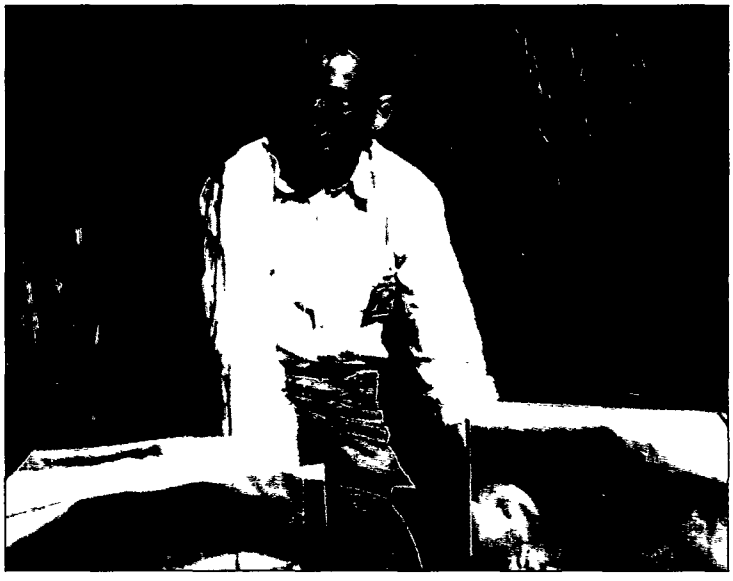
weapons-material production plants, and with radioactive products released into the Columbia River from the reactors at Hanford. Later, nuclear testing led to the spread of radioactive cesium and strontium isotopes, which prompted research projects on soil migration, root uptake, uptake by grazing and browsing animals, and transfer to food products. A major part of the aquatic research was conducted at Oak Ridge, Hanford, and Savannah River, whereas much of the work on soils, plant uptake, and the dairy pathway was done at agricultural schools within major universities. Together, these research efforts pioneered the quantitative study of environmental processes and provided not only the mechanistic understanding, but also the historical databases that supported the DOE's early environmental restoration program, and that underlie today's ongoing cleanup of contaminated defense sites.



EXPLORING NEW FIELDS Eugene Odum, a young University of Georgia professor, pioneered the use of radionuclides as ecological tracers in the fifties at the Savannah River reservation. In recognition of his contributions to ecological research, Odum shared the 1987 Crafoord Prize, awarded by the Royal Swedish Academy of Sciences in areas not covered by the Nobel prizes.

But the first ecological research linked to the nuclear era focused on radioactivity's direct effects—work that predated even the AEC. Already mentioned on page 12 were studies by fisheries scientists from the University of Washington, aimed at assessing the possible effects of effluents from Hanford's wartime reactors. And by 1946 the region's sheep and cattle were being monitored for radioactive iodine uptake. Nor was the plant kingdom ignored. For thirty years, starting in 1949, Brookhaven scientists studied the effects of radioactivity on plants, first on introduced species and plants of economic importance and later on native species. An important result of this work was the discovery that the volume of the cell nucleus in different plant species was an important factor in determining the species' relative sensitivity to radiation.

Then, in 1951, the AEC took a major step toward the systematic study of ecology: The agency granted $10,000 each to the University of South Carolina and the University of Georgia to conduct a biological inventory of the Savannah River site, in preparation for constructing a facility there to produce materials for nuclear weapons. Eugene Odum led the Georgia effort, in time putting together a research center of international repute, first called the Laboratory of Radiation Ecology, then the Savannah River Ecology Laboratory. Early studies of plant succession and pioneering applications of radiotracers to the study of food chains and food webs led to studies of wetlands ecology, endangered species of the Southeast, regional biodiversity, and the environmental chemistry of trace metals.

Also in the fifties, the AEC created its Environmental Sciences Branch to support studies of terrestrial, freshwater, and marine systems, with the emphasis on the long-term fate and effects of radionuclides. In this encouraging environment, Stanley Auerbach at Oak Ridge shifted his emphasis from laboratory experiments to field work focused on how radionuclides might migrate through the food chain, from water and soil to plants, animals, and humans. A

1975 ERDA established the first integrated program dedicated to understanding the movement of contaminants and other materials in coastal waters.

1975 Research at Oak Ridge documented the importance of dry deposition as a contributor to total acid precipitation in a forested watershed.

1976 Global carbon cycle models predicted the future doubling of atmospheric CO_2 from the combustion of fossil fuels. The following year, ERDA would launch the first systematic federally funded program to study global climate change as a possible consequence of this rising atmospheric CO_2 level.

1976 Edward Goldberg at the Scripps Institution of Oceanography used radionuclide profiles in marine and lake sediment cores to quantify the historical effects of human activities on aquatic environmental quality.