

PHYSICS

New-Type Atom Smasher

The 300 million electron volt synchrotron will eventually enable scientists to fire atomic bullets of one billion electron volts.

➤ A 300 MILLION electron volt synchrotron, the powerful new-type atom-smashing machine based on a revolutionary principle which eventually will enable scientists to fire atomic bullets of one billion electron volts, will be completed at the University of California early next year, Prof. Ernest O. Lawrence, director of the Radiation Laboratory, announced. It is being constructed with the assistance of the Manhattan District.

The synchrotron, combining features of the cyclotron and the betatron with the new principle, will accelerate electrons as projectiles. It is hoped, with the almost incredible new energies, that it will be possible not simply to "smash" the atomic nucleus, but to split the particles—protons and neutrons—which are the basic building blocks of the nucleus.

Since the projectiles themselves will be in the energy ranges of cosmic rays, it will be possible to create these fundamental radiations for close study in the laboratory. Thus scientists will cross into a new unknown of atomic research, a seven-league stride closer to understanding the elemental forces of the universe.

Devised independently by Prof. Edwin M. McMillan, co-discoverer of neptunium, and the Russian scientist, V. Veksler, the synchrotron principle was said by Prof. Lawrence to be as important a development in atom-smashing as was the cyclotron. In a recent letter in *Physical Review*, Veksler said he is supervising construction of a 30 million electron volt synchrotron in Moscow.

This principle is what Prof. McMillan calls the theory of phase stability. It bypasses part of the theory of relativity which imposes limitations on the energies which can be reached in the acceleration of particles. Relativity predicts that as particles reach higher energies their mass increases and they tend to slow down. In the cyclotron this meant that atomic bullets, when they reached very high energies, would fall out of step with the regularly-spaced high-frequency electrical pushes applied to speed them up. Arriving too late at the accelerating point, they would be out of phase and receive no push.

Like a mechanical drill sergeant, the synchrotron will be able to march electrons around a circular orbit an indefinite number of times, keeping the projectiles in perfect step with the high-frequency pushes. This will be done by increasing the magnetic field of the machine's electromagnet as the particles reach higher energies. Thus the increased magnetic force will jerk lagging projectiles up to the acceleration point exactly in time to receive a new push.

Theoretically, there is no limit to the number of times the synchrotron can "call the turn." Practically, the energies achieved will be limited by the strength of the field which can be created by the electromagnet. When the speeding particles reach a certain energy the magnet can no longer exert the necessary force to jerk them up to the acceleration point, and the relativity limitation becomes effective.

In the University of California synchrotron this point will be reached at 300 million electron volts. Prof. McMillan said that he believes present knowledge of electromagnets will permit construction of one which could be used to accelerate electrons to a billion electron volts.

The synchrotron will be doughnut-shaped, hollow in the center. The laminated transformer-steel electromagnet will weigh 135 tons, and its maximum field strength will be 10,000 gauss. The orbit of the acceleration tank between the poles will be one meter. The tank will have one C-shaped accelerating "dee".

The machine will operate up to two million electron volts as a betatron, the sheer force of the magnetic field driving the particles around the tire-shaped tank. At 300 million electron volts the electrons will have circled the tank 200,000 times before emerging as a beam, and the particles will weigh 600 times as much as they do at rest.

By comparison, Prof. Lawrence's new cyclotron has a magnet weighing 400 tons, and an accelerating tank 184 inches in diameter.

Prof. McMillan's theory of phase stability will be applied to this huge machine to achieve higher energies with



COUNTS BIKINI FISH—To get an accurate and scientific survey of fish in the Bikini Lagoon, Vernon E. Brock, director of Fish and Game for the Territory of Hawaii (right) and Ensign Richard Cron, Houston, Texas, use an undersea camera. Some species never before classified have been found at Bikini. Joint Army-Navy Task Force One photograph.

heavy particles—protons, deuterons and alpha particles. The application will differ from that in the synchrotron. Instead of altering the magnetic field to keep the particles in step, the frequency of the accelerating electrical impulses will be changed, coming at slightly longer intervals in order to hit the lagging projectiles as they arrive at the acceleration point. This is called frequency modulation. Prof. Lawrence has estimated that the giant cyclotron, which was started prior to the war and designed to accelerate deuterons to 100 million electron volts, will be able to produce deuterons of double this energy as a result of Prof. McMillan's theory.

