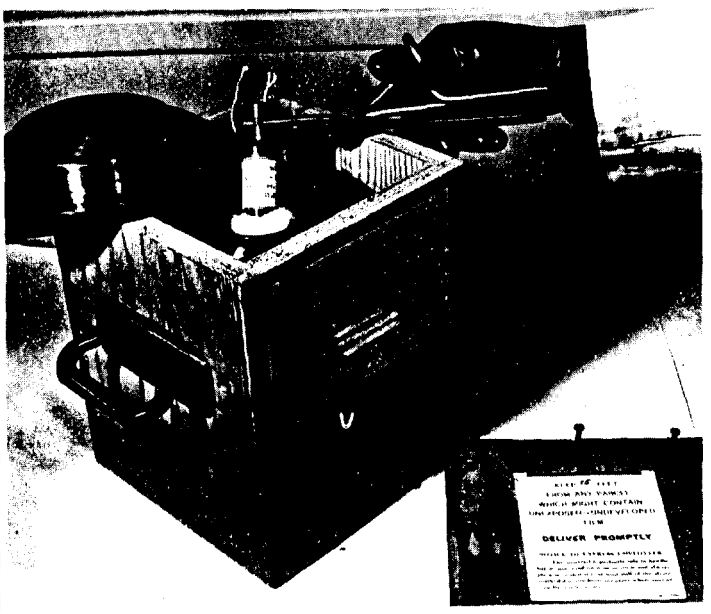
An element and all its isotopes occupy the same place in the periodic table—because all behave alike chemically, though they have different weights.

Some isotopes occur in nature. Others have to be made in the laboratory. Some are stable—others are radioactive. The radioactive ones give off radiation and they disintegrate into different kinds of atoms. Man-made radioactive carbon, for example, disintegrates eventually into stable nitrogen.

Hydrogen isotopes are probably the

Atomic Energy Commission

Before being irradiated in nuclear reactor, the sample to be made radioactive is inserted in an aluminum capsule as shown. Isotopes have many uses in medicine, industry, and research.



National Film Board photo

Radioactive isotope of phosphorus made in Canadian nuclear reactor is being placed in heavy metal container for shipment to scientific researchers. Note the precautions taken.

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easiest to understand. There are three kinds of hydrogen atoms. Scientists call them hydrogen 1, 2, and 3—or protium, deuterium and tritium. The most common hydrogen atoms found in nature are hydrogen 1, which has a weight of approximately one unit of atomic mass. Each protium atom contains one proton in its nucleus with an electron—which has relatively no weight—revolving around it. Deuterium, or hydrogen 2, is twice as heavy—but it also has one proton and one electron, giving it the same chemical behavior as protium. What gives it the extra weight? A *neutron*, added to the proton in the nucleus, weighs the same as the proton, but has no electrical charge and does not act chemically.

Tritium, hydrogen 3, is three times as heavy as hydrogen 1 because it has two neutrons added to the one proton in its nucleus. It is radioactive and disintegrates into a stable isotope of the element helium.

Both hydrogen 1 and 2 are stable and are found in nature. Hydrogen 3 was made in a cyclotron before anybody knew that it existed in a natural state. A few years ago, traces of natural tritium were discovered.

With a few exceptions, most natural isotopes are stable. They don't disintegrate or change with time. Most radioactive ones are made artificially. Some, such as the heavy elements radium and radon, occur naturally. Best known is uranium—which led to the design and operation of the nuclear reactor. The cyclotron can make more *kinds* of isotopes than a reactor, but a reactor can produce, at much smaller cost, *larger quantities* of most of the isotopes that are useful.

Began with Crystal Radio

These isotopes are the full-time concern of Dr. Aebersold. His career in nuclear physics began in 1932, the day he called on Professor Lawrence, but he started thinking about science much earlier. Looking back, Dr. Aebersold remembers an early spark of enthusiasm kindled when he was about ten. "I guess it was science fiction," he said, "that first got me interested in physics. I used to like H. G. Wells and Jules Verne. Then I started reading any science magazines I could find."

