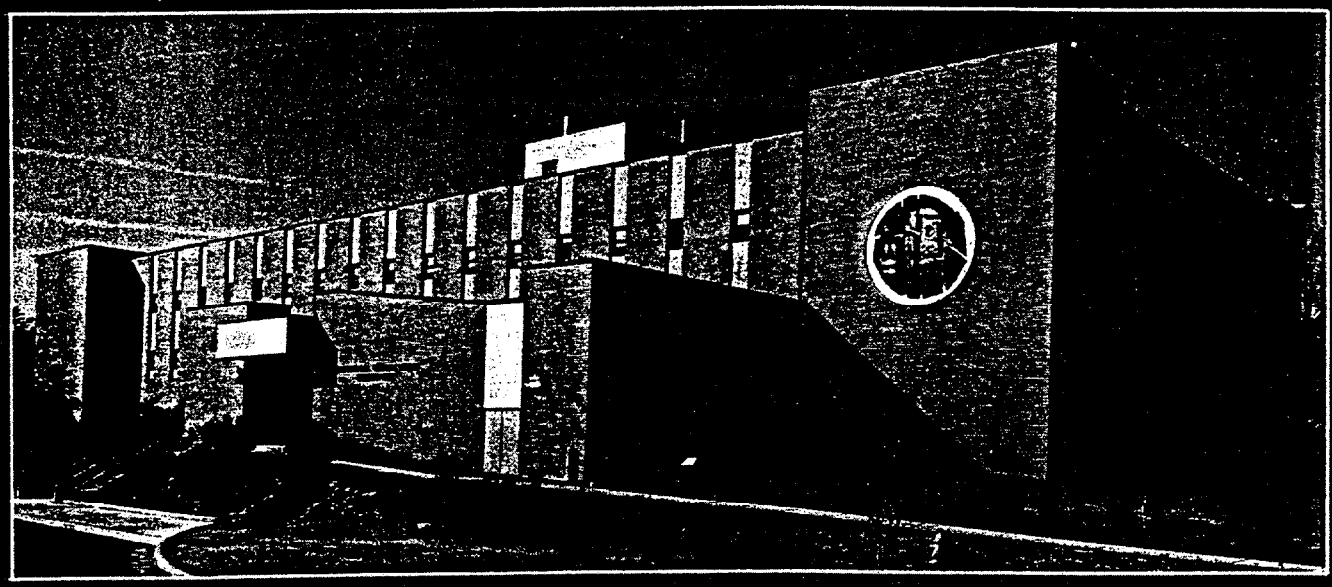
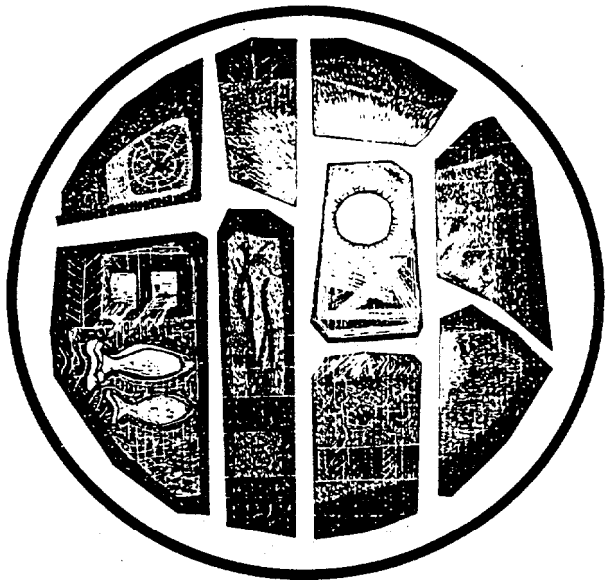
ENVIRONMENTAL SCIENCES DIVISION



50th Anniversary

Oak Ridge National Laboratory



TREES FOR LIFE

THE TREE IS OUR LIFE AND OUR LIFE IS IN THE TREE. IT IS FROM THIS CONCEPT THAT MY WORK HAS GROWN FOR THIS OUTDOOR MURAL. THE FLAT MOSAICS DELINEATE MY ABSTRACT VISUAL IDEAS CONCERNING THE ENVIRONMENT. SKETCHES FROM NATURE, THE COLOR BALANCE IN VARIOUS EARTH TONES, AND "THE SUN" ARE UTILIZED TO CONVEY A CERTAIN SPIRITUALITY ABOUT GROWING THINGS. THE MOST POWERFUL ASPECT OF THE MURAL IS THE "NEGATIVE SPACES" BETWEEN THE NINE MOSAIC PANELS BY MEANS OF WHICH I HAVE CREATED THE ESSENCE OF TREES FOR LIFE.

Charles Counts

1977

In 1977, Charles Counts, an internationally known potter, teacher. and artist. was commissioned to create this symbol for the new Environmental Sciences Building at the Oak Ridge National Laboratory. Charles Counts, a native Oak Ridger, now maintains a home, studio. and craft center in Rising Fawn. Georgia.

ORNL/M-2732

A HISTORY OF THE ENVIRONMENTAL SCIENCES DIVISION OF OAK RIDGE NATIONAL LABORATORY

B Y

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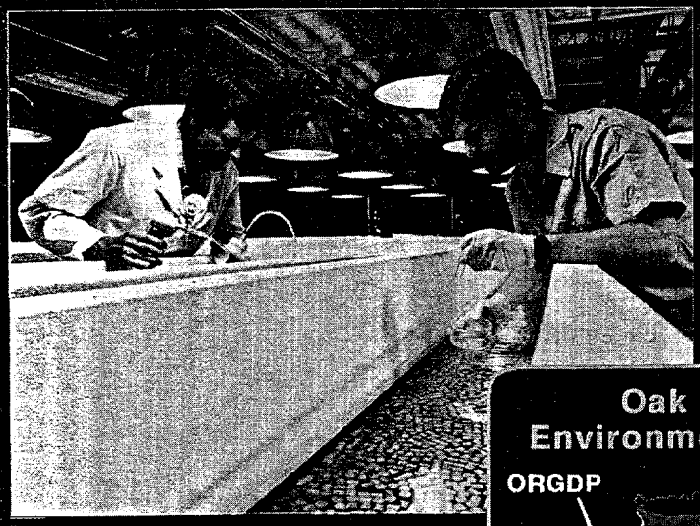
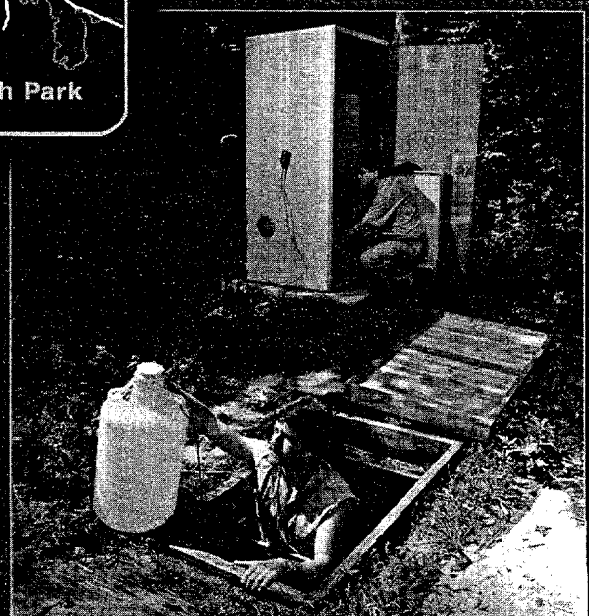
MISSION

The mission of the Environmental Sciences Division is to understand and evaluate how the development and use of energy affect the environment. To accomplish this mission, ESD

- **Conducts basic and applied research**
- **Assesses environmental impacts of projects and policies**
- **Develops and demonstrates environmental technologies**
- **Supports education activities**





FOREWORD

Each division at the Oak Ridge National Laboratory (ORNL) has been asked to prepare a brief history for ORNL's 50th Year Celebration. In the Environmental Sciences Division (ESD) this assignment was undertaken by Stanley Auerbach, the founding director of ESD. David Reichle, Robert Van Hook, Steve Hildebrand, and Ken Cowser (a former member of the original Health Physics Division's radioactive waste research section) reviewed drafts and made useful additions and comments. Judy Aebischer was the technical editor. Graphic arts support was provided by Kathy Barnes and her staff-Mitchell Williamson designed the front and back covers and offered helpful suggestions on format. Draft preparation and electronic publishing were accomplished by Donna Rhew and members of her staff-Linda Jennings, who was responsible for the desktop design (i.e., organization of the pages, creating text shapes, and positioning photographic images), Karen Gibson, and Delores Ogle. Joe Rich coordinated the preparation of the document for the printer.

CONTENTS

INTRODUCTION

On May 15, 1972, Alvin M. Weinberg, the director of Oak Ridge National Laboratory (ORNL), issued a memorandum announcing that the Ecological Sciences Division had become the Environmental Sciences Division (ESD). This act, however, constituted more than a mere renaming of a division that had been established two years earlier on March 13, 1970. It was a recognition that the broader field of environmental sciences would provide both opportunities and challenges for the Laboratory.

The Health Physics Division (HPD) had been responsible for initiating and carrying out environmental investigations since the Laboratory began operations in 1943. By the 1950s, additional environmental research was being conducted in HPD, especially research on the geological implications of radioactive waste disposal and on radiological assessment and environmental transport modeling. The creation of the Ecological Sciences Division, which came out of the Radiation Ecology Section of HPD, reflected ORNL's greatly increased activities and interests in environmental matters as well as the growing national and international recognition of the Laboratory's ecological research programs. The new division also began to play a key leadership role in impact assessment. By the time the HPD Director Karl Z. Morgan retired in September of 1972, the need for a division dedicated to the rapidly developing environmental activities had been recognized. The environmental components of HPD had been shifted to other Laboratory organizations, such as the Chemical Technology Division, and the radiological and environmental assessment and modeling group, along with several geologists and soil scientists who were in the waste disposal research group, had joined the ecologists in the newly named and more broadly defined Environmental Sciences Division.

ESD will be in its 20th year during the 50th anniversary of the Laboratory; during this time the Division has contributed significantly to ORNL's prominence in environmental sciences. But this history of ESD would not be complete without taking into account the people as well as the activities and events of the last 50 years that contributed directly or indirectly to the development of environmental sciences at ORNL. Attention will be given not only to ecology and radioecology, but also to the pioneering environmental engineering, sanitary engineering, and geological studies for the safe and ultimate disposal of high-level radioactive wastes. Recognition must also be given to those who initiated and led the development of methods and approaches for radiological hazard assessment that were precursors of the current sophisticated methods of environmental and health risk assessment and risk management.

Many individuals were involved in the pre-ESD HPD environmental and radiological research and development activities. A number of these scientists and engineers worked at ORNL on assignment from federal or private sector organizations. In attempting to reconstruct their roles and actions, the author has had to rely on reports and other documents as well as personal recollections and general accounts. Any omissions, mistakes, or oversights are not intentional but result from both the passage of time and the author's lack of direct involvement in many of these activities.

Because of space limitations, the details of many of the projects and the roles of the scientists and technicians who were responsible for carrying them out could not be represented here. For a more comprehensive overview of the environmental research activities, the reader is referred to *Life Sciences at ORNL* [ORNL Review 22(2,3)] 1989.

1. THE EARLY YEARS 1943-1954

Shortly after the establishment of the Clinton Laboratories (which in 1948 became ORNL), management found it necessary to plan for the handling and disposal of radioactive byproducts from various operations. On the basis of geological and hydrological considerations, Melton Valley-White Oak Creek and its downstream impoundment (White Oak Lake) were selected as areas for receiving radioactive effluent releases.

The need for protection against undue radiation exposure and the need for environmental surveillance were recognized early by ORNL health physicists under Karl Z. Morgan, who helped found the field of radiation protection. Morgan and his colleagues coined the term "health physics" to describe the combined study of the physical properties of radiation and its health risks.

In 1943 the health physics organization initiated a program of environmental monitoring and surveillance in the White Oak Creek-White Oak Lake area. Because these bodies of water drained into the Clinch River, a radioactive monitoring and outflow control system was built into the earth dam impounding the waters of White Oak Creek. Radioactivity in the outflow waters was monitored to ensure that the releases from White Oak Lake would not exceed the standards for radionuclide concentrations in drinking water as established by the nation's health physicists and other radiation protection specialists.

At that time HPD, under Morgan's leadership, was already involved in radioactive waste disposal research using scientists from the Army Corps of Engineers, the Public Health Service, and the U.S. Geological Survey. In 1948 the waste disposal studies were organized as a separate section with the addition of Roy J. Morton, a sanitary engineer, as section leader. The program was a joint undertaking of ORNL, the Tennessee Valley Authority (TVA), the Atomic Energy Commission-Oak Ridge Operations (AEC-ORO), the U.S. Geological Survey (USGS), and the U.S. Public Health Service (PHS). The new program had three major objectives: (1) to evaluate and minimize radiation hazards in ORNL's radioactive waste disposal practices, (2) to provide fundamental information on the behavior of released radwastes, and (3) to obtain information that might contribute to national defense. The senior members of that early group were sanitary engineers and included 0. R. Placak and Conrad Straub from PHS and L. R. Setter from TVA Also involved in the broader effort was a geologist, Paris Stockdale, from The University of Tennessee (UT) and George DeBuchananne (USGS). This group initiated a variety of studies aimed at a systematic survey of Watts Bar Reservoir. At the same time, Stockdale and DeBuchananne began a program of geological and hydrological studies in Bethel Valley, Melton Valley, and other parts of the Oak Ridge Reservation (ORR).

The White Oak Lake drainage basin was of increased interest because radioactivity had increased in the waters and bottom sediments. Morgan and others recognized the need to start investigations into the potential impacts that the radioactivity might have on the local flora and fauna. About the same time HPD developed instrumentation for measuring radioactivity on the bottom of rivers and lakes. This first instrument (the "Flounder"), which consisted of an array of beta-gamma tubes mounted in a watertight, heavy-duty frame, enabled the Division to begin an annual survey of the radioactivity of the Clinch and Tennessee rivers-covering 200 to 500 miles of river. Because of the concern about ecological contamination, AEC authorized a radioecological survey of the White Oak Creek drainage system, to be carried out under contract by the Fish and Game Branch of TVA It would be based in HPD and conducted in collaboration with the Division's Waste Disposal Research Section. This effort was consonant with interagency cooperative research policy then prevalent. The stated goals of the project as approved in January 1950 were "(1) to determine what radioactive elements have accumulated in living things in the stream, (2) where they have accumulated, and (3) what has been the effect on survival rates, population balances, and types of organisms." To carry out this effort, TVA established a research team under the leadership of Louis Krumholz, a well-known aquatic ecologist. The project ran from 1950 to 1953. Its findings stirred some controversy, but in general the results

showed that the radioactivity in the drainage was not linked to any serious ecological problems, although a demonstrable accumulation of radionuclides was found in the biota associated with the creek and the lake. The termination of this early radioecological impact project, however, did not spell the end of.Morgan's concerns about the potential impacts of radioactivity on the environment and especially on the ecology of land and water. Indeed, his continuing concern would have a profound and positive impact on the future of ecology at ORNL.

During this time the Waste Disposal Research Section was broadening its program. A number of agencies were concerned with radioactive contamination of drinking water and sewage. Decontamination of these waters became an important study objective of the section. To carry out the kinds of large-scale laboratory investigations, a special facility was needed. Such a facility was approved in 1949-50 and completed in 1951. This facility, known as the Health Physics Waste Research Building (Building 3504), became the center of waste disposal research at ORNL. Among the early workers on water treatment for removal of fission products was E. F. Gloyna from the University of Texas, who went on to become a distinguished professor and Dean of the College of Engineering at Texas.

In 1950, as part of the geological studies, 51 wells were drilled around the ORNL settling basin, White Oak Creek, and the burial grounds. Radiologging of these wells was initiated to assist in the study of groundwater movement. This activity intensified over the next few years with assistance from USGS, who provided collaborating staff, especially R. M. Richardson. The large effort in water decontamination was augmented by additional chemists and sanitary engineers. W. J. Lacy came from the Corps of Engineers, because of the Corps' interest in large-scale decontamination of water supplies that would be needed in a nuclear war. From PHS came Herman Krieger, Morton Goldman, Bernd Kahn, and Al Friend to augment the staff already there. At this same time, the development of analytical instrumentation that was needed for these waste-related studies was also under way, and Jim Garner, Bernd Kahn, and Bill Lacy were doing early research on the application of crystal spectrometers for the identification of gamma-emitting radioisotopes in White Oak Creek and the Clinch River.

