PHYSICS

Atom Power Two Decades Old

Power of the atom, first unleashed 20 years ago, still poses the puzzle of whether it will be used for good of mankind or destructively, Ann Ewing reports.

➤ THE BIRTHPLACE of atomic power, which can save the world with a virtually limitless supply of energy or obliterate it in a planetary holocaust, was in a squash court at the University of Chicago on Dec. 2, 1942.

However, the story of atomic bombs, atomic power plants and hydrogen bombs (which may someday be tamed for peaceful purposes) actually began in 1896. That is when Antoine H. Becquerel discovered radioactive elements, which spontaneously give off X-rays and other powerful radiation.

This fascinating discovery led, with a strong boost from Albert Einstein's new way of looking at the universe around us, in what now seem to have been inevitable steps, to the first self-sustaining atomic pile. The war climate of the 1930's and U.S. entry into World War II served only to greatly accelerate the inevitable.

Uses After World War II

In the 20 years since then, the atom has been used both for destruction and for mankind's welfare. The radioactive elements discovered after 1896 are now man-made in atomic piles by the hundreds of pounds for use in agriculture, industry, medicine and research.

The atom's most promising use, however, is still in the future: as a civilian power source that can compete with conventional fuels—coal, oil and gas—on a cost basis, without Government subsidies. Dr. Glenn T. Seaborg, chairman of the Atomic Energy Commission, has predicted that by 1966 water-reactor plants will be economically competitive with conventional power plants in such areas as New England and California.

Since that first atomic pile in Chicago went "critical" under the leadership of the late Dr. Enrico Fermi, 105 research, test and training reactors of various designs and power levels have gone into operation in the United States out of a total of 198 throughout the world.

For producing heat and power, there are some 122 nuclear reactors in operation or under construction throughout the world, about half belonging to the U.S.

Actually, some of these such as the ones in Greenland and Antarctica are now competitive with conventional power-producing methods, since costs of fuel shipments to these remote locations is so high.

As more and more atomic reactors reach "criticality," when their reactions are self-sustaining, scientists and engineers are considering the use of digital computers to evaluate and eventually to control power production. They would by-pass the human operator and send commands directly to the reactor.

Perhaps the most far-reaching new advance in the use of radioisotopes is the development of electric power directly from the heat given off during the decay of radioactive substances. Instruments aboard earth-circling satellites are thus powered, as are an unmanned weather station near the Arctic Circle, a seismograph device on the Atlantic Ocean floor and a light buoy in the Chesapeake Bay.

The Atomic Energy Commission is also developing nuclear reactors for rocket propulsion of satellites and interplanetary probes. This is known as the ROVER program.

AEC scientists believe that before another 20 years have passed nuclear-propelled rockets will be taking man on expeditions to explore the far reaches of space.

Reactors now in operation on earth range in power from a few watts of thermal energy in small training reactors to the 800-megawatt electric power capacity of a new reactor now nearing completion at Hanford, Wash. In terms of electric power production, this will be the most powerful single reactor in the world.

Nuclear power plants are operating today in at least six countries—Canada, France, West Germany, the Soviet Union, United Kingdom and the United States.

During 1962, the world's first nuclear powered merchant ship, the 22,000-ton NS SAVANNAH, went into operation, visiting ports on the Atlantic and Pacific Coasts.

For defense of the United States and the Free World, nuclear-powered submarines set one record after another in speed, time submerged and maneuverability. Surface nuclear ships also are setting new records. The Army is developing a family of small, transportable units of the type now operating in the Antarctic, Greenland and Alaska.

