nologies. Together with industrial engineers, and using model systems such as laboratory animals, cultured cells, and bacteria, they worked to define the health risks posed by the manufacture of synfuels from oil shale and coal, and by several advanced fossil fuel combustion technologies. The resulting database remains one of the most extensive bodies of information available on the short- and long-term toxicity of the complex chemical mixtures that emerge from the production and use of fossil fuels.

The aim of all this, of course, the epidemiological studies, the controlled animal experiments, and the toxicological studies, is to understand the nature of the risks posed by our society's activities. This kind of "risk assessment," born of AEC, ERDA, and DOE research, led to guidelines for the use of diagnostic x-rays, to confidence in the safety of countless radiopharmaceuticals, and to safety standards for the presence of radionuclides in the air, in food, and in drinking water. It is also one of the underpinnings of our ability to assess the likely consequences of such incidents as the reactor accidents at Three Mile Island and Chernobyl.

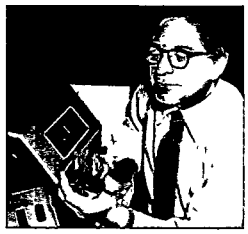
Constant Vigilance

Well before the years of the AEC, standards prescribing safe practices in dealing with radiation had grown increasingly strict. But safety would become a preoccupation with the energy agencies. Among the earliest apostles of radiation safety was Herbert Parker, a British-born medical physicist who became chief health physicist and eventually director at Hanford. Among his contributions, Parker's concept of the *rem*, still a standard measure of biological dose, is perhaps the most obvious. But more than that, the vigilance of the earliest pioneers and those who followed them has been a driving force behind today's safety consciousness. In that same postwar era, increasing attention to radiation health protection led the AEC's Division of Biology and Medicine to establish graduate-level programs at the University of Rochester, the University of Washington, and Vanderbilt, all linked to field training programs at nearby national laboratories. Fifteen other universities added similar programs later. All told, these programs have produced about a thousand professionals with postgraduate degrees in health physics, industrial hygiene, and radiation biology.

Support also extended to the development of techniques to assess individual radiation exposure. Film-badge dosimetry was the early standard, followed in the sixties by thermoluminescence dosimetry, developed largely at the University of Wisconsin. This is the method now used by radiation workers worldwide. Research also took an entirely new turn in the sixties, focusing on ways to quantify the dose

One atom at a time Samuel Hurst at Oak Ridge developed resonance ionization spectroscopy, a laser-based technique that succeeded for the first time in counting individual atoms. The earliest success was the detection of a single cesium atom among 10^{19} argon atoms.

1951 Using an ion-exchange technique originally developed to separate fission products, Oak Ridge researchers devised a simple method for isolating the components of DNA and RNA, a discovery that would significantly accelerate biochemical studies of these materials around the world.



1956 At Oak Ridge Larry Astrachan and Elliot Volkin (pictured) discovered a previously unrecognized form of RNA, which they called "DNA-like RNA." Four years later, this species would become known as messenger RNA, the essential courier of genetic instructions to the sites of protein synthesis in the cell.

1956 At Brookhaven W. L. (Pete) Hughes synthesized a radiolabeled version of thymidine, whose uptake by cells signals the synthesis of DNA.