During the 1952-53 period the radioactive waste group became interested in the possible use of earthen pits for the disposal of wastes. The first pits were small units for testing interactions between soils and wastes and the efficacy of unlined vs lined pits for retention of radionuclides. In 1953 the program began to change in direction and breadth. Ken Cowser, a sanitary engineer, was hired into the program; previously, most of the sanitary engineers, with the exception of Roy Morton, had come from other agencies. In March of 1954 the section was reorganiied into an overall Reactor Waste Disposal Project to be directed by Ed Struxness. The activities of the new section were concerned with three general problems: (1) the safe disposal of liquid, solid, and gaseous wastes associated with the nuclear power program, (2) the disposal of wastes from operations and research projects at ORNL, and (3) related research and development problems.

Thus in the middle of the 1950s the HPD leadership initiated two lines of activities that would have profound implications in the decades ahead. Radioactive waste disposal research would address, with innovative concepts and approaches-but tragically without a politically acceptable solution, at least in most of the 20th century-the problem of ultimate disposal of high-level radioactive wastes in the United States. Radioecology was restarted and would result in the establishment of ORNL as a world-class research center for environmental sciences, including both the ecological and earth sciences.

2. ECOLOGY AND RADIOACTIVE WASTE DISPOSAL

Although the first ecological survey was terminated in 1953, national events provided a new opportunity for ecological research. The nation grew interested in the potential of nuclear energy for generating commercial electric power, and Congress was considering legislation to commit the country to this new effort. A year later the Atomic Energy Act of 1954 was passed, committing AEC to the development of nuclear power.

Within HPD, Morgan and his key staff in waste disposal-Roy Morton and Ed Struxness, then Morgan's group leader at the Oak Ridge Y-12 Plant-had quickly realized the potential difficulties of radioactive waste disposal and the associated ecological and environmental problems that could result from a large-scale nuclear power program. Morgan, who was responsible for the safety of the Laboratory's waste disposal system, acted to expand the waste disposal research program. In 1953 he brought Struxness from the Y-12 Plant to be in charge of a new HPD waste disposal research and engineering program that would have an ecological component.

Struxness shared Morgan's interest in the ecological aspects of radiation hazards and had taken course work under Orlando Park, an ecologist at Northwestern University. Together, Morgan and Struxness pushed for the establishment of a formal ecological research program at ORNL. During this time Struxness brought Park to Oak Ridge to help him plan the new program. Park's initial purpose was to conduct a series of laboratory experiments to determine the impacts of radioactive wastes on the environment. He outlined a two-pronged effort: (1) experiments on the direct effects of gamma radiation on natural populations, especially of arthropods, and (2) preliminary food-chain experiments to determine the patterns of uptake and bio-accumulation. Funding was made available in 1954, and Stanley Auerbach, a former student of Park's, was offered a position to carry out the investigations and lay the basis for an expanded, longer term effort. A second professional staff position in the ecology group was also established as part of the program, but it was not filled until 1957.

When Auerbach arrived from Roosevelt University in Chicago at the end of August 1954, he immediately started conducting radiation experiments. Meanwhile, Struxness, with Park's assistance, began to press AEC to recognize the need for ecological research. Park visited the other national laboratories and brought back reports on the status of their environmentally related activities. Park also encouraged the ecological research community represented in the Ecological Society of America to make the academic community aware of the need for a national research program in ecology dealing with the impact of radioactivity. As a result, in the spring of 1955, the AEC Division of Biology and Medicine set up a national ecology program in Washington, D.C. John N. Wolfe, a respected plant ecologist, was appointed its director.

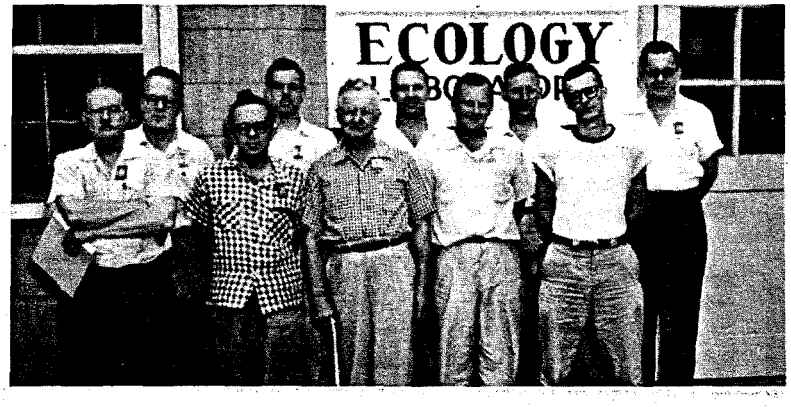
During this period Auerbach continued his radiation experiments and began to study the uptake of strontium radionuclides by earthworms in a series of laboratory experiments. Struxness encouraged him to plan for expanded research by engaging scientists from academic institutions to work at ORNL during the summer. Faculty summer research was already well established at the Laboratory and proved to be an exceedingly useful approach for developing the embryonic ecological research program. The summer of 1955 was a busy and fruitful one. The team that was assembled for that first summer was composed of Henry Howden, an entomologist from UT; Victor Sheldon, a soil chemist from the University of Missouri; and two doctoral students, Robert Davis (microbiology) and Manfred Engelmann (invertebrate ecology). Orlando Park participated in the activities on a part-time basis.

Two events that occurred in the latter half of 1955 changed the direction of the research. First, late in the summer, Struxness advised Auerbach that the portion of Building 2001 that contained the new ecology laboratories would be turned over to the Metals and Ceramics Division (M&C) because of the growth and expansion of the metallurgy

programs that were occupying the adjacent quonset building (Building 2000). Because of a critical shortage of space at ORNL, it was necessary to move the program to the Y-12 Plant. At this time Laboratory management was also considering the possibility of transferring the program to the Biology Division because of perceived similarities in research goals. Struxness, Morgan, and Auerbach believed that the goals and field orientation (especially in the rad waste area) of the developing ecological program would not be consistent with the Biology Division's laboratory research orientation. Moreover, Alexander Hollaender, director of the Biology Division, had *no* wish to include ecological research in his division. Space was found in Building 9711-1, which housed the Y-12 Technical Library; Most of this frame building had been stripped so that only a shell structure remained. With $25,000 of capital funds provided by M&C, Auerbach designed a three-laboratory, four-office complex that had both constant temperature and constant humidity year-round. The facility was completed in the spring of 1956.

The second significant event was the Laboratory's decision to drain White Oak Lake. The lake's capacity to receive and retain radioactive waste effluents had come into equilibrium with input. For the previous 5 years, ORNL had been carrying on a major research and development (R&D) effort in reactor fuel element reprocessing. Millions of curies of fission products were being generated. In order to provide emergency storage capacity in case of'a major high-level radioactive waste spill or leak, management decided to open the dam and drain the lake; if an emergency situation arose, they could later close the dam and use the impoundment area to contain any spills. Thus, beginning in the autumn of 1955, the lake was slowly drained. This decision was an early and appropriate example of what is now called risk management.

In 1956 the second originally planned professional staff position was filled in the ecology group, albeit temporarily, by Charles Rohde, an acarologist/ecologist who came on leave of absence from Northern Illinois University. Rohde initiated a series of radiation experiments with laboratory populations of a species of mite that was found in chicken manure. While the experiments were unique and very useful, highly wlorful scatological names were applied to the research program as knowledge of the culture media became known. During this time, Auerbach was completing his radiation experiments on the fauna in the mini-ecosystems that could be found in the rotting wood of tree trunk cavities. This laboratory research lasted until 1957.



The 1956 summer ecology research group outside the newly recreated laboratory in Building 9711-1 at the Oak Ridge Y-12 Plant. Individuals shown (left to right) are Orlando Park, Charles Rohde, Stan Auerbach, Manfred Engelmann (student), James Lackey, Kurt Bohnsack, Ellis Graham, Eugene Odum, Al **Broseghini** (student), **and Ed Struxness (June 21, 1956).**

In early 1956 John Wolfe made his first visit to Oak Ridge. He advised Auerbach and Struxness that AEC management did not consider the laboratory radiation studies to be relevant to AEC problems. Since Wolfe's research philosophy was strongly, if not totally, field oriented, he advised Auerbach to redirect his program. Struxness also urged Auerbach to move in this direction and take his research out to the experimental waste disposal sites. Struxness and Wolfe considered a move to the newly drained and highly contaminated lake bed necessary to ensure that the ecological research program would be relevant to the

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Ecology Research Program at Laboratory Is Sparked by Work of Dr. Orlando Park

Ecology-that branch of biology which deals with the mutual relationship among organisms and between themselves and their environment--i; playing an important part in the program of the Oak Ridge National Laboratory Health Physics Division. The effect of radioactivity on natural populations—bacteria, fungi, mites, and insects in the soil and fresh water — is closely connected with the problem of radioactive waste disposal. a problem that is constantly growing because of the expansion in the nation's development of nuclear reactor plants.

The Laboratory has been extremely fortunate, in carrying out its ecological research program. in enlisting the aid of one of the country's foremost ecologists. He is Dr. Orlando Park. professor of biology at Northwestern University, Evanston, Ill.

Dr. Park. who spent the summer months working with the Health Physics Division and still visits ORNL as a co"-sultant. began participation in ihc local program through the efforts of E. G. Struxness, a member of the division's Technical Advisory Committee a" d acting head of its A pp l i cd Radiobiology Section. During the period from June 19 lo September 19 of this year. Dr. Park spent his full time at ORNL. aiding in the setting up of a plan for a" experimental attack on the effect of radioactivity on "Plural populations. At present. the program exists largely on paper, but it continues to expand. and Dr. Park expects that practical work in the field will get under way in the near future. Dr. Stanley Auerbach is continuing the investigations begun by Dr.

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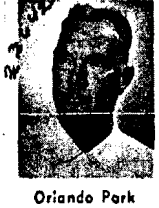


Orlando Park

Ecology Program

Continued from Page 1

Park before his return to Northwestern.

Work is Progressing

In a recent interview, Dr. Park spoke highly of the progress of his work at Oak Ridge National Laboratory.

"I have found everyone down here very helpful," he said. "The many groups with which I have worked have been extremely cooperative—the Health Physics and Biology Divisions and other ORNL groups, the Atomic Energy Commission, the Public Health Service, TVA, and the University of Tennessee-Atomic Energy Commission Agricultural Research Program. The ecological program has been very successful. Up to now. the work has largely been of a planning nature. Now, I think, we have enough basic information and our next step is to apply it."

Born in Elizabethtown, Ky.. Dr. Park received his BS and PhD degrees in zoology at the University of Chicago. He is also interested in forest ecology and entomology, specializing in beetles. and has carried out a great deal Of ecological work in the American tropics. He has been with Northwestern University since 1934.

Earlier this year, the Ecological Society of America, a member society of the American Institute of Biological Sciences, held its annual meeting in Gainesville, Fla. This society set up a committee on the study of the effects of radioactivity on natural populations. and Dr. Park was appointed chairman of the committee.

Dr. Park is the' author of many published papers and, together with W. C. Allee, A. E. Emerson, T. Park. end K. Schmidt, is the author of a book, "Principles of Animal Ecology." He is a member of the Ecological Society of America. the British Ecological Society, the American Society of Zoology. the American Society of Naturalists, the Entomological Society of America, and the Biological Society of Washington, D. C., and is an honorary member of the Panama Canal Zone Natural History Society. Dr. Park makes his home in Evanston, Ill., with his wife; they have one married daughter. While in Oak Ridge this summer the Parks resided at 717 Vanderbilt Avenue

Friday, Nov. 25, 1955

Health Physics Duo Will Attend Meeting

Stanley I. Auerbach and Charles J. Rohde of the Health Physics' Division, Oak Ridge National Laboratory, will attend the Third Annual Meeting of the Entomological Society of America in Cincinnati;, Ohio, from November 28 through December 1.

Auerbach To Give Paper

Dr. Aucrbach will present a paper before the Ecology and Rionomics Section of the society on "Effects of Gamma Radiation on the Biology and Etiology of Soil Anthropods."

Charles J. Rohde, who recently joined the Health Physics Division of Oak Ridge National Laboratory, is particularly interested in acarology, which is the study of the important soil animals; knovvn as mites.

Taught In Illinois

Dr. Rohde has been a member of the faculty of Northern Illinois State College for the past eight years. He received his B. S. degree from Wisconsin State College, M. S. from Marquette University, and his Ph. D. degree just this year, from Northwestern University. All three were given for the study of biology.

The father of five girls, Dr. Rohde resides with his family at 109 Sequoia Lane in Oak Ridge.

New Members

DE RYEE A. CROSSLEY JR. recently joined the Health Physics Division of Oak Ridge National Laboratory. Dr. Crossley received his B.S. and M.S. degrees in zoology from Texas Technology College, Lubbock, in 1950 and his Ph.D. degree in entomology from the University of Kansas, Lawrence, in 1956.

HERMAN L. HOLSOPPLE JR., who was formerly wit h Cramet Incorporated, Chattanooga, recently joined the Analytical Chemistry Division of Oak Ridge National Laboratory. Mr. Holsopple received his B.S. degree in biological sciences from the University of Tennessee in 1950.

SAM L. **SCHEINBERG** recently became a member of Oak Ridge National Laboratory's Biology Division, Mr. Scheinberg received his B.S. degree in poultry genetics from Cornell University in 1949 and' his MS. degree in poultry breeding from Iowa State in 1950.

WILLIAM E. THOMAS recently became a member of the Aircraft Reactor Engineering Division at Oak Ridge National Laboratory. He is a veteran of two years with the United States Army, and is a graduate of Tennessee Polytechnic Institute, whet-c hc received a B.S. dcgt-cc in mechanical engineering in 1952.

ALBERT **GRONSTROM** recently became a member of the Insprction Engineering Department at Oak Ridge National Laboratory. He came to ORNL from the Catalytic Construction Company, Oak Ridge.

environmental contamination problems of waste disposal. Thus began the first major shift in the ecological research effort: the combining of ecology and radioactive waste disposal.