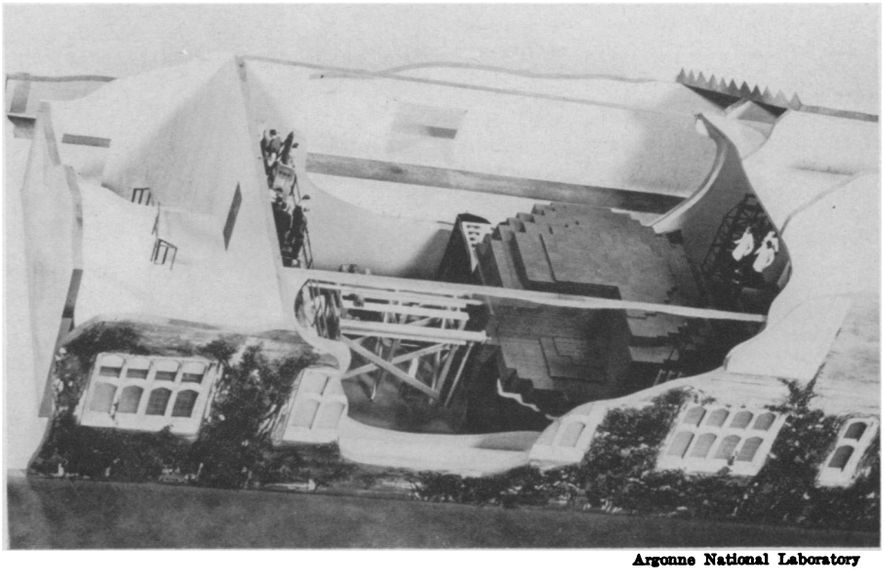
Project PLUTO is the program to demonstrate the feasibility of nuclear ramjet propulsion system for use in strategic missiles. A nuclear ramjet would have the capability for supersonic flight over long distances at low altitudes. The project is a coordinated effort of the AEC and the Air Force.

Tests Continued in 1962

During 1962, both the U.S. and Russia continued tests of atomic and hydrogen weapons with underground and atmospheric explosions.

As part of the program to develop peaceful uses for atomic explosions, a midget thermonuclear device of about 100 kilotons yield was detonated 635 feet underground in the alluvial flats at the northern part of the AEC's Nevada test site. The explosion formed a crater 1,200 feet in diameter and 320 feet deep, moving about seven and a half million cubic yards of earth and rock, with most of the radioactivity trapped underground.

The vast array of accomplishments and advances in man's use of nuclear energy in the past 20 years represents the work of hundreds of nuclear scientists and engineers, and Government, educational and industrial



Argonne National Laboratory

MODEL OF FIRST ATOMIC PILE—One of mankind's most historic steps, the first harnessing of the atom's might, took place in the prosaic surroundings of a squash court, shown here in a realistic artist's conception.

administrators. Their work will be of benefit to the world's billions.

One important feature of the AEC's 20th anniversary celebration of the first atomic pile is the distribution of some 25,000 posters. Of these 22,000 went to the Science Clubs of America throughout the country, and 3,000 to college and public libraries.

Other features will be mostly local in nature, including open houses at AEC research facilities. Members of the late Dr. Fermi's team will receive medallions at a dinner commemorating the achievement.

There are now several multi-nation nuclear organizations active in stimulating peaceful uses of nuclear energy, including the European Atomic Energy Community, or EURATOM, consisting of Belgium, France, West Germany, Italy, Luxembourg and The Netherlands. The U.S. cooperates with EURATOM through an extensive program of assistance in nuclear power development.

Capstone of the Atoms-for-Peace program was the organization of the International Atomic Energy Agency with headquarters in Vienna.

The IAEA was five years old on July 29, 1962, and today 78 countries are members.

Atoms-for-Peace Program

The Atoms-for-Peace program for international cooperation in the nuclear field is now a part of the U.S. foreign policy and assistance. A key feature is the sale by the U.S. of enriched uranium for fuel in research and power reactors abroad, under safeguards to insure against diversion of the material to military use.

One result of the momentous achievement of December 1942 is the rapid development of high-energy nuclear physics and the discovery of some 30 sub-atomic particles that inhabit the nucleus.

Concerning the future development of peaceful thermonuclear power, taming the fusion reactions of hydrogen bombs, most scientists are cautiously hopeful, even though there have not been any important "breakthroughs" in research. Of the four basic methods being tested for magnetically confining the plasma in which fusion takes place, the "picket fence" method based on cusped geometry appears the most promising.

Magnetic mirrors, stellarators and the "pinch effect" are among other approaches under investigation, with varying combinations of those four methods being tested around the world.

One encouraging development in the drive for peaceful fusion power is the availability of superconducting magnets, which work at temperatures near absolute zero, or 459.7 degrees below zero Fahrenheit. For their size and weight, superconducting magnets are the most powerful built.

When developed, fusion would provide a virtually inexhaustible power supply, since the world's oceans could be mined for the heavy hydrogen or other lightweight elements necessary for the fusion reactions.

• Science News Letter, 82:322 November 17, 1962

Latest *machine tool* is four-in-one device that combines a 10-inch lathe with a vertical milling machine, drill press and jig borer.