U of A's underground radiation laboratory

Experiments range from particle physics to radiation food science

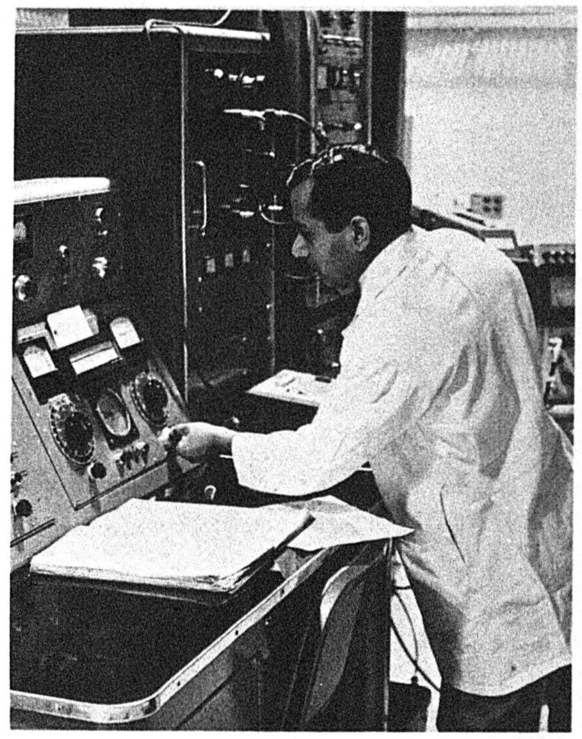
If you dig a hole in the patio to the east of the chemistry building, you must go through five feet of dirt and three feet of solid concrete. You will now be in the U of A's radiation laboratory.

There are easier ways of getting in, of course. One entrance is by a key-operated elevator in the chemistry building. The other entrance is through a tunnel at the north end of the chemistry building basement.

The radiation lab is perhaps the least known lab on campus. Built in the summer of 1964, the underground laboratory houses apparatus for experiments ranging from particle physics to radiation food science.

There are two major radiation sources in the lab. One is a Van de Graff particle accelerator and the other is a cobalt-60 'bomb'. The Van de Graff is similar to a larger device which is in the Nuclear Research Centre. Until the U of A's department of physics bought the large six million volt machine in 1964, they used the two million volt machine now in the radiation lab.

Experimental results are taken (left) and strict watch kept on all phases of the operation (right). Safety precautions are strictly observed.



SIMPLE CONVERSION

The Van de Graff was converted to accelerating negatively-charged particles (electrons) from its use by the physicists as a positive ion accelerator. This conversion is relatively simple and involves reversing the polarities of the voltages applied to the particle 'gun' and to the target. The machine was re-converted to positive ions last summer for use by a physicist said Mr. Earl Cairns, the technician in the lab.

The current produced by a Van de Graff is limited by the charge-carrying capacity of the belt. The six-inch belt of the smaller machine means a lower current can be carried by it than by the belt of the larger machine, which is at least twice as wide.

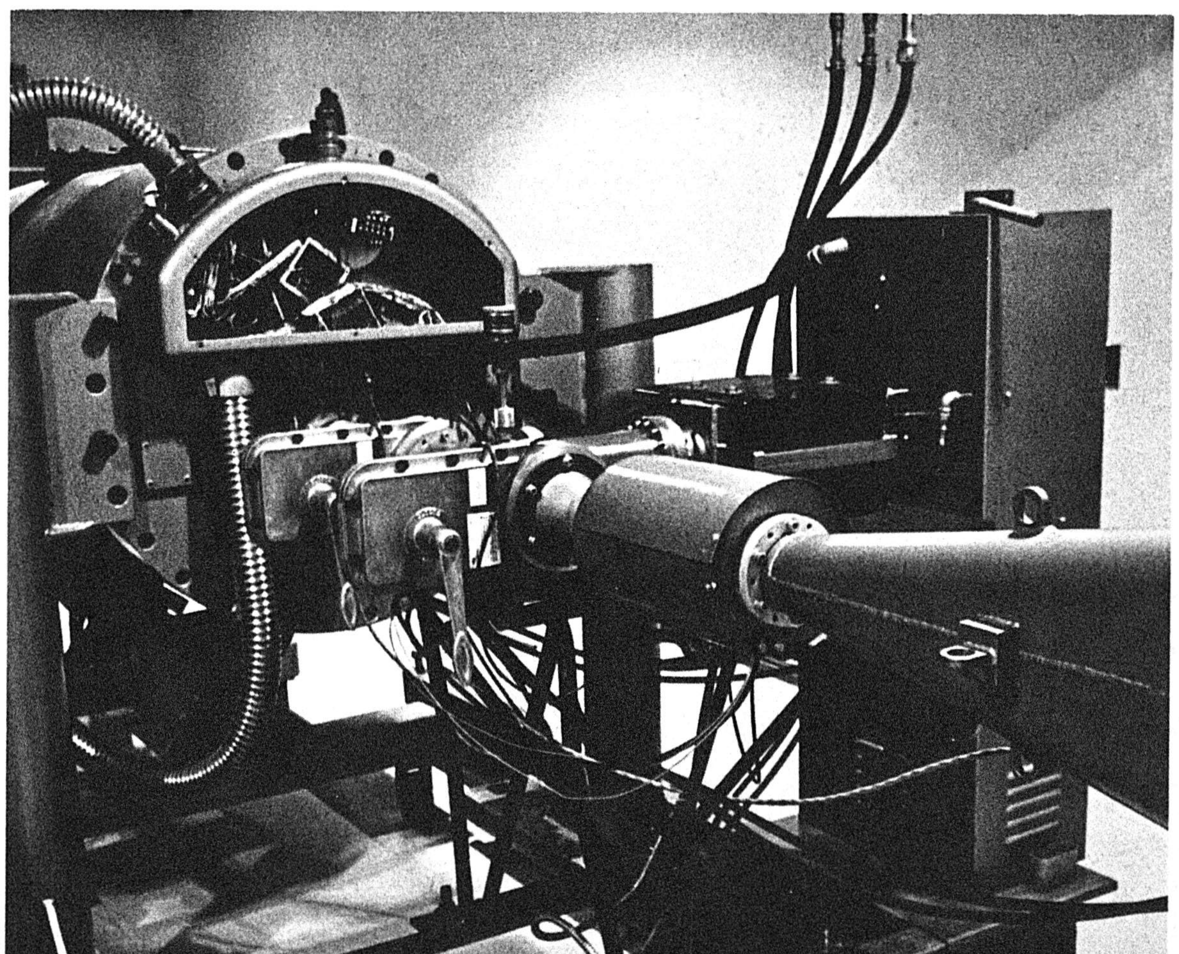
A high rate of current drain is not always desirable because it proportionately lowers the voltage of the machine, reducing the speed of the particles.