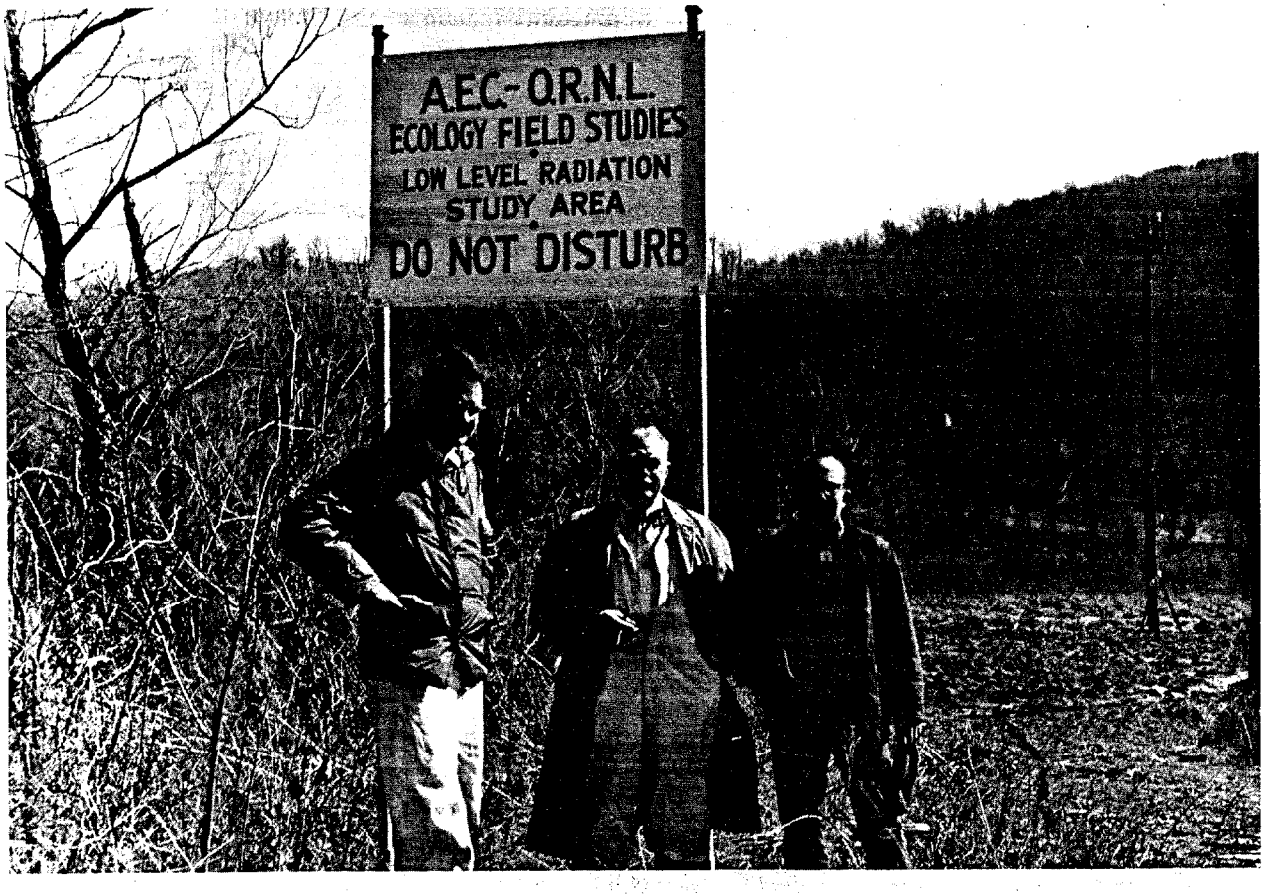
Rohde had already signaled his intention to return to teaching. Meanwhile Dac Crossley, who was finishing his Ph.D. in entomology at the University of Kansas, was recruited and arrived in late 1956. To prepare for the new research on the lake bed, another soil chemist, Ellis Graham, was recruited from the University of Missouri for the summer and undertook the initial characterization of the chemistry of the then bare lake bed sediments. Eugene Odum, a distinguished ecologist from the University of Georgia, was brought in to advise on the development of an ecosystem approach to research on, the lake bed because of his already ongoing program at the Savannah River Plant. A research grid was established on a portion of the lake bed, taking into account the radiation" levels and accessibility to staff. Because HPD had increased concerns about the Clinch River, Auerbach also brought in James B. Lackey, a distinguished aquatic ecologist and planktologist, to initiate a survey of plankton fauna and flora of the Clinch River as a prelude to conducting uptake studies of fission products by these organisms. Likewise, plans were laid to. begin surveys of the fauna of the ORR as part of the move toward large-scale, field-based research in accord with, John Wolfe's ideas.

Another project that was initiated at about this time concerned the experimental waste disposal pits, which were functioning as ion exchange columns, although actively leaking some ^{137}Cs, ^{60}Co, ^{90}Sr, ^{106}Ru, and other radionuclides into the nearby forest environments. This potential problem offered researchers the opportunity to evaluate the uptake and distribution of radionuclides by trees growing near the waste pits. The first project began in the summer of 1956, but continued for only about 3 years because of difficulties in the interpretation of data; these difficulties arose from the uneven distribution of tree species, the variability in isotope distribution, and the problems of working around the pits, as well as from a lack of resources. All these problems made the development of a forest ecosystem approach difficult. Nevertheless, the radioecologiczl research opportunity remained, and some 25 years later Charles Garten, Roger Dahlman, and others carried out and published a series of key studies on fission product uptake and turnover by trees growing next to the waste pits.

In 1957 Paul Dunaway, a mammologist, joined the group to initiate studies on the small mammal populations that were beginning to invade the lake bed. Auerbach and Crossley began research on the succession of plants and insects, including the patterns of radionuclide uptake and turnover in these invading populations. Two soil scientists were recruited-Tsuneo "Tammy" Tamura and Don Jacobs. They shortly transferred to the waste disposal research effort, which was also undergoing active expansion under Struxness's direct leadership.

By 1958 the program fully incorporated the concept of radioecological research that included the transport and fate of radionuclides as well as their effects within a total ecosystem context. Auerbach began to search for an ecologist who could carry out this research effort in a forest ecosystem context. Jerry Olson, whom Auerbach met when Olson gave a paper at a scientific meeting, was a staff member at the Connecticut Agriculture Experiment Station. He had worked while a graduate student at the University of Chicago on the biogeochemical succession of sand dunes and had developed a mathematical framework for succession. He now had a strong interest in forest ecosystem processes. Upon joining the group in 1958, he began a series of innovative studies that would have wide impact on the Oak Ridge program in radioecology.

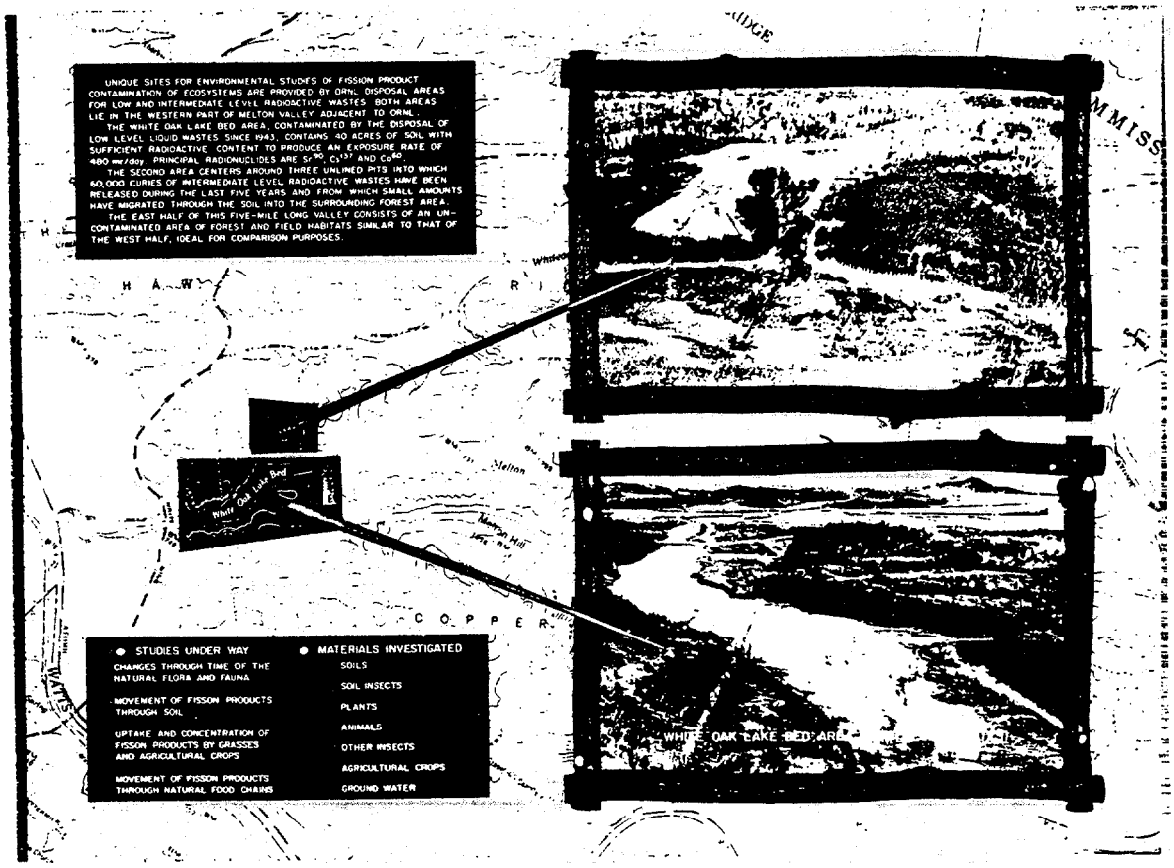
About the same time Morgan and Struxness were becoming increasingly concerned about the lack of knowledge about the fates of radionuclides that were being released through White Oak Dam into the Clinch River, In the early years of operation, the concept of dilute and disperse was an active waste management practice. Morgan and Struxness believed it was urgent to obtain fundamental information on the physical, chemical, and biological dynamics of this river, which for nearly 20 years had received releases of low-level radioactive wastes. As part of his planning for the



Visit of Orlando Park (Northwestern University) to the-newly created agricultural plot on upper White Oak Lake bed below waste pits 2 and 3 in 1959. A newly installed meteorological instrument pole is in the background. Jerry Olson is shown at left, Stanley Auerbach at right.

comprehensive river study, and to use these data to evaluate the total hazards to downstream populations and the riverine environment, Struxness advised Auerbach that the ecology group would be responsible for the aquatic biology and related ecology phases. The study was to be initiated in 1959. Thus the terrestrially focused radioecology program was now to expand into aquatic ecology. Since resources were lacking, funding was sought and obtained from AEC. Daniel Nelson, who had just completed his doctorate under Eugene Odum at the University of Georgia, was hired as the first aquatic ecologist. Under his direction the ecological investigations sought to determine the uptake and turnover of radionuclides in the biota and the effects of ionizing radiation on aquatic organisms. Primary interest was focused on fish populations and bottom organisms such as clams.

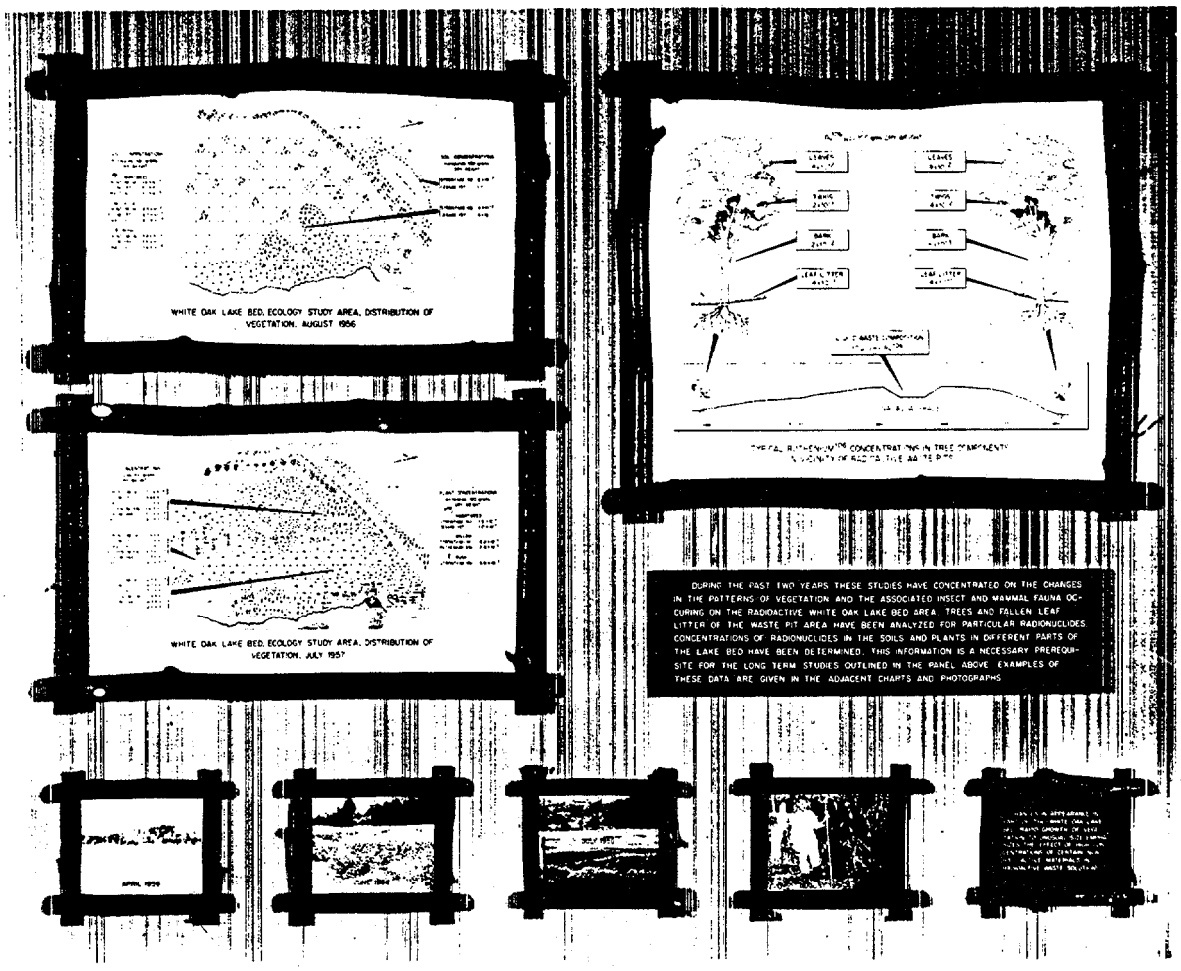
From the beginning of the ecology research program, Laboratory Director Alvin Weinberg had continually signaled his interest in the program. He believed that ecology could play an important role both at ORNL and for the nation. Therefore, when the time came to launch the new steel work boat that had been especially constructed for the new aquatic ecology effort, he and the pertinent members of the Laboratory Executive Committee were invited to the launching site at a new mooring facility that the ecology research program had built



ENVIRONMENTAL STUDIES IN DISPOSAL AREAS FOR RADIOACTIVE WASTES

Nuclear power programs are expected to produce, in addition to high-level wastes, large volumes of low- and intermediate-level wastes. A considerable roving in cost will result if some of these wastes can be safely released into the natural environment. The purpose of the Health Physics Environmental Studies at the Oak Ridge National Laboratory is to provide data which will assist in the determination of safe release concentrations. The kinds of ecological information needed include data on the distribution and movement of fission products in soil; on the movement, turnover, and concentration of fission products in food chains; on the uptake and concentration of fission products in plants ond animals; and ultimately on the subtle changes wrought by radioactivity through time. At the Oak Ridge Notional Laboratory unique facilities for studying these different phases of the environmental problem exist because the Laboratory has been releasing low- and intermediate-level radioactive wastes into natural areas near by. As a result of these operations carried on over a period of years Oak Ridge National Laboratory now has about 100 acres of land contaminated with mixed fission products plus similar, but uncontaminated, terrain ideal for comparison purposes.

Principal investigators: S. I. Auerboch and D. A. Crossley, Jr.



SOME RESULTS OF ENVIRONMENTAL STUDIES, 1956-1957

The waste disposal areas at the Oak Ridge National Laboratory provide o unique opportunity for a study of the effects of radiation on a deciduous forest environment. Concentrations of radionuclides in typical plants have been determined along with chemical, physical, and radiochemical properties of the soil. Particular emphasis has been placed on concentration and distribution of strontium-90, cesium-137, and ruthenium-106. These contaminated areas are, for the most part, newly created and are changing rapidly. Since all natural systems tend to change until they reach equilibrium with their environment, it is necessary to follow these changes through time in order to establish and evoluote the possible effects of radioactive wastes on ecosystems. Core must be taken not to attribute unusual phenomena to rodiooctivity until all other possible causes, such as chemical effects of the wastes themselves, ore eliminated.

Principal investigators: S. I. Auerbach and D. A. Crossley, Jr.

on the river. After all the officials had assembled, including those from AEC-ORO, the boat was lifted by mobile crane from the lowboy truck and lowered into the river where it promptly sank to the bottom. The new Clinch River ecology program was off to an auspicious start! In spite of temporary setbacks such as this, however, the end of the decade found the new ecology program established with a diverse and growing staff. The original facilities at the Y-12 Plant were filled, and the remaining space in Building 9711-l was remodeled to accommodate additional laboratories and processing facilities. In addition to those already named, the group was augmented in 1959–60 by Stephen V. Kaye, a mammologist; John Witherspoon, a plant ecologist; and Martin Witkamp, a soil microbiologist. With assistants and technicians providing additional experience, the unit was now able to approach ecological problems from a variety of perspectives, based on quantitative ecosystem ecology. At the same time, the Clinch River Study, with its ultimate goal of analyzing and assessing potential hazards, would become the precursor of environmental risk assessment, of radionuclides.

View of the agricultural test plot in upper White Oak Lake bed taken in the summer of 1957 during the studies of the uptake of ^{90}Sr, ^{137}Cs, and ^{60}Co by corn.

