

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.