When he was 12, young Paul came across an article that told him how to build a crystal radio set. He could hardly wait to assemble all the parts. "I used my own money," he recalls, "so it took a good deal of saving and planning. I'll never forget the thrill of first hearing voices and music on my radio—and thinking of this miraculous transmission through space. I relived this thrill last year when my 16-year-old son, Paul, built his own radio—but his was built with transistors."

By the time he reached college, Paul Aebersold's mind was made up. He was going to be a physicist. As a physics student at Stanford, he maintained an A average, made Phi Beta Kappa in his junior year, and received his B.A. degree, cum laude, in 1932. But it was not his academic record that led him to Berkeley, where he joined the pioneer team of atom smashers. Paul Aebersold was a track star, too.

Mission: To Educate Public

That year, 1932, the Olympic tryouts were being held at Berkeley. Young Aebersold went up from Stanford for the tryouts and decided to take some summer courses at the university. That's how he happened to call on Professor Ernest Lawrence.

At Berkeley Dr. Aebersold helped to build the 27-inch, 60-inch, and 184-inch cyclotrons, producing many of the first man-made isotopes. Convinced that isotopes could be valuable tools in medicine, he aided in the first experiments to determine the effects of nuclear radiation on animals. Then he helped to develop techniques for treating human beings with man-made radioactive materials. He was the first to calculate proper dosages. Dr. Aebersold was responsible for experiments that led to the first program of laboratory safety for protecting scientists from radioactivity.

He is still concerned with safer methods of handling radioactive materials. But he feels that his main mission is to educate the public about what isotopes can do. Every week he makes at least two or three talks to such varied groups as manufacturers, doctors, advertising people, farmers, university professors, and nuclear physicists.

What *can* man-made radioisotopes do that nothing else can? Enough books and pamphlets have been written on the subject to fill a library. The list of Dr. Aebersold's own written works on isotopes fills five closely typewritten pages. Out of the thousands of uses for isotopes that have been described, here is one example of a medical use, in Dr. Aebersold's words:

"Let us assume that we want to find out how rapidly sodium travels through the body and at what rate it is taken into various body fluids and tissues. All we have to do is to take some table salt and irradiate it in the reactor at Oak Ridge. This gives us radioactive sodium. We can give some of this radiosodium to a person by mouth or by vein and then follow its path through the body with a geiger counter or some other radiation instrument.

"The gamma rays from radiosodium are so penetrating that we can detect them just by holding a counter over various areas of the body. This simple procedure allows us to see when blood carrying the radioactive sodium reaches a certain part of the body. In fact, this technique is used for determining the adequacy of blood circulation to . . . the arms and legs."

Avenue to New Knowledge

Using experiments such as the one described by Dr. Aebersold, doctors have learned that, in about 15 seconds, a dose of radiosodium will travel from one arm through the heart, through the lungs and into the other arm. Sixty seconds later, the sodium will be diffused into the tissues and will be excreted from the sweat glands on the opposite arm.

Radioisotopes have become a valuable product. The first shipment of man-made atoms for industrial use was made in 1946, when Dr. Aebersold was at Oak Ridge as director of the commission's Isotopes Division. Since then, 135,000 shipments have been made—valued at \$19,000,000 ($\$1.9 \times 10^7$).

Nineteen million dollars sounds like a lot of money, but if industry and medicine had done the same jobs with natural radioisotopes, the cost would have been many times greater. A million grams of radium, needed to produce this same amount of radioactivity, would cost \$20,000,000,000 ($\$2 \times 10^{10}$).

"Some isotopes, such as U-235, are a valuable source of power," Dr. Aebersold said at a recent press conference. "But isotopes in general are far more valuable through their power to gain new knowledge."

—Barbara Land

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