Under Struxness, the radioactive waste research began to grow in several directions. The waste storage pit work was expanded with the construction of three large pits above the upper end of White Oak Lake. These pits were experimental and operational at the same time. They were experimental in that they were located in Conasauga shale, which had been found to have high sorptive properties for a number of fission products and therefore was being considered for a possible approach to dealing with large volumes of what were then known as intermediate-level radioactive liquid wastes. The pits were also operational in that they were to be used as receiving basins for the large quantities of intermediate-level radioactive wastes that were being generated by the fuel element reprocessing studies being carried out by the Chemical Technology Division in Building 3019. Thousands of curies of ^{90}Sr, ^{137}Cs, ^{60}Co, and ^{106}Ru were sent to these pits. -With the exception of ^{106}Ru, the other radionuclides were retained in the soil immediately adjacent to the pits. But the high air-radiation doses in the pit area rendered them too hazardous for continuing use and they were filled and capped. Excess rainfall over evaporation was another limiting factor in their ability to handle large quantities of liquid waste. In place of the pits, a number of covered trenches that distributed wastes into the surrounding soils were used. Simultaneously, field studies of low-level, solid radioactive waste disposal were begun. These studies involved HPD staff (Cowser and Tom Lomenick) and Bill McMasters of USGS. Site selection and operational

techniques evolved as a consequence of these studies.

There was also a need to reduce the quantities of radionuclides entering White Oak Creek from normal Laboratory operations. Drawing on the extensive laboratory and pilot plant studies of water decontamination processes that had been carried out by the radioactive waste research group over the years, a group under Ken Cowser established the operational parameters of a process-waste water treatment plant that was built adjacent to the two receiving basins of the low-level process-waste system. The plant, which was based on the lime-soda softening process and that utilized chemical feeding, flash mixing, coagulation, and sedimentation, was completed in 1957 at a cost of $265,000. It had a capacity of 500,000 gal per day and proved to be highly effective in reducing the quantities of strontium, cesium, and other radionuclides from the effluents, thereby lowering considerably the levels of fission products and other radioisotopes entering White Oak Creek.

Geologic mapping of the hydrology and geology of the Oak Ridge Area was initiated with the assistance of the USGS. The intent was to add the geologic formations to the standard geologic maps of East Tennessee. In addition, surface drainage patterns of key streams were to be added. The goal was to produce a new and better topographic base map of the original ORR.

Just as the ecology effort was being augmented by new staff and new directions, so also was the waste group. Struxness began to broaden the program so that it would not only encompass local problems and challenges but would also address the already perceived national need for a satisfactory long-term solution to what was going to be a critical issue for the success of nuclear power, namely, the development of a totally safe and acceptable means for disposing of high-level radioactive wastes. But instead of relying on cooperative support from other agencies such as the U.S. PHS, whose resident staff were starting to return to their home agency after several years of productive research at ORNL, he began to add staff to ORNL to fit the growing specialty needs of the program.

Sanitary engineers had been the backbone of earlier efforts, and Struxness and Morton had had the advice of two of the nation's outstanding leaders in that field, Abel Wolman of Johns Hopkins and Gordon Fair of Harvard. On Fair's recommendation, Frank Parker, a recent graduate of Harvard with background in water resources and radiological health, was employed. Parker represented a transition that was beginning in the engineering field, in which the new concept of environmental engineering was beginning to replace sanitary engineering as the field of civil engineering

Stanley Auerbach and Charles Kraus sampling trees in vicinity of the seeping high-level radioactive waste pits (1958).

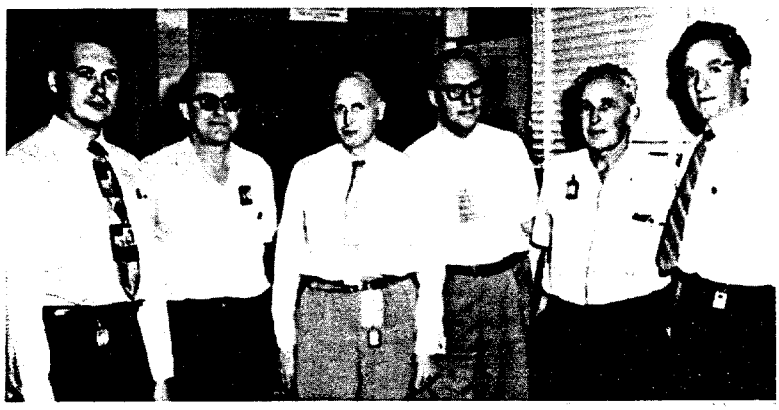
that dealt with water resources and related problems. An early result of this new approach was the organization of the Clinch-River Study in 1958. Struxness, assisted by Parker, organized a cooperative, multiagency study that would look at all aspects of the Clinch River contamination problem. The formal S-year program of study, which was drawn up in 1959, was unique in that it had the active involvement and cooperation of several federal agencies: AEC, the Department of the Interior (Geological Survey), the Department of, Health, Education and Welfare (Public Health Service), and TV& three state agencies: the Tennessee Department of Public Health (TDPH), the Tennessee Stream Pollution Control Board (TSPCB), and the Tennessee Game and Fish Commission (TGFC); and ORNL, where the effort, was headquartered in the HPD. The program was directed through a steering committee composed of representatives from each of these agencies with Struxness serving as chairman,

During the 1956–59 period, Struxness recruited a multidisciplinary group of individuals to pursue several main lines of investigation that were highly relevant to the waste disposal issue. The two soil scientists, Don Jacobs and Tsuneo Tamura, were to tackle many of the critical questions about fixation and behavior of fission products in soils and related media. Geologist Wallace de Laguna came from USGS and would be responsible for initiating an innovative but ultimately failed approach to disposal of large quantities of radioactive wastes. Geologist Tom Lomenick came from UT. Civil engineers Bill Boegly and Lou Hemphill were recruited from, outside ORNL, while Lou Bradshaw and Fleming Empson came from other parts of HPD.

During this period of the 1950s the problem of long-term disposal of high-level nuclear wastes was being examined by a number of national organizations, especially the National Research Council, which had established a committee to look into this looming problem. The conclusion of the committee, after several years of study, was that rock salt formations were a highly promising disposal medium for radioactive wastes. The ORNL group was well aware of these findings through their contacts in USGS and elsewhere. Struxness consulted with a number of leading geologists such as C. V. Theis and Ring Hubbert. They encouraged him to develop a research and development effort looking at salt beds as possible sites for disposal of high-level wastes.

As the decade drew to a close, the HPD waste research staff *were* pursuing major lines of investigation on a number of new approaches to high-level waste disposal. Empson and Lacy had initiated a basic program of characterization of wastes derived from irradiated reactor fuel elements. Boegly, Tamura, Empson, and others were testing the feasibility of the self-sintering of high-level wastes, using the self-generated heat produced in the wastes by radioactive decay, de Laguna was examining the feasibility of the disposal of wastes in deep wells; and Parker, Boegly, Bradshaw, Empson, Hemphill, and their colleagues had studies under way on the various mechanical, thermal, and related physical properties of rock salt as well as on its response to high-level irradiation. Contacts had been established with commercial salt mines that supplied blocks of rock salt for these experiments. A subcontractor

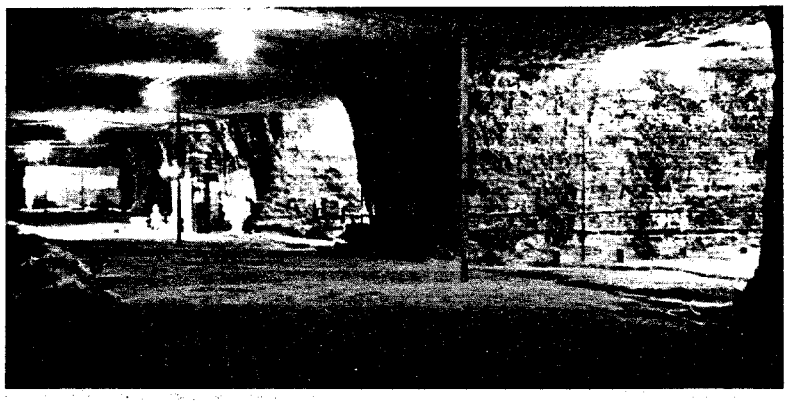
One of the three open, intermediate-level radioactive waste pits constructed in the mid-l 950s to test the feasibility of using such pits in a disposal method predicated on the assumption that radionuclides move into the surrounding soil and are retained there (1956–57).



Key members of the Radioactive Waste Disposal Research Section meeting with foreign visitors. Left to right are Ken Cowser, Ed Struxness, the two foreign visitors, Roy Morton, and Frank Parker (1958?).

was hired to investigate several operating mines as possible sites for field experiments to test the properties of salt beds under more realistic disposal conditions.

Some of the mine owners were amenable to the use of their mines for the field tests, since the first tests involved the use of irradiated fuel elements from the engineering materials test reactor, which were confined in metal containers rather than radioactive wastes. Of the mines looked at, the Carey Salt Mine in Hutchinson, Kansas, was chosen. It had a favorable geology and the necessary support services (shafts, hoists, power, railroad sidings, etc.). Accordingly, the Laboratory entered into a contract with the Carey Salt Mine Company to use an unoccupied section of their mine to study the properties of unmined salt under a variety of stress conditions related to high-level radioactive waste disposal operations.



View of one level of the Carey Salt Mine, Hutchinson, Kansas, showing the large mined-out chambers bounded by floors, pillars, and ceilings of rock salt 11959).

The H

Dec. 23, 1958 Tuesday

87th Year C No. 173 10 Pages Hutchinson

Atomic Waste May Go 'Into Carey Salt Mine

WASHINGTON (AP) — The Atomic Energy Commission is looking into the possibility that abandoned salt mines might especially good places to dump radioactive waste.

The commission is considering using part of Carey's Hutchinson mine, which is not now used for salt Production.

The waste materials would be simulated, with no radioactivity involved, so there will be no radiation hazard.

Salt mines are considered an answer to what to do with radioactive waste, the AEC said, because: (1) There is no Water in salt mines so there would be no drifting of radioactivity: (2) Where cracks occur salt is self sealing; (3) Salt is non-absorbent and would not absorb radioactivity.

The experiments will be directed by the AEC's Oak Ridge, Tenn., National Laboratory, which has held preliminary discussions with the Carey Salt Co.

The ARC said the earth scientists division of the National Academy of Science3' National Research Council in 1955 first considered the possibility of natural salt formations as a good place to dispose of atomic waste. It was decided this warranted further study. It was carried out at Oak Ridge and at the University of Texas.

The experiments indicated the method showed promise but required field-scale tests.

The Carey mine was selected, the ARC said, because of the geology of the areas, the geographic ocalion and facilities available at the mine.

The AEC said Carey indicated an interest in tbe experiments and a willingness to provide the space and experimental facilities required.

Carey Says 'No Danger'

Howard Carey Sr., chairman of tbe board of Carey Salt Co., Tuesday confirmed that the Carey mine is being considered for! storage of atomic waste.

"We're proud to be part of a community that is able and willing to assist. the federal government in a Project of this kind," Carey said.

"I want to stress two this," Carey continued.

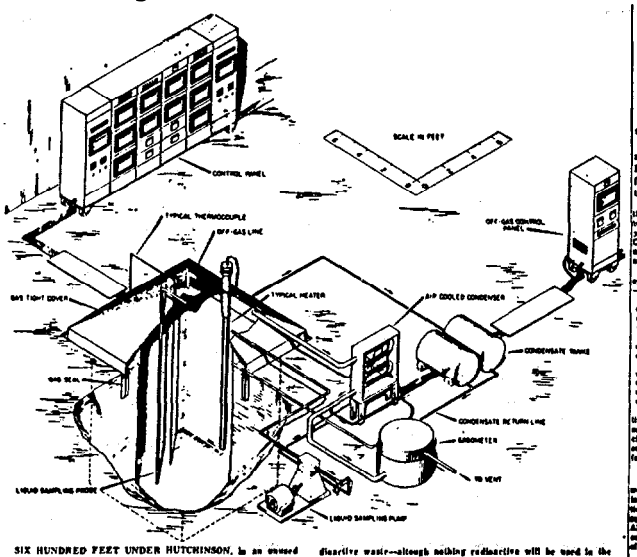
"First. the experiment3 which are planned will in no way affect our salt mining operations. They will be conducted in worked-out sections of the mine.

"Second, no actual atomic matter wig be used. The experiment will be carried out with synthetic materials. So there is absolutely no danger to anyone from radioactivity."

Carey explained that if the tests prove successful and it is decided to store actual atomic waste in salt strata under Hutchinson, it will be stored in areas where salt mining will be unaffected.

Hutchinson, Kansas, Sunday, March 8, 1959 MO 2-3311 Price 15c

Atomic Age Comes to Hutchinson; Carey Salt Mine Tests to Start



SIX HUNDRED FEET UNDER HUTCHINSON, in an unused portion of the Carey Salt mine, atomic energy experts will put this experimental device together, starting Monday. It could prove one of the most important developments of the atomic age. It will determine whether radioactive waste can be stored safely in salt formations. Into the pit (shown cut-away in the drawing) will go 5,000 gallons of chemicals that resemble radioactive waste—although nothing radioactive will be used in the experiment. A gas-tight cover will seal the pit. Electricity will heat the chemicals, as they would heat themselves if they were radioactive. The various devices around the pit will measure the effect of the heat, chemical reactions and gas on the surrounding salt.

Radioactive Studies On

Hutchinson will take a big but cautious step into the atomic age Monday.

Work will begin on a study of disposing of radioactive wastes in natural salt formations. The Atomic Energy Commission Saturday announced the contract for the tests between its Oak Ridge National Laboratory, and the Carey Salt Co. of Hutchinson.

Howard Carey Jr., president of the firm, said preparation for the tests will begin Monday on a 1K-year-old mashed section of the Carey mine. They will continue at least until next January — possibly longer.

The measurements — from Carey and atomic energy spokesmen — emphasized three points:

1. There will be absolutely no danger from the tests because no actual radioactive material will be used.

2. There will be no interference with normal Carey mining operations.

3. No one can say for sure what the tests will lead to — whether any actual atomic waste will ever be stored in this area.

Behind these emphatic, negative points lies a story of grave national importance, and of fascinating possibilities for Hutchinson, which was unfolded at a conference here Saturday.

Reports Given

Meeting with Carey officials were Edward G. Struxness, nuclear scientist at Oak Ridge National Laboratory; Wayne Range, public information officer for the AEC at Oak Ridge; and Don Cowan, director of public relations of Oak Ridge National Laboratory.

Struxness, leading in the weeks discussion, research and engineering section at Oak Ridge, was principal engineer for the group, which, incidentally, provided him a reunion with his brother, Dr. F. J. Struxness.

"The Carey Salt Co. is making a significant contribution to the solution of one of our most grave problems," Struxness said. "Hutchinson can be proud of the part it will play."

Whatever the outcome of the tests, they definitely will put Hutchinson on the atomic map.

"This is a world - wide problem," Struxness said. "It will be watched closely by scientists and government officials. Hutchinson can expect to entertain many interesting visitors from over the country and the world in the coming months."

General Problem

"The waste disposal problem," he said, "might be the greatest deterrent to the development of economic use of atomic energy. This test is just another step, in an orderly succession of events, since 1945, directed at solving the problem."

The problem is this:

An atomic reactor might be compared to a coal - burning furnace. Fuel is put in it and reaction takes place to produce heat. Wastes are produced as a result of the fission products which build up within the fuel elements of atomic reactors.

Stored Ashes

Periodically, these fuel elements have to be replaced. The elements, removed from the reactors, are chemically processed to recover Uranium 235 which did not burn, and to extract the Plutonium.

This is the ashes the ashes from the furnace to recover unburned pieces of coal. Then the ashes are thrown away.

But the processing of the fuel element results not in harmless ashes, but in a fluid residue — a nitric acid solution which is toxic, corrosive and highly radioactive. Its chief radioactive components are three: them - Sr and Cesium-137. It cannot just be dumped out.

Piracy On Hand

At present, there are 50 tanks full of this waste on hand. It is stored in stainless steel tanks carefully supervised. There are $101 million worth of these tanks at Hanford, Wash., alone. Others are at Idaho Falls, Savannah River, Oak Ridge. They cannot be moved. One estimate is that it costs $2 million a year to maintain and watch this storage.

"We have been trying to find some other way to dispose of the waste that is cheaper and safer," Struxness said.

He emphasized that none of the existing waste would ever be stored here or in any other salt formation. It can't be moved

What Could It Mean?

What lies ahead for Hutchinson if tests prove this is the ideal place to dispose of radioactive wastes?

The IF is such a big one that the officials here Saturday refused even to speculate on the possibilities.

But they did cite facts concerning the handling of radioactive wastes on which a lot of speculation can be based.