The Russian, Veksler, published his

theories in Russia before Prof. McMillan's first article on the subject was printed in the *Physical Review* last September. However, with communications what they were under wartime conditions, Veksler's articles were not known to Prof. McMillan until two months after he sent his letter to the *Physical Review*. Prof. McMillan was working at the University of California atomic bomb factory at Los Alamos, N. Mex., when he formulated this theory of phase stability. Prof. Lawrence stated that the Manhattan District has given every encouragement to the development of the synchrotron with the purpose of maintaining the pre-eminence of American fundamental science.

Science News Letter, May 11, 1946

ENGINEERING

Rocket Devices Patented

Nine patents have recently been granted to the late Prof. Robert H. Goddard. A hydro-pneumatically controlled automatic steering apparatus for aircraft is included.

➤ ROCKET DEVICES invented by the late Prof. Robert H. Goddard of Clark University and Roswell, N. Mex., are beginning to be made public through the issuance of U. S. patents. Nine such patents, for which applications were filed during or before the war, have been granted during the past few weeks.

One of them is a design for what might be called a rocket landing-strip to receive, if not space-ships from Mars and Jupiter, at least the ultra-high-speed stratosphere craft which rocket propulsion may make possible. Essentially, this device is really a big tube closed at one end, and with a trumpet-like flare at its open end. The rocket-craft is expected to enter this like a ferry going into its slip; wheels at various points on its circumference help to guide it smoothly. As it passes into the narrower part of the tube it will practically fill it, and will thus act as the piston in a grand-scale pneumatic shock absorber. As its nose reaches the closed end it will contact a final checking device built on the principle of the recoil cylinder under an artillery piece.

Several of the patents cover variations in the Goddard fuel system, which is based on the use of the combustion of gasoline or other hydrocarbon fuel with liquid oxygen. A tank of liquid nitrogen is also carried, to fill the empty space created in the gasoline tank as the latter is used up.

Prof. Goddard was especially concerned with keeping the temperature of the combustion chamber within manageable limits. In several of his designs, this is done by wrapping around it a helical coil from the liquid nitrogen tank. The liquid nitrogen thus heated passed as a gas under pressure to the gasoline tank. Some of the combustion chambers revolve as the fuel burns; ribs or baffle-plates within them mix the fuel and oxygen more thoroughly. Another design calls for a triple-walled combustion chamber.

Included among the nine patents are an exploratory research rocket, to be propelled by a series of explosive charges, automatically fed from a tubular magazine and set off in series; also a hydro-pneumatically controlled automatic steering apparatus for aircraft.

The patents are numbered, inclusively, 2,395,113—2,395,114, 2,395,403—2,395,406 and 2,396,566—2,396,568. Half-rights in all patents are assigned to the Guggenheim Foundation.

Science News Letter, May 11, 1946

MEDICINE

\$5,000 Awarded for Virus Research Technic

➤ DR. ERNEST W. GOODPASTURE, professor of pathology and dean of the School of Medicine of Vanderbilt University, Nashville, Tenn., will receive the \$5,000 Passano Foundation Award on

May 15 for his discovery of a method of growing disease viruses on chick embryos.

The vaccine which has protected American troops against typhus fever, and improved defenses against influenza, smallpox, yellow fever, fowlpox and rinderpest through vaccines are among the results of Dr. Goodpasture's discovery.

The Passano Foundation was established in 1944, by the Williams and Wilkins Company, medical publishers, "to aid in any possible way the advancement of medical research," especially research promising clinical application.

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