

Nuclear safety and other reactor development

Our largest activity in reactor development is the nuclear safety program. From a modest beginning in 1955, when a few observations were made on fission product release from overheated reactor fuel, the scope of the program has increased to encompass almost all of the safety problems which confront the nuclear power industry, including seismic effects on reactors, structural problems of pressure vessels, reactor safety standards, and an information center serving the industry. In addition, the Laboratory conducts a variety of smaller studies in support of most phases of the U.S. reactor development program.

Isotopes development center

It is natural that we should always have been interested in fission products, for they presented so many problems in the early work on plutonium purification—problems that were only resolved by gaining an understanding of the fission products themselves. In addition, the Laboratory found itself with an available reactor and a collection of the best electromagnetic separators in the world. As a result of these circumstances, modest production of radioisotopes and separated stable isotopes was undertaken, and, on August 2, 1946, the first commercial shipment of radioisotopes—to the Barnard Free Skin and Cancer Hospital—was made. For many years the Laboratory remained the world's largest producer of radio- and stable isotopes; the impact on science, technology, and medicine of the Laboratory's efforts in isotope production has been enormous. At one time, processes for producing commercial quantities of about 100 radioisotopes and more than 250 stable isotopes of 52 elements were operating. By the end of 1962, more than 1½ million curies of radioisotopes and 5 kilograms of enriched stable isotopes had been shipped. For many years now, ORNL has been steadily withdrawing from radioisotope production to make way for private industry. In spite of this, each year the number of curies shipped from the Laboratory has increased, reflecting a transition from making many small shipments to making a few very large ones. Today we are concerned mainly with those difficult problems of isotope technology such as big power sources with which private industry is not prepared to cope. The Isotope Development Center, in addition to producing isotopic power sources, seeks new ways of using radioisotopes and radiation and provides an information service for radioisotope users.

Controlled thermonuclear program

Research on ways of obtaining power from the fusion process has been under way since 1953. The ORNL approach is based on continuous high energy injection into a containing magnetic field. Two large devices, DCX-1 and DCX-2, have been built to study the processes involved. More recently, increased emphasis has been placed upon the theoretical aspects of plasma instabilities and finding ways of dealing with them.

Life sciences

Biology.—Some of the earliest investigations carried out at ORNL had to do with the effect of radiation on animals and man and finding ways of ameliorating these effects. Over a period of many years, an extensive mouse colony was established to permit study of these effects, and experimental techniques were developed. By 1946 the program was sufficiently extensive to warrant establishing a Biology Division at the Laboratory. In the last few years, biological science at ORNL, as elsewhere, has undergone growth at a rate akin to that of physics during the early decades of the century. The Biology Division is now the largest division of the Laboratory. Many of the programs being carried out for other federal agencies are based in large measure upon experience acquired in the study of radiation effects: problems of aging, the effects of germ-free environment on animal welfare, and chemical mutagenesis. Equipment is being developed, and techniques for applying ultracentrifugation to the separation of viruses and to the preparation of vaccines are being pursued. The entire biology program at ORNL is underlain by a very large program of basic research in many areas of modern biology.

Ecology.—During the war years radioactive waste from the Laboratory was discharged to the environment, and it is natural that adjoining areas should be exploited as a unique laboratory for studying the effect of radiation on the environment. The program has expanded greatly and now constitutes a comprehensive effort aimed at understanding most aspects of radiation ecology.