For that speculative story of what the coming years of the atomic era could mean to Hutchinson, see Page 2.

Three tests are named at finding disposal places for future waste.

Why not just dig a hole in the ground and bury it? You can't.

Salt Formations Favored

It would heat the earth, and it would move through it. In Struxness' term, it would "migrate." It could contaminate the soil, underground water supplies and the food that comes from the earth.

In 1955, the AEC asked the National Academy of Sciences for recommendations. After long study the Academy said "rock salt formations provide possibly the most promising solution to the problem."

The Hutchinson test — and others like it — will determine whether the scientists are right.

"We are going to know what we are doing before we do anything," Struxness stressed.

"Why salt formations?

"A salt mine is the driest place in the world, as you Hutchinson people know," Struxness said.

"Salt does not allow water to permeate. It is very soluble and will quickly recrystalize if a leak occurs. It is plastic and will quickly seal cracks."

Artificial Waste

Before any actual atomic waste is placed in a salt cavern or disposal pit, the experts want to prove that chemical interaction between the waste and the salt can be controlled, and that the heat from the waste also can be controlled.

They will make these tests in the Carey mine without using actual radioactive materials. Chemicals similar to the waste in their effect on salt will be used. The heat will be produced artificially by electricity.

They must also know the exact effect of radioactivity itself on salt. This is being determined in the laboratories at Oak Ridge.

$42,000 Cost

The Carey mine was selected, officials said, because of the geology of the area, its geographic location and the facilities available in the mine.

The agreement between Carey and Oak Ridge is a cost-fixed - fee subcontract. The cost of the initial work is estimated at $42,000. Six atomic energy experts are expected to work on the test at the outset, with fewer as it gets underway.

"We want to do whatever we can to help solve that national problem," Carey said. "This will be an interesting experience for the company and for Hutchinson."

The Kansas House of Representatives gave tentative approval Saturday to three bills designed to keep the state up to date with the atomic age.

One bill would authorize the creation of a State Atomic Energy Advisory Board which would coordinate nuclear activities.

Further news on Burger's Adv.

Intercepted Letter

HOWARD CAREY JR.
Industrialist
Hutchinson, Kan.

Dear Jake

Sen. Schoeppel isn't going to like the atomic tests

Yours,
Hutch

3. RADIOECOLOGY AND ECOSYSTEM SCIENCE

In 1959 the ecology unit became the Radiation Ecology Section of the Health Physics Division. Its research programs reflected a continued emphasis on the transport of radionuclides and the chronic effects of radiation. At the same time the unit was moving into forest ecosystem research and was starting to explore the potential of radioisotope tracers for understanding and possibly quantifying ecosystem processes. Dunaway and Kaye began to study the accumulation and turnover of radionuclides as well as the effects of chronic radiation in, the small mammal populations on the, White Oak Lake bed and surrounding areas. Experimental pens for maintaining the animals were-established in another part of the reservation. Systematic efforts to census the mammalian fauna of the entire, reservation were initiated, and a reference collection of endemic species was established., As their research progressed during the 1960s, Dunaway and Kaye began to try to explain why vertebrate species vary in their sensitivity to radiation. In their studies of hemopoietic systems they pursued the physiological mechanisms behind their observations. But while they used techniques that were developed and used by radiobiologists, their study of mammals in a natural environment distinguished their research from that of the Biology Division.

Members of the summer ecology research group prior to boarding an Atomic Energy Commission plane to conduct. an aerial reconnaissance of the Oak Ridge Reservation. From left to right are John Witherspoon; Don Jacobs; Stan Auerbach (kneeling); Paul Dunaway; the late Bill Willard, University of Georgia; the late Ray Richardson, U.S. Geological Survey (kneeling); and Gayther Plummer, University of Georgia (1958).

The untimely death of Royal Shanks, a distinguished plant ecologist at UT, cost the program a valued collaborator and advisor. After he died, however, his extensive library was put up for sale. This presented an opportunity to create a specialized library on ecology at ORNL, something that was totally lacking at the time. Laboratory management was persuaded to provide the necessary funds and space, and library services were provided by the Y-12 Technical Library staff, whose facilities shared the same building.

Dac Crossley, who was also working on the White Oak Lake bed, measured the uptake of radionuclides by insects in the field. By 'combining these data with those of laboratory studies comparing the accumulation and excretion of radionuclides and plant material by insects, he was able to use measurements of the radionuclide content of insects in 'the 'field to derive their

consumption of plant material and, therefore, the magnitude of the transfer of energy and nutrients along food chains. This work also had significant implications for risk assessment. By measuring radioactive movement by insects, the risk to humans of radioactive materials transported by insect food chains could be predicted; Crossley, however, was primarily concerned with understanding the ecology of insect-plant and predator-prey food relations, especially since the insects contained only a tiny fraction of the radioactivity in the lake bed ecosystem and were not likely to pose any danger to humans.

Jerry Olson initiated much of the new section's innovative research. Working with Royal Shanks of UT and with Crossley, Witherspoon, and Witkamp, he started a project in forest ecosystem processes using the uncontaminated forests on the ORR and in the Great Smoky Mountains National Park. They set up field experiments to measure the movement of nutrient elements from soil to trees and the return of these elements to soil, and approached this problem in two ways: by studying the factors affecting the breakdown and decomposition of forest litter and by tracing the movement of individual elements through trees, and back to soil, by way of litterfail and leaching by rain. Auerbach had already become convinced that, because of its location, the developing ORNL terrestrial ecology program should emphasize forest ecosystems. Moreover, his experience with studying isotope uptake in trees around the waste pits had demonstrated the need to work with single isotopes that could be introduced and followed as tracers. In 1959 Olson, Witherspoon, and their colleagues began to use radiotracers to study forest element circulation and litter decomposition. Olson developed procedures for injecting known quantities of one or more radionuclides into a tree and subsequently following and quantifying its movement through the tree and into the leaf litter.

Another of Olson's innovations was the application of computer simulation models to ecosystems. He began in 1958 with a model of the accumulation of organic matter on the forest floor. The next year, with the assistance of Robert Neel, a graduate student in physics, he developed an analog model that simulated the flow of carbon within a forest ecosystem divided into four compartments, each receiving and donating material to other compartments. This was the beginning of a multiyear effort that would have widespread implications for much of the subsequent ecosystem research at ORNL.

On both a national and international level, interest and concern about radioactive contamination of the environment was growing as a result of the large-scale testing of nuclear bombs in the atmosphere. Worldwide radioactive fallout was beginning to be documented in the public press. The growing presence of ^{90}Sr in milk and subsequently in the breast milk of mothers and in the teeth of children served to make the public aware of a key and hitherto unrecognized ecological process-the food chain. Aboveground nuclear bomb testing was actively under way at the Nevada Test Site, and HPD staff were carrying out a number of key dosimetry studies there. ARC had established a large program in ecological monitoring of the weapons fallout in the desert areas. Morgan approached Auerbach with the suggestion that the Radiation Ecology Section also consider proposing a research effort out there. Auerbach declined because it was not related to the waste orientation of the ORNL program, staff expertise in desert ecology was lacking, and it would detract from efforts already planned. But the growing concern over possible nuclear war gave a new impetus to AEC's programs in radioecology, with a special focus on the effects of large-scale radiation on terrestrial ecosystems and the problems resulting from large-scale contamination of the earth's ecosystems with long-lived radioactive fission products.

The latter part of the 1950s witnessed the construction of the major addition to the Laboratory's main building (4500N). The new south wing would provide major expansion space for a number of the research divisions, including HPD, who would then vacate the main health physics facility (Building 2001). This would provide an opportunity to move the Radiation Ecology Section back to ORNL and at the same time provide major expansion space (22,000 ft^2) for the program. Laboratory management approved the request of Morgan and Struxness, and funds in the amount of

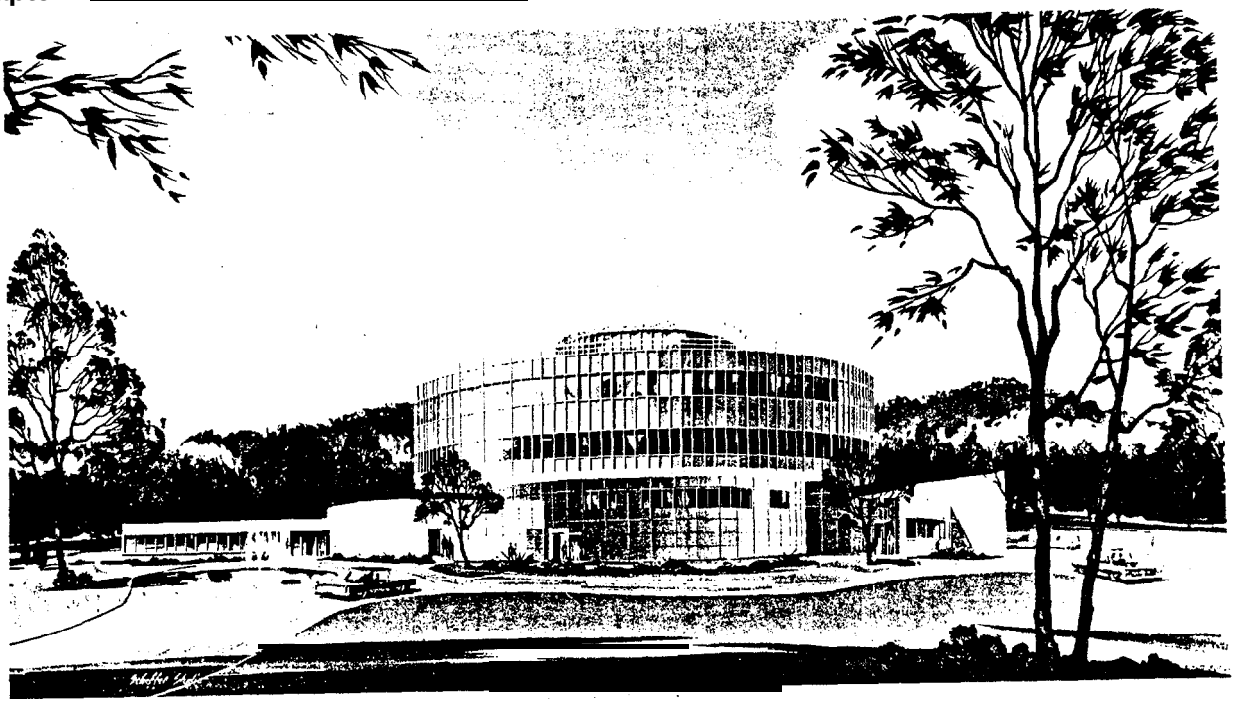
approximately $100,000 were made available for remodeling and refitting of laboratories. (When the time finally arrived for the physical transfer of materials, equipment, and supplies from the Y-12 Plant to ORNL, the complex arrangements for providing personnel to move the operation from one union jurisdiction (Y-12) to another (ORNL) became bogged down. Much of the material was already boxed, so Auerbach had the technicians load the section vehicles with the boxes and take them to the new facility. Since this was a violation of the union contract, Auerbach received a grievance for every box transferred by his staff-the all-time record for the most grievances for one 'operation-but the mission of, moving the section was completed within the planned schedule.)

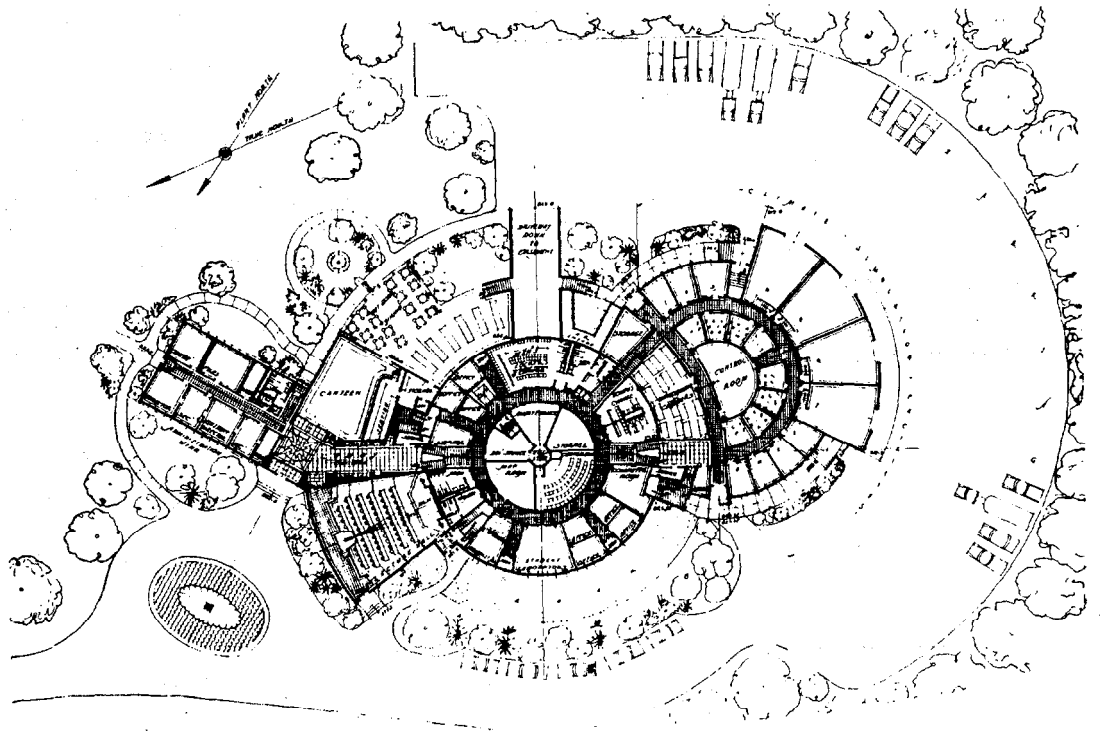
The move back to ORNL coincided with a period of dynamic planning at the Laboratory, and the ecologists were encouraged to actively participate. Planning for the future inevitably raised the question of facilities. Because of this and hardly before the paint had dried on Building 2001, Auerbach became involved with a long-range planning group in the Engineering Division. With their positive encouragement and backing, he started planning a totally new facility that would be designed especially for large-scale ecological and related environmental research. What emerged was a radically new design based on a circular configuration for the building. Its innovative features won the support of Laboratory management, and during the next few years the idea was developed into a formal engineering and architectural conceptual design that was completed in 1965 and proposed to AEC. However, the timing was not propitious for funding of a major building for any kind of environmental, much less ecological, research; the dream of a new building would have to wait.

The move back to ORNL brought the ecologists much closer to Melton Valley, where much of the field research was under way. The focus was on the use of radiotracers to provide means for quantifying transfer processes in ecosystems while simultaneously yielding information about problem radionuclides such as the fission products. Cesium-137 was one of the major fission products that had been released to the local environment through the various waste disposal research and development efforts. Likewise, it was a major constituent of bomb testing fallout. The potential of ^{137}Cs for studying forest ecosystem processes was being actively pursued by Olson, while his colleagues in the section were using radiocesium and other tracers to unravel different ecological processes.

In the autumn of 1961 the First National Symposium on Radioecology, sponsored by AEC, was held at Colorado State University. This meeting brought together the ecologists who had responded to John Wolfe's call for a new national program in radioecology. The symposium included reports on the new radiation studies being carried out using large field irradiators and several papers on radionuclide behavior and radiotracer research. ORNL was heavily represented. To the Oak Ridge group, the meeting also brought out the need for training ecologists in the use of radioisotopes as a research tool in ecology. The Oak Ridge Institute of Nuclear Studies [(ORINS), subsequently Oak Ridge Associated Universities (ORAU) and now Oak Ridge Institute for Science and Education (ORISE)] had been conducting special training courses in the use and applications of radioisotopes. When approached with the idea of operating a special summer session for training ecologists, they responded enthusiastically. The ORNL ecologists outlined a curriculum and devised a number of laboratory and demonstration projects that would be used in the course. These projects and experiments illustrated how radioisotopes could be utilized in ecological research. Funding was obtained, and the first institute was held in the summer of 1962. These summer sessions were continued through 1964, by which time it was felt that demand was insufficient to maintain a separate effort. After that, ecologists who wished to take the training, including new staff members at the Laboratory, enrolled in the regular course.

