EDUCATION IN NUCLEAR ENGINEERING

By CHARLES STICKELS, '55 (Chem-Met)

Ann Arbor—A Nuclear Engineering program leading to a Master of Science of Engineering (Nuclear) degree has been started at Michigan. The program consists of nineteen hours from the eight courses offered plus electives which fulfill the requirements for the master's degree and which meet with the approval of the Committee on Nuclear Engineering. This Committee is composed of representatives from various engineering fields and administers the program. Associate Professor H. J. Gomberg (E.E.) is chairman. The other members of the Committee are Assistant Professor Borchardt (C.E.); Associate Professor Brownell (Chem.E.); Assistant Professor Kerr (E.E.); Professor Nichols (Aero); Professor Schwartz (Mech.).

The requirements for the course are a bachelor's degree in any recognized field of engineering including Engineering Physics and approval by the committee. Some of the basic courses may be taken in a student's senior year.

Arrangements are being made with Argonne National Laboratory and Oak Ridge National Laboratory so that interested students can obtain practical experience working with nuclear reactors. It is expected, however, that the University's application for a reactor will soon be granted by the Atomic Energy Commission and in a few years students will be able to work with a reactor here in Ann Arbor.

So far two men have received degrees in the program. This year there are eight men enrolled in the program and a total of thirty taking various courses in the program. The courses in the program are: Introduction to Nuclear Engineering; Measurement in Nuclear Engineering; Procedure and Design in Handling of Radioactive Material; Interaction of Radiation and Matter; Wave Mechanics in Nuclear Engineering; Theory of Nuclear Reactors; Practice of Nuclear Engineering; Thesis Problems. These courses are designed to give a practical base in Nuclear Engineering from which either peacetime or wartime application can be made.

In a speech before a meeting of electrical engineers in New York last month Associate Professor Gomberg said, "The lifeblood of any such new development [industrial use of atomic power] is men trained in the new discipline and thinking necessary to carry the new field forward. Yet today, there is one major source of such men—the Oak Ridge School of Reactor Technology. The source of almost all information needed in the nuclear power field is the Atomic Energy Commission." In the same speech he also said, "the training of new men in an atmosphere of emphasis on industrial application as opposed to exclusive government utilization must be brought into being rapidly. Industry must begin to move so as to take up the responsibility for this new development and to convince the young men that the outline for their talents is broader than governmental service." This need for nuclear research to be done by someone other than the government lest all our nuclear research be put into military uses is one of the main reasons why the University is offering this program. Because of this concentration to date in wartime applcation of nuclear power, there are many opportunities for men in the peacetime applications.

In 1920 a great war had just ended; a war that had brought hardship and suffering abroad, but a war that had brought aviation to the United States. Aviation meant the future for young men of the '20's, and their interest and the seeming limitless horizons of aviation spurred industry and nourished the growth of aeronautical curricula at schools and universities throughout the United States. The tremendous accomplishments of aviation through these last 35 years are a tribute to the vision and enthusiasm of these young men.

Now, 30 years later we can see about us a situation closely paralleling the development of aviation in the '20's. This most recent great war has bequeathed to this generation atomic energy, and to today's young men this is the future; to the University and to industry of today goes the task of duplicating aviation's feats.

But, the young man of today cannot like his father in the '20's take an engineering degree and then begin lending a hand in his developing field. For a prospective nuclear engineer an engineering degree is only the beginning; he must acquire a solid background in physics, chemistry, electronics and mathematics before he can begin to learn applied nucleonics. For those students whose interests and talents would lead them to nuclear engineering this article is written; I intend it as a review of some of the educational opportunities available here at Michigan and at government institutions (notably, Oak Ridge).

The development of peacetime uses for atomic energy has received considerable impetus on this campus due to the University's Phoenix Project begun shortly after the war. The building of a million dollar nuclear reactor and accompanying research equipment should place this school among the best-equipped in the nation. In keeping with this progress the Engineering College has instituted courses within various departments and has arranged graduate degree programs in nuclear engineering. Almost all of these programs include project work at government laboratories (e.g. Oak Ridge or Argonne National Laboratories) since much of this subject matter is still classified information.

Developments in nucleonics have proceeded in three general directions and the study of each requires a somewhat different approach. First, atomic energy has developed as a tool for scientific and engineering study. The use of radioactive tracers to study the course of chemical reactions is an obvious example. Second, development of radioactive materials has led to studies of how radiation affects its surroundings. The engineering problems of shielding come under this category. And last, atomic energy has developed as a source of immense power. Under this heading falls the development work leading to atomic bombs and the leashing of atomic power through nuclear reactors.

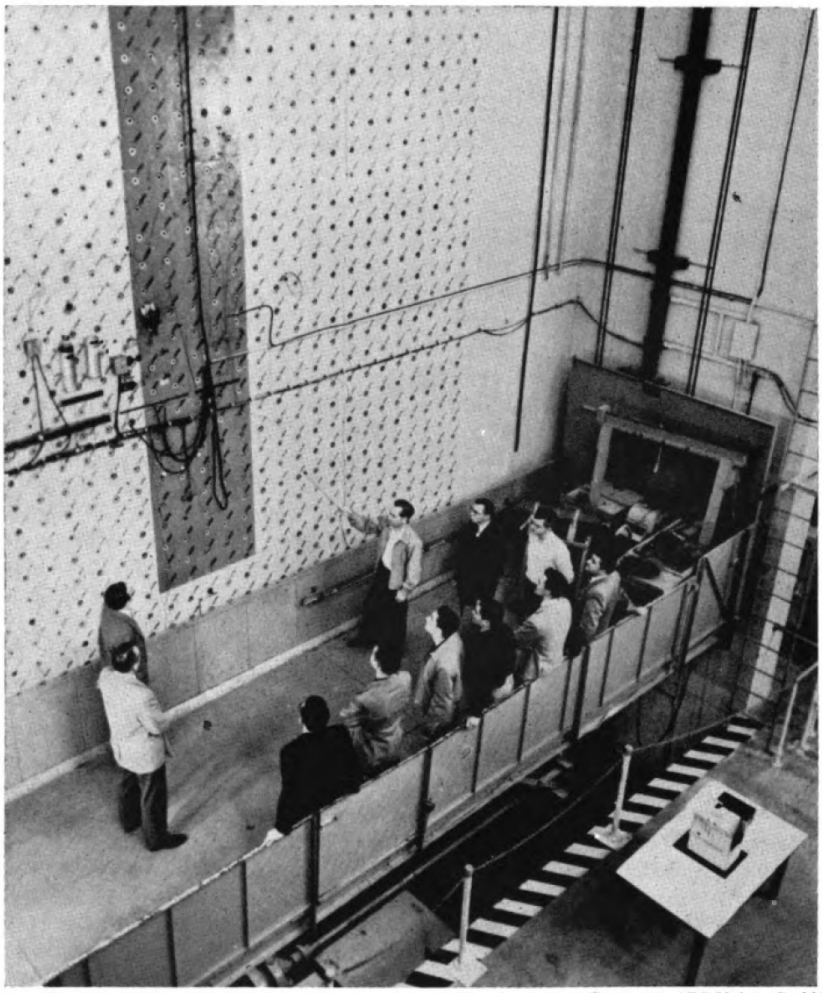
While progress in these first two categories offers opportunities for engineering development that are of undisputed importance, they can, for the most part, be treated within established engineering

fields. For example, the electrical engineer can produce a wide variety of measuring devices dependent upon radiation and the structural engineer should be able to attack shielding problems through methods already established. But this third category, this new source of such tremendous power, cannot be treated adequately within other fields; this is the special meat of the nuclear engineer.

For the young engineer considering education in nucleonics two alternative paths for graduate study seem open; he can obtain his training at the University, or he can attend a government-sponsored school at one of the National Laboratories. However, in reality, to get the best education not either but both paths must be followed. The prospective nuclear engineer must have a sound background in math (differential equations, boundary value problems, and perhaps vector analysis, Fourier series and other more advance topics) and inorganic chemistry, and take courses in atomic physics, nuclear physics, physical chemistry, physical metallurgy, engineering mechanics, fluid dynamics, heat transfer, and electronics. The place to obtain this background is the University.

With this sort of a background the student's education in applied nucleonics can commence, assured of a sound foundation. At present, the best place to learn applied nucleonics is the Oak Ridge School of Reactor Technology (in governmentese, ORSORT). This is a part of the training division of the Oak Ridge National Laboratory which is operated for the Atomic Energy Commission by Carbide and Carbon Chemicals division of Union Carbide. These people give a 50 week training program in reactor technology designed to "provide advanced education in reactor theory and technology to engineers and scientists who will engage directly in reactor research, design, and development."

The curriculum at ORSORT is broken down into several courses: Reactor Analysis (180 hours) deals with the basic theory of the nuclear chain reactor. Reactor Engineering (72 hours) breaks down the reactor system into its constituent engineering problems and employs engineering technique for their solution. Reactor Technology (90 hours) is given in three parts: reactor shielding, reactor control, and reactor feasibility studies. Experimental Reactor Physics (72 hours) provides a background in classical atomic and elementary nuclear phenomena by performing experiments of theoretical importance. Reactor Materials (72 hours) concerns the properties of reactor materials. Reactor Chemistry (72 hours) covers the separation processes related to the operation of nuclear reactors and Reactor Nuclear Physics (45 hours) provides additional background to aid in understanding the nuclear processes occurring in reactors. In addition to this course work, to culminate the session ten to twelve week Reactor Design Problems are attacked by teams of students and a group thesis is prepared.



Courtesy: AEC-Union Carbide

Massive uranium graphite reactor at Oak Ridge.

As of last September ORSORT has 212 alumni most of whom are presently engaged in research and development in the atomic energy program in industrial organizations, the U. S. Atomic Energy Commission, and the National Military Establishment. Among the 43 industrial organizations employing ORSORT alumni are: Allis-Chalmers Manufacturing, Babcock & Wilcox Tube, Bendix Aviation, Boeing, Consolidated Vultee, Pratt & Whitney, and North American Aviation Companies, Westinghouse, G. E., DuPont, Monsanto, Hercules Powder, Metropolitan Edison, Newport News Shipbuilding, and others stretching from one end of the industrial spectrum to the other. This widespread interest among industries of such diverse nature is a clear indication of the almost limitless potential for atomic energy, nuclear reactors, and their many applications. This range shows the scope of nuclear engineering, and the variety of work for the nuclear engineer.

A treatment as brief as this of such an important topic is bound to be inadequate for a person interested in educating himself in applied nucleonics. Unfortunately, I know of no single book or recent magazine article which has dealt with this problem. However, information on an academic program here could undoubtedly be obtained from departmental counselors and information on ORSORT can be obtained by writing

Oak Ridge School of Reactor Technology
Post Office Box P
Oak Ridge, Tennessee