PULSED

Like the large machine, the output of the radiation lab accelerator may be pulsed. The current of the machine is limited to 250 millionths of an amp at continuous operation. With 3-100 billionths of a second pulses, Mr. Cairns hopes to raise the current to three amps.

Radiation from accelerating electrons is much more dangerous than that from positive particles. In fact, a person can receive a lethal dose in a minute and a half by standing within three feet of the machine while it is in operation. This radiation consists mainly of X-rays.

Personnel are protected from this radiation by a variety of devices. The concrete walls of the Van de Graff room are four feet thick but the entire room can be surveyed through a window consisting of four feet of water sandwiched between two sheets of glass. The target itself, where the radiation emanates from, is shielded by a ton of lead bricks.



THE VAN DE GRAFF PARTICLE ACCELERATOR
. . . accelerates negatively-charged particles (electrons)

GATE GUARDS

The Van de Graff room is guarded by a gate connected to the computer. If the gate is opened, the accelerator is automatically shut down. There is no residual radiation when the machine is off. Radiation monitors are strategically located throughout this and other rooms.

Most of the accidents damage equipment rather than personnel. If the particle beam is concentrated on a sheet of metal it can sometimes burn through it. Mr. Cairns cited the case of an accident in the Nuclear Research Centre. Someone forgot to turn on the magnet current and the undeflected particle beam burnt through a plastic window, destroying the vacuum and necessitating time-consuming repairs.

He said these accidents were "not uncommon".

One of the experiments done with the accelerator is measuring ion mobilities. Typical of scientific experiments, once the apparatus has been created and set up, collection and evaluation of data is relatively simple.

LIQUID PURIFIED

For this experiment, a liquid is purified and the ions present removed by a variety of techniques in the sample preparation room. The pure liquid is placed between two electrodes placed about 1 centimeter apart, in a glass sample apparatus.

In the accelerator the electron beam is focused on a piece of gold foil. This produces intense X-ray radiation. A thin slice of the rays are selected by an arrangement of two rectangular pieces of steel, placed one-ten thousandth an inch apart. Most of the radiation is absorbed but that which travels through the tiny slit between the steel beams irradiates the sample.

The powerful X-rays ionize a thin slice of the sample between the electrode plates. A charge placed on the electrodes makes the ions move toward either of the electrodes. If the beam is pulsed and the ions are detected when they reach the electrodes the speed of the ions can be calculated, which is the ion mobility of the sample.

EASILY CALCULATED

The number of ions created can be measured and calculated easily. The sample is irradiated continuously and the conductance is measured. From this the number of ions created can be calculated (about one billion per c.c.).

The other radiation source, the cobalt-60 'bomb', has the appearance of an old-fashioned furnace. The radioactive core of an isotope of cobalt is heavily shielded so that the room the 'bomb" is in is completely safe at all times.

A sample to be irradiated is placed in a compartment which is lowered into the core, where the ring-shaped core surrounds the sample. Water is continuously run through the machine to dissipate the heat produced by radioactive decay.

The 'bomb' is rated at 12,300 curies, the unit of radioactivity. Maximum safe dose for an unprotected man is around a thousandth of a curie.

VARIOUS EXPERIMENTS

Experiments being done with the cobalt-60 source include straight radiation chemistry, ordinary experiments done with the help of radiation, and irradiation of milk and cereal grains in order to prevent spoilage.

Although chemists make the most use of the radiation lab facilities there are also physicists, biologists and geneticists in the lab. The geneticists work on the effects of radiation on heredity and reproduction.

One experiment not directly involving radiation is the work being done at high pressures (up to 80,000 pounds per square inch). This pressure is achieved by gas-operated oil pumps. At these pressures, the conductance, viscosity and dielectric properties of liquids are measured. Viscosity is measured by timing the rolling of a ball through the liquid.

The high pressure cells containing the liquids have windows made of sapphire, which can take the high pressure.

The common characteristic of all the equipment in the lab is portability. None of the apparatus is built into the building and much of it is on wheels. This flexibility means experiments can be set up and revised quickly and new equipment brought in.

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