During this period the Laboratory's interest in education was growing. Although ORNL had a long, ongoing relationship with UT, Alvin Weinberg and the administrators of the university perceived that both institutions had much to gain if they could take advantage of the Laboratory's top scientists in some form of teaching role that would assist the

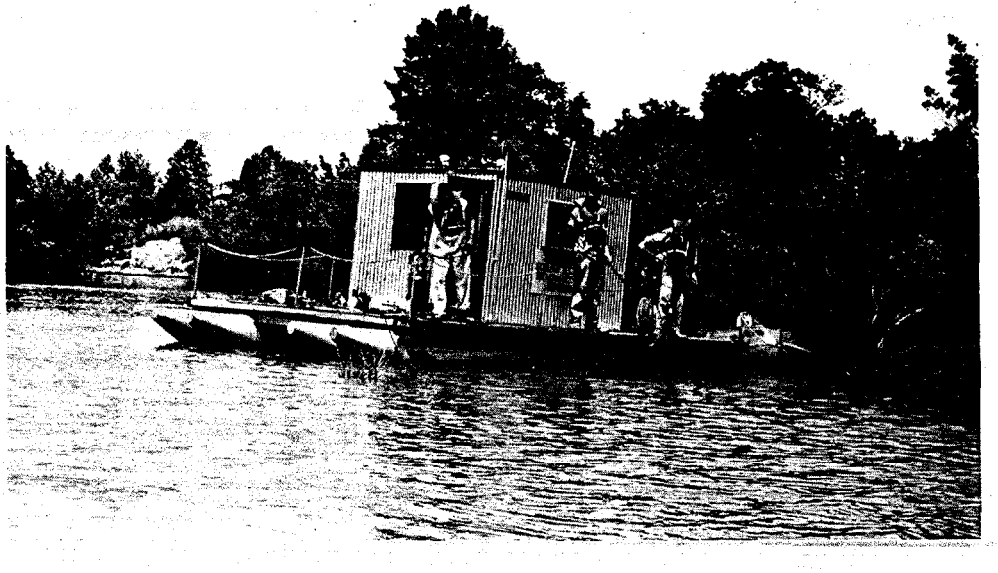




Artist's drawing of the original 1963 design of the Environmental Sciences Laboratory and the conceptual plan for the first floor.

university and attract top-notch graduate students who could do thesis research at the Laboratory. The Ford Foundation was approached, and they responded by funding what came to be known as the Ford Foundation Professorships. These were awarded to outstanding members of ORNL, who would be reimbursed for up to 20% of their time, to teach a course or lead a seminar at UT. The costs for this would be paid out of the Ford grant. In addition, participants would receive an additional 10% as bonus and reimbursement for travel costs. Approximately 20 ORNL staff received these appointments. One of these was Jerry Olson from the Radiation Ecology Section. Olson started teaching in the Botany Department, initiating what was to become a highly productive joint relationship. The Radiation Ecology Section began to have not only a developing interaction with UT biology departments but also a growing influence on the strengthening of the ecology curriculum and graduate program at UT. The advantages of having graduate students who could carry out thesis research at ORNL under the supervision of laboratory ecologists were becoming obvious. Auerbach believed that such students would not only contribute significantly. to the research efforts, but would also serve to continuously stimulate and challenge the staff. Such graduate programs were already well established and effective in the radiation physics section of HPD, and the Biology Division was the unchallenged leader in this field. Literally scores of graduate students and postdoctoral fellows from all over the world carried out research in its facilities during the early 1960s.

The new Clinch River Study was also well under way. Under Daniel *Nelson,* the ecologists were carrying out pioneering research on the use of clam shells (both modern and prehistoric) that were obtained from **middens** as indicators of ^{90}Sr contamination. Because the shells grew with annual additions, Nelson devised a unique method for separating the annual rings and measuring the contained strontium, thus obtaining patterns of accumulation over time. Studies of fish population behavior, creel censuses, and body analyses for contained radionuclides provided data that were essential for the hazard analyses that were being initiated in **the** Clinch River Study under **Struxness** and Frank Parker and carried out by Ken Cowser, Walter Snyder, and others in HPD.



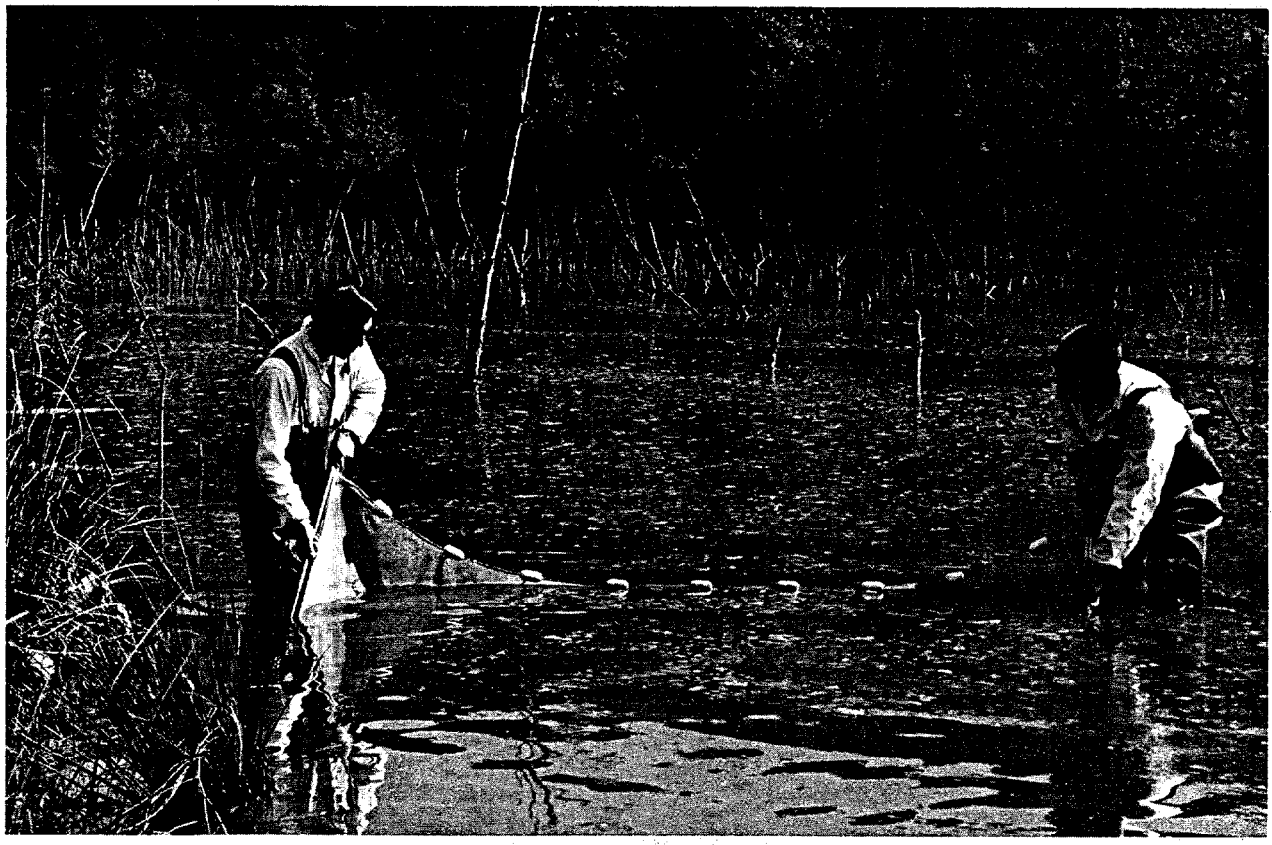
Ecology workboat operating during the 1959-64 Clinch River Study for which the boat was specially built. It served the aquatic research program for 25 years. individuals working (left to right) are Bob Martin (Tennessee Tech), Neil Griffith, and the late Dan Nelson.

Other radioecological studies of the effects of chronic radiation on aquatic fauna were also being initiated under Nelson. The small **ponded** area that

remained behind White Oak Dam supported a large population of midges (chironomids). With the advice and assistance of genetics researchers from the Biology Division, Nelson brought in a graduate student from UT, B. Gordon Blaylock, who initiated a Ph.D. thesis project on chromosome aberrations in these organisms that ultimately proved to be one of the most exciting pieces of radiation research findings in a natural population exposed to chronic low-level radiation. Martin Witkamp carried out studies on the effects of radiation on soil microflora around the unshielded test reactor at Dawsonville, Georgia, in preparation for future studies to be done around the new fast-burst neutron test reactor being constructed for HPD behind Copper Ridge on the ORR.

Meanwhile Crossley, Dunaway, and Auerbach were carrying out their studies on the contaminated White Oak Lake bed. Dunaway's studies of cotton rats had evolved into sophisticated analyses of blood protein responses and pathologies. Crossley was following the transfer of the radionuclides through the plant-insect food chains and devising techniques for calculating consumption of food materials by measuring the uptake and turnover of the radionuclides by the insects. Auerbach was following the succession of plant associations on the bed and the patterns of fission product accumulation as a function of species and biomass.

As the 1960s began, the combination of radiological and ecological perspectives were being melded in the new field of radioecology with its



Gordon Blaylock, assisted by Neil Griffith, collecting mosquito fish (Gambusia sp.) in White Oak Lake as part of aquatic radiation effects studies.

OAK RIDGE NATIONAL LABORATORY NEWS

A Publication for the ORNL Employees of Union Carbide Nuclear Company, Division of Union Carbide Corporation

48 OAK RIDGE, TENNESSEE Friday, June 3, 1960

MEMBERS OF THE CLINCH RIVER STUDY STEERING COMMITTEE are pictured above as they gathered for a recent meeting at Oak Ridge National Laboratory. Seated left to right are W. G. Belter, Division of Reactor Development, AEC, Washington; S. Leary Jones, director of Stream Pollution Control Board, Tennessee State Health Department; W. H. Jordan, assistant director of ORNL; F. E. Gartrell, Health and Safety Division, Tennessee Valley Authority; Roy J. Morton, Waste Disposal Section, ORNL Health Physics Division. Standing left to right are E. G. Struxness (chairman), assistant director of the ORNL Health Physics Division; D. J. Nelson, Ecological Research, Health Physics Division; A. A. Schoen, Biology Division, AEC Oak Ridge; W. M. Martin, Stream Pollution Control Board, Tennessee State Health Department; E. G. Godfrey, Surface Water Branch, U. S. Geological Survey, Washington; S. I. Auerbach, Ecological Research, Health Physics Division; and F. L. Parker, Waste Disposal Section, Health Physics Division.

Clinch River Radioactive Waste Study To be Broadened Under New Program

Oak Ridge National Laboratory's study program primarily concerned with health and safety aspects related to release of low-level radioactive waste solutions to the Clinch River will be broadened by a new study announced by the AEC last week. The new program, a comprehensive study of the Clinch River downstream from the Oak Ridge area, will determine the dispersion and ultimate fate of radioactive materials, evaluation of any potential direct or indirect effects of liquid waste disposal activities, and evaluation of the usefulness of the river and similar streams for waste disposal purposes. Eight state and federal government groups are jointly cooperating in the research program.

The ecological aspects of the program are designed to study the role that river plant and animal life has on the ultimate distribution of radioactive materials, and to provide information on basic aquatic biology. The study is expected to include a survey of fish.

Oak Ridge National Laboratory will continue its current program of surveying and sampling to assure that radioactive material released to the river is below the maximum permissible concentrations for drinking water as recommended by the National Committee on Radiation Protection.

The new joint research program will be conducted under the supervision and guidance of a steering committee representing the participating organizations. Organizations involved in the study in addition to ORNL are: AEC, Tennessee Game and Fish Commission, Tennessee State Health Department, Tennessee Stream Pollution Control Board, Tennessee Valley Authority, U.S. Geological Survey, and U.S. Public Health Service.

Low-level radioactive liquid wastes are released to the Clinch River from Oak Ridge National Laboratory at White Oak Creek. The waste solutions come from the Laboratory's research and chemical processing activities and have been processed through a waste treatment plant prior to discharge to the creek.

Waste solutions having a higher radioactive content are stored at the Laboratory in huge underground storage tanks, while intermediate level waste solutions are stored in large seepage pits which permit the radioactivity to decrease and to become fixed in the ground. Eventual seepage from the pits is through White Oak Creek.

Friday, February 24, 1961

Auerbach Elected Fellow of AAAS

S. I. Auerbach, Health Physics Division, has recently been elected a Fellow of the American Association for the Advancement of Science in recognition of his standing as a scientist.

Auerbach

Auerbach, who came to ORNL in 1954, received his B.S. and M.S. degrees from University of Illinois and his Ph.D. degree from Northwestern University.

His fields of interest are health physics, problems of environmental contamination by radioactive wastes, radiation effects on populations, and biological cycling of fission products.

Auerbach has written numerous papers on the effects of ionizing radiation on insects and invertebrate organisms. He has also written papers on the uptake and accumulation of strontium-90 and cesium-137 and other fission products by native cultivated plants.

Thursday, March 30, 1961

Auerbach Attends IAEA Conference

S. I. Auerbach of Health Physics Division is attending an International Atomic Energy Agency conference on selected topics in radiobiology this week at Vienna, Austria.

Auerbach

He is part of a panel on "Effect of Radiation on *Ecological* Systems of the Biosphere Due to Atomic Industry Operations." He will also give a report on United States ecological research with emphasis on the biological effects.

In addition, Auerbach will confer with IAEA on preliminary plans *for* an International Agency Symposium on Ecological Effects *of* the Atomic Energy Industry and assist the Agency in establishing methods for an ecological survey at atomic energy installations.

THE OAK RIDGE NATIONAL LABORATORY NEWS

A Publication *for the* ORNL *Employees of Union Carbide* Nuclear Company, Division *of Union Carbide* Corporation

Friday, May 19, 1961 OAK RIDGE, TENNESSEE

A SUBCOMMITTEE OF ECOLOGY STUDY COMMITTEE of the Ecological Society of America met at the Laboratory this week to discuss "Chemical Cycles in Ecological Systems." Participants included S. I. Auerbach, ORNL Health Physics Division; J. J. Davis, Hanford Atomic Laboratories; J. S. Olson, ORNL Health Physics Division; and J. E. Cantlon, Michigan State University.

Research Problems in 'Chemical Cycles In Ecological Systems' Discussed Here

Subcommittee of Ecology Study Committee of ESA Met at Oak Ridge National Laboratory May 15-16

A subcommittee of the Ecological Society of America met at ORNL this week to discuss research problems concerned with "Chemical Cycles in Ecological Systems." This committee and several subcommittees have been sponsored by National Science Foundation to review the present state of knowledge in certain areas of ecology and help promote advancement of these areas.

The ecological problems of chemical cycles discussed included the movement of nutrient elements, truce elements and radioactive isotopes in both terrestrial and marine environments. The circulation of elements from soils to plants to animals and back to soils is important in maintaining productivity of the lands. Cycles of movement from waters to organisms and sediments and back to waters are important for biological activity in freshwater and marine environments.

Natural cycles of movement of the chemical elements guide the dispersal of radioactive contamination that reaches the environment as fallout or radioactive waste. Basic research on these cycles has recently received a stimulus from the use of tracer isotopes for estimating the rates and amounts of accumulation of substances between different kinds of organisms and from the organisms to the environment and back to the organisms, just as physiologists earlier took advantage of tracers to follow the movement of atoms between the different organs or different molecules inside a single individual.

Significance of Studies

The significance of such studies for environmental contamination and the value of radioactive tracers have led to recent expansion of AEC programs in this kind of research. Much research in agriculture, forestry and fisheries ultimately requires more basic understanding of these ecological processes.

While physics, chemistry and biology have achieved spectacular success in understanding the organization of atoms, molecules, cells and organisms, one of the major challenges remaining for science is to understand how these many small systems operate together in the maintenance of populations of organisms and larger ecological systems consisting of many kinds of organisms plus their environments.

Balance Changes

Changes in the balance of gains and losses of the chemical elements to different parts of an ecological system are among the major factors controlling the development and maintenance of such a system, and are scheduled to receive increasing attention in the near future.

J. S. Olson, ORNL Health Physics Division, geobotanist, is chairman of the Subcommittee on Chemical Cycles in Ecological Systems. Other members of the Subcommittee are J. E. Cantlon, Michigan State University, secretary of the Ecological Society of America; J. J. Davis, Hanford Atomic Laboratories; and H. T. Odum, University of Texas Institute of Marine Science.

Advisors of the Subcommittee include J. D. Ovington, British Nature Conservancy; L. R. Pomeroy, University of Georgia; and R. E. Shanks, University of Tennessee.

Wider scientific discussion of these problems will be continued in two symposia late this summer. At one of the symposiums, a section on "Cycling and Levels of Nuclides in Terrestrial Environments" will be chaired by S. I. Auerbach, ORNL Health Physics Division.

Biology and Health Physics Members To Present Papers At AIBS Meeting

The meeting of Biological Societies, sponsored by the American Institute of Biological Sciences, which is scheduled to be held at the University of Connecticut, Storrs, August 26-30, will find two members of the Health Physics Division and eighteen members of the Biology Division from Oak Ridge National Laboratory participating. Many speakers from various Atomic Energy Commission installations and private research organizations will participate in the five-day series of symposiums.

Health Physics Members

Roy J. Morton and Stanley I. Auerbach of the Health Physics Division will present papers at the first radiation ecology symposium sponsored by the Ecological Society of America and the American Society of Limnologists and Oceanographers. Mr. Morton's paper will be "The Engineer's Need of Ecological Research," and Dr. Auerbach's paper will be entitled "The Soil Ecosystem and Waste Disposal to the Ground."

Biology Papers

The following members of the Biology Division will present papers at the sessions: K. C. Atwood, "Genetic Effects of Ionizing Radiations on Lower Plants"; Alan D. Conger will present a paper (co-authored by M. L. Randolph and A. H. Johnston) entitled "Chromosomal Aberration Production By X-Rays and By Monochromatic 2.5-Mev and 14-Mev Neutrons."

Other papers by Biology Division members will include "The Origin of Prototrophs In Crosses of Purple Adenine Mutants in Neurospora Crassa" by F. J. de Serres; "A Non-Linear Frequency-Dose Relation for Recessive Lethals Induced by X-Rays in Drosophila" by C. W. Edington; "Forecasting the Rate of Induced Marker Loss For Maize Endosperm" by A. C. Faberge; "DNA Synthesis and X-Ray Effects At Different Mitotic Stages In Grasshopper Neuroblasts" by M. E. Gaulden.

Other Papers Presented

H. E. Luippold will present a paper on "Inaccuracy of Measuring X-Ray-Induced Chromosomal Damage By Scoring At Anaphase" which was authored by Sheldon Wolff and H. E. Luippold. A. W. Naylor will present a paper on "Aspartic Acid Metabolism in Barley and Wheat Leaves" which was authored by N. E. Tolbert, L. P. Carter, and A. W. Naylor. R. C. vanBorstel and M. L. Pardue authored a paper to be presented by M. L. Pardue entitled "On the Nature of Radiation-Induced Dominant Lethal Mutations In Hybrobracon and Drosophila."

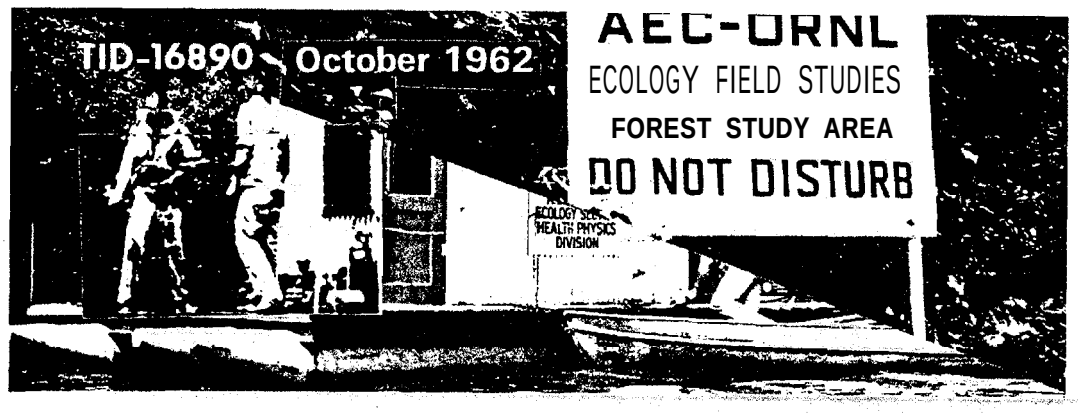
T. H. Pittenger will present a paper on "Complementary Cytoplasmically Inherited Mutants In Neurospora." L. B. Russell will present a paper on "A High Rate of Somatic Reversion in the Mouse," co-authored by Mary H. Major. L. B. Russell will also present a paper entitled "Dominant Lethals Induced at a Highly Sensitive Stage In Mouse Oogenesis."

Other papers included are "Lack of Linearity Between Mutation Rate and Dose For X-Ray-Induced Mutations in Mice" by W. L. Russell, and "The Production of Wild Type Alleles From Heterozygotes of Notch and Split in Drosophila" by W. J. Welshons.

Mary H. Major, G. E. Hunt and L. M. Rohrbaugh will also attend the meeting from the Biology Division.

focus on quantitative field approaches to understanding the fates and effects of radioactive materials within an ecosystem context. Moreover, the tools were now at hand for the ecologist to begin to quantify the complex processes that operated at the several levels of biological organization from the population through the ecosystem.

Dac Crossley inoculating forest floor litter with radioisotopes as part of a food-chain transfer experiment (e&y 1960s).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ECOLOGY FIELD STUDIES
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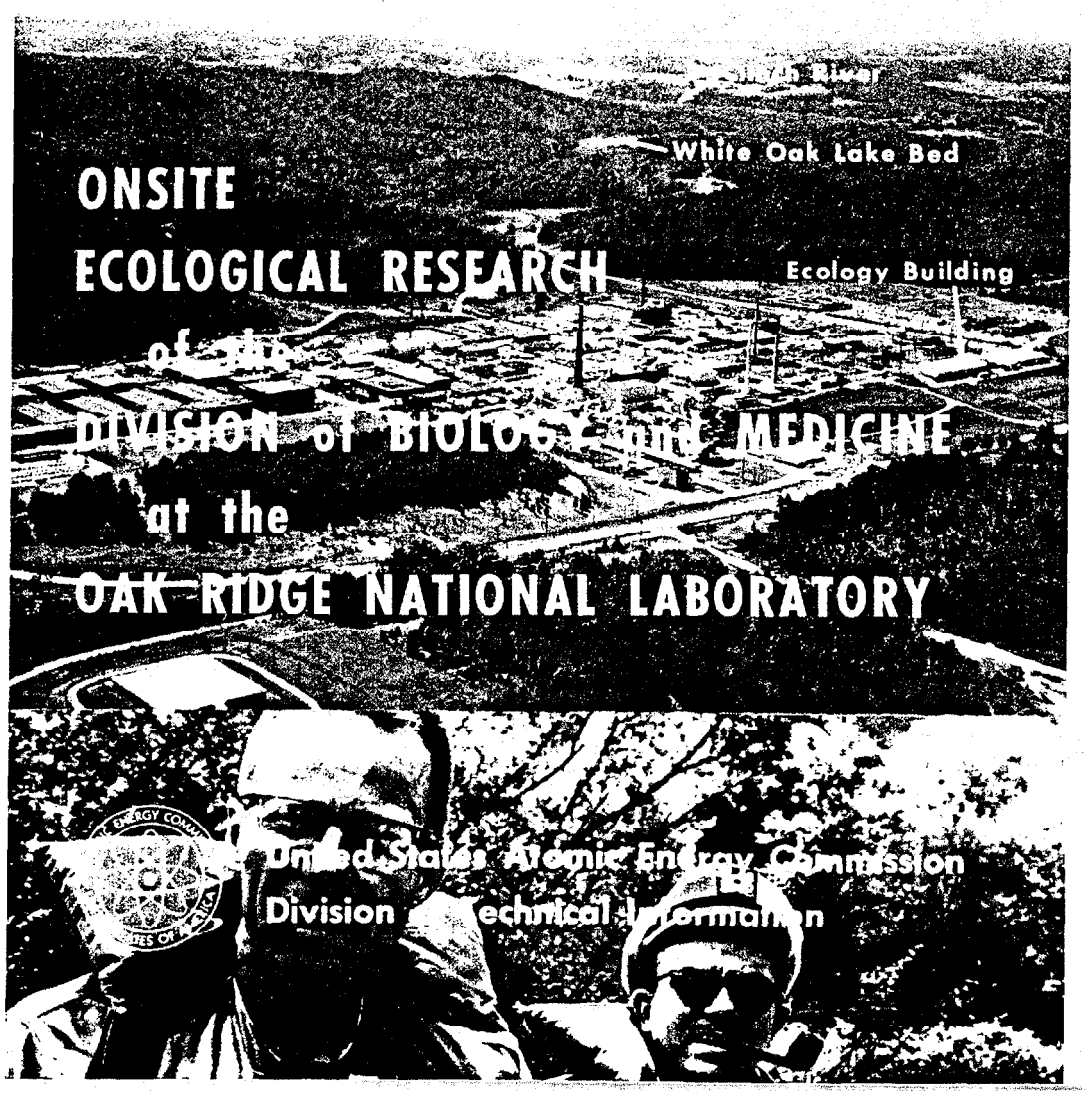
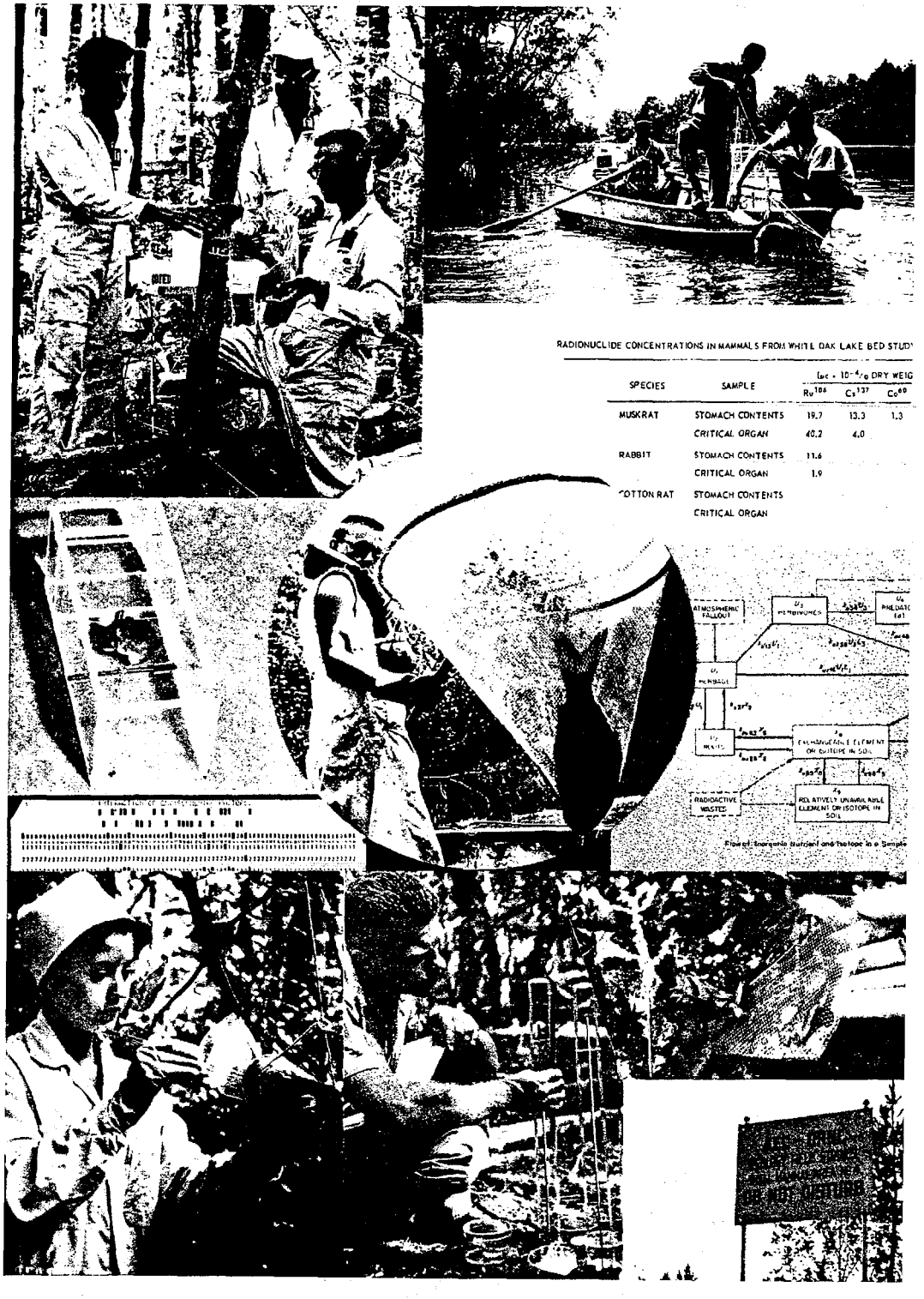

White Oak Lake Bed
ONSITE
ECOLOGICAL RESEARCH
Ecology Building
of the
DIVISION of BIOLOGY and MEDICINE
at the
OAK RIDGE NATIONAL LABORATORY
United States Atomic Energy Commission
Division of Technical Information



RADIONUCLIDE CONCENTRATIONS IN MAMMALS FROM WHITE OAK LAKE BED STUDY

SPECIES	SAMPLE	(μc ÷ 10^{-6} g DRY WEIG		
		Ru^{106}	Cs^{137}	Co^{60}
MUSKRAT	STOMACH CONTENTS	19.7	13.3	1.3
	CRITICAL ORGAN	40.2	4.0	
RABBIT	STOMACH CONTENTS	11.6		
	CRITICAL ORGAN	1.9		
COTTON RAT	STOMACH CONTENTS			
	CRITICAL ORGAN			

4. THE DYNAMIC SIXTIES: ECOSYSTEM RADIOECOLOGY, PLOWSHARE, WASTE DISPOSAL, SYSTEMS ANALYSIS, AND THE INTERNATIONAL BIOLOGICAL PROGRAM

The 1960s were watershed years at the Laboratory. Nuclear power was being pushed as the energy of the future, and the Laboratory's reactor programs were viewed as a key part of this effort. Basic science, especially "big biology," played a commanding role as did those areas of applied science such as chemical technology that were dedicated to various aspects of nuclear power technology development. Atomic energy in the mind of the general public was mostly associated with the bomb and with secrecy. The major countries of the world were actively developing and testing nuclear bombs by exploding them in the open at various elevations from ground level to high altitude.

Environment and health concerns related to nuclear energy were mostly muted at the beginning of the decade but began to emerge because of the discovery that radioactive fallout was producing large-scale contamination of the biosphere. As the decade wore on, these concerns grew to include not only problems associated with atomic energy but with all forms of contamination and pollution. In retrospect, the sixties can be seen as the transitional decade in the United States between the postwar period and a new era of public understanding and concern about technology, health, and the environment.

Ecologist Dan Nelson hauling in gill net as part of the fish population survey of the Clinch River Study.

The beginning of the sixties found HPD involved in a burgeoning and dynamic environmental research activity that was addressing key problems associated with the large-scale application of nuclear energy in the nonmilitary public sector. Recognizing this new development, Morgan reorganized the Division into two major research components in addition to the applied monitoring and surveillance groups. The environmental component, reporting to Ed Struxness, consisted of two sections: radioactive waste disposal research under Frank Parker and ecological research under. Auerbach. Ed Struxness, who had been promoted to assistant division director, was responsible for the environmental R&D components; at the same time, he maintained an active leadership role in a number of the waste disposal research activities and in the Clinch River Study.

The research units were scattered over the Laboratory. Division headquarters, radiation physics and dosimetry, and the applied group occupied space in Building 4500S. The Radioactive Waste Research Section was headquartered in Building 3504, while the Radiation Ecology Section occupied the newly renovated and remodeled Building 2001. Since much of the research activity was taking place in Melton Valley, which was the location of the waste areas, the two environmental sections maintained close interactions on many of the problems. Within the radiation ecology section, most of the effort was focused on the contaminated White Oak Lake bed and on forest studies involving the use of radiotracers to study movement of chemical elements and isotopes through ecological systems. The Clinch River Study was under way and involved members of both sections in the field studies and operations.

By 1961 the several lines of terrestrial research involving radionuclide behavior in relation to ecological processes were beginning to converge toward a strong ecosystem approach. Computer models developed by Olson were ready to be tested on a larger scale. The research on the White Oak Lake bed and the various small-scale tagging studies using trees or forest floor litter had given the staff both experience and confidence in developing tracer techniques and working with hazardous radioisotopes, Moreover, one was not unmindful of Alvin Weinberg's oft-stated belief that national laboratories should be dedicated to "big science" research projects involving many scientists, either because of the scale of the research equipment or because of the complexity of the problem. Staff discussions were initiated-to come up with ideas for a big project. One of the ideas that emerged was that of tagging a stand of forest large enough to be treated as a system, yet capable of being sufficiently bounded that it could be treated as an entity. Olson was given the task of planning and organizing the experiment and, perhaps most important, finding such a stand on the ORR that was sufficiently isolated to minimize problems of possible intrusion and hazard.

Olson and his technicians located a stand of tulip poplar growing in a sinkhole site that was isolated and fenced within the restricted areas of the Laboratory's two unshielded reactors (Health Physics Research Reactor and Tower Shielding Facility). The decision was made to use ^{137}Cs, a fission product that is prominent in weapons fallout, as a tracer. Although it is long-lived (30-year half-life), it does not present the internal hazard problems of ^{90}Sr, and since it is a moderately strong gamma emitter, it is easy to detect.

Tagging the tulip poplar forest stand with ^{137}Cs. Each tree was individually inoculated with a proportionate quantity of the radionuclide. Shown (left to right) are William Cate, Jerry Olson, Hubert Waller, Stanley Auerbach, Dac Crossley, and John Witherspoon (1962).

THE OAK RIDGE NATIONAL LABORATORY NEWS

A Publication for the ORNL Employees of Union Carbide Nuclear Company, Division of Union Carbide Corporation

Vol. 15 — No. 21 OAK RIDGE, TENNESSEE Friday, November 23, 1962

CLINCH RIVER ECOLOGY STUDIES presently are being conducted by the Ecology Section of ORNL's Health Physics Division. In conducting the studies, the group utilizes a pontoon boat built especially for this purpose. The boat is 24 feet long by 12 feet and eight inches wide. Constructed of 16 gauge steel, the pontoons are 28 feet long and 25 inches in diameter. Total dead load weight of the boat is 7,500 pounds, and live load weight is 9,500 pounds. Live load capacity is 2,000 pounds. The boat is powered by two 40 horsepower motors. Conceptual design was by S. I. Auerbach, Health Physics, and design and engineering were by W. J. Boegly Jr., Health Physics, and Engineering and Mechanical staff members. The boat was constructed by Poole and Thomas Iron Works, Clinton, and outfitted by Engineering and Mechanical Division shops.

ORNL's Ecologists Conducting Fresh Water Studies on Clinch

One of the problems most often considered today by health physicists and other scientists concerned with environmental consequences of radiation is the biogeochemical cycle of elements released into the environment. The Ecology Section of ORNL's Health Physics Division is conducting both fresh water and terrestrial studies in an attempt to expand information in this area.

The fresh water studies, conducted primarily on the Clinch River, are a relatively new undertaking, having been initiated in October, 1959, as part of the Clinch River Program. A natural laboratory for these studies has been provided by the release of low-level radioactive wastes since 1943 from the Laboratory via White Oak Creek to the Clinch River and then to the Tennessee River.

Directed by S. I. Auerbach, the fresh water studies have primarily involved clams and fish. The studies are designed to provide necessary data for evaluation of possible long-term consequences of exposure to continuous releases of low-level radioactivity, to determine the quantities of radionuclides which may be taken up by aquatic organisms and how environmental factors effect this accumulation, and to increase basic knowledge of stream ecosystems.

Nelson in Charge

D. J. Nelson is in charge of the actual experiments. Staff members who participate in the various studies are R. C. Early and N. A. Griffith, and ORINS graduate fellows taking part are B. G. Blaylock and R. S Martin.

Clams were chosen for one of the major studies for three reasons. Fresh water clams have a shell consisting primarily of $CaCO_3$, with some strontium, and new layers of shell are laid down as the clam grows. Thus, a cross section of the clam shell contains a history of the mineral deposition of the animal in successive

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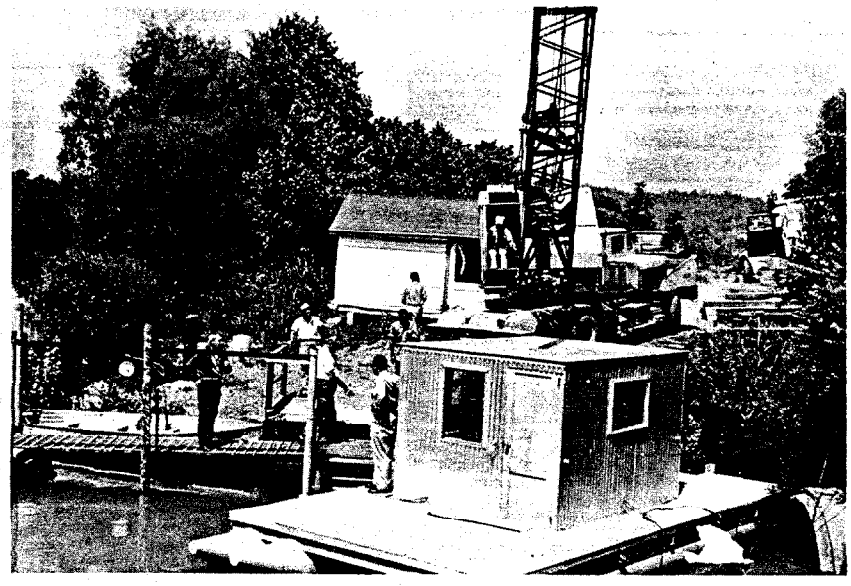


Ecology Section of Health Physics Division Conducting Fresh Water Studies on Clinch

Continued from Page 1

annual layers.

Secondly, clams concentrate strontium up to 8,500 times the concentration in water and take up stable and radioactive isotopes in the same proportion occurring in the water.

Another reason for studying clams is that they are relatively immobile on the river bottom and pump water through their siphons most of the year. Consequently, clams are fairly accurate biological samplers of Sr^{90} content in river waters.

Objectives

There are three objectives of the studies. An effort is being made to determine the content of stable strontium and calcium and Sr^{90} as a function of species and location in the Clinch and Tennessee Rivers. Also, the group is trying to ascertain whether clams may be used as a biological samplers of Sr^{90}, considering Sr^{90} releases from ORNL as a tracer. The third objective is to obtain information on long-term changes in stable strontium and calcium in clams by analysis of prehistoric Indian-midden, pre-TVA, and present-day clam shells.

Chemical analysis for strontium and calcium is made by emission spectrometry. Spectrographic methods are then used to check strontium determinations further.

Chemical analyses made to date have shown that strontium deposition in clam shells is independent of calcium deposition. Analyses also have shown that strontium content varied by a factor of 3.5, depending upon the species analyzed, age of the specimen, and location of collection.

Biological Indicators

The group studying clams has demonstrated for the first time how clam shells may be used as biological indicators of the behavior of Sr^{90} over almost 500 miles of the Tennessee River.

Behavior of Sr^{90} was determined by comparing the specific activity ratio in clam shells collected at various locations downstream from the release site of the isotope. Information obtained by analysis of clam shells indicates that Sr^{90} released by the Laboratory tends to remain in solution and reductions in concentration of the radionuclide result from dilution of contaminated water with uncontaminated water flowing into the river from other streams.

The attempt by the group to obtain information on long-term changes in stable strontium and calcium in clams also has met with success. Separation and analysis of annual layers of clam shell have shown there is a nonhomogenous distribution of strontium. Distribution of the radionuclide seems to be dependent upon structure of the shell and age of the clam. Shell growth rate is the controlling factor of strontium deposition in clams.

The studies have shown that strontium content and calcium content are independent, suggesting that inclusion of strontium in calcium-rich biological tissues may be explained on a physical basis. Strontium is apparently trapped in the deposited matrix by the fast growing calcareous tissues. Likewise, when there is a large surface-volume ratio, strontium excluded from deposited shell may escape to the external environment more readily.

Fish Studies

In carrying out studies concerning fish, ORNL ecologists have caught and tagged over 5,200 fish from the Clinch River near White Oak Creek. The tagging is being done by ecologists primarily to determine movements of fish in the Clinch River system.

There also are three other objectives of the fish studies. The group hopes to determine the uptake and metabolic turnover of strontium and cesium by fresh water fish from a river environment containing Sr^{90} and Cs^{137}; obtain information on whether the ratio of radioactive atoms to stable atoms in the environment may be utilized to predict the body burden in fish subject to chronic releases of low-level radioactive wastes; and ascertain whether there is a seasonal change in strontium and cesium concentration in fish tissues.

Autoradiograph Studies

Autoradiographic studies of fish scales are being made by the group in conjunction with the fish tagging studies. The autoradiograms show the growth rings in which there are concentrations of radioisotopes. These concentrations are so low that exposure periods of up to six months are often required. ORNL's ecologists postulate that since growth of scales is proportional to body growth, the radioactive rings indicate periods when the fish were in contaminated areas.

Radionuclide content of fish from the Clinch River has been found to vary considerably, resulting from the fact that the fish move into and out of the radioactive waste areas.

It has been hypothesized by the group that maximum concentrations of Sr^{90} and Cs^{137} to be expected from chronic release of these isotopes may be calculated when stable strontium and cesium content of fish flesh and water are known. Strontium is measured by flame spectrophotometry and spectrography, methods developed by ORNL's Analytical Chemistry Division. More recently the Analytical Chemistry Division has developed a new flame spectrophotometric method for determining stable cesium.

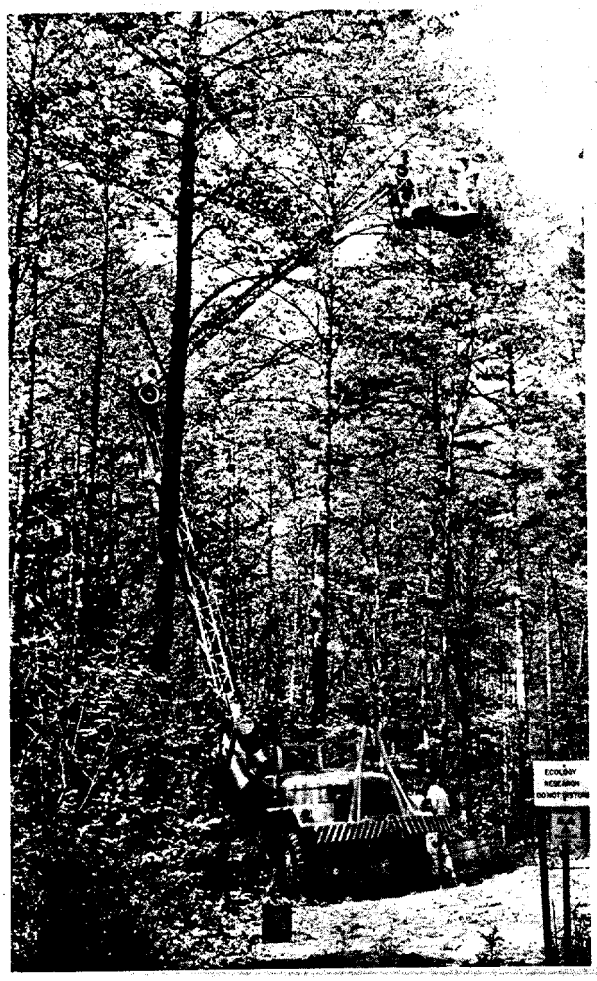
NETTING FISH stunned by a direct current shocking device is R. E. Martin, an ORINS graduate fellow working with the Ecology Section of the Health Physics Division. The shocking device feeds charges into the water by means of electrodes mounted in the bow and stern of the Ecology Section boat. Fish are then netted, tagged, and released, or kept for radiochemical analysis. The tagging is being done by ORNL ecologists to determine movements of fish in the Clinch River system.

Seasonal Change

Progress also has been made by the Laboratory ecologists in their effort to determine whether there is a seasonal change in strontium and cesium concentration in fish tissue. Experiments completed to date indicate that there is a seasonal change of both strontium and cesium concentrations. The minimum concentration occurs in the Spring and the maximum concentration occurs in late Summer or early Fall.

In addition to the major studies involving clams and fish, ORNL's ecologists are conducting minor studies. Two of the more significant studies involve midges, an insect similar to Drosophila, and a new method for analyzing river water. Effects of chronic low-level radiation on a natural population of midges living in the bottom muds of White Oak Creek and the Clinch River are being studied by cytogenetic methods. Distribution of radionuclides among dissolved, particulate, and collodial fractions of river water affects the mode of entry of the nuclides into the food chain and their downstream trasportation. The group, in cooperation with the Biology Division, has developed a density-gradient centrifugation method which makes possible the separation of particulate organic and inorganic matter, colloids, and solutes in natural water.

Other fresh water studies being conducted by ORNL's ecologists are the role of heterotrophic microorganisms in the concentration of specific radionuclides on organic matter; uptake and elimination of various radioisotopes by crayfish; and the role of tubificid worms in the transport of radioactive bottom sediments in the Clinch River



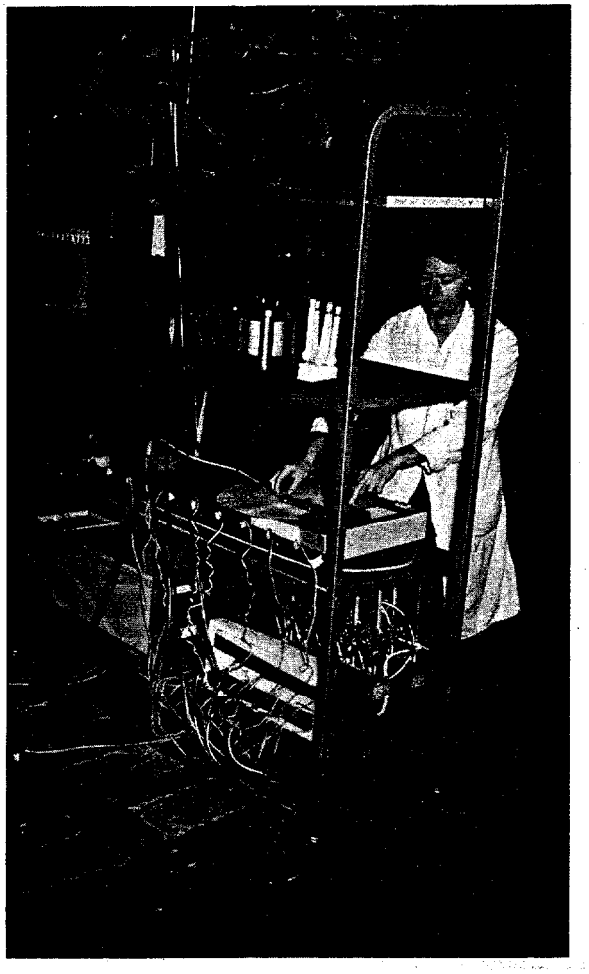
Routine canopy sampling in the cesium forest. Hubert Waller and William Cate are shown in the aerial bucket; Jerry Olson is standing by the truck. The original canopy sampling tower is to the left of the aerial arm (19651.

Moreover, it is mobile within most biological materials, making it suitable for tracing patterns of flow or transfer between ecosystem components. Olson and his colleagues worked out a design that would involve tagging all the tulip poplar trees in a 20- by 25-m stand. Approximately 360 mCi would be injected into 35 trees, the quantity per tree being proportional to its mass; and the tagging was to be done in the spring of 1962. Thus was set in motion the "cesium forest" experiment, which was to become the centerpiece of forest research at ORNL and which would shortly lead to a broader effort in ecosystem radioecology.

Olson's experiments in modeling were drawing heavily on the compartment modeling concepts and ideas being applied and developed by health physicists in their studies on prediction of radionuclide transfers between cells or between organs of a single individual. Olson's modeling efforts were done on an analog computer. Aside from its contribution to ecology, this modeling research was convergent with the new concepts of systems analysis being developed elsewhere, but it had another important result as well. By demonstrating that the methods of ecology were similar to those of other laboratory scientists and that ecologists could contribute to ARC and Laboratory missions, ecological research established a legitimate place for itself at Oak Ridge. Moreover, by the early 1960s this effort, together with research in the contaminated areas, the Clinch River, and associated laboratory research, had made Oak Ridge one of the largest American centers of field-based experimental ecological research.

In 1961 ORNL management decided to hold down the size of the Laboratory. Each division was given a limited quota of new personnel. Expansion would be based on two criteria: (1) uniqueness of the program and (2) value of the program. Within HPD a total of ten new positions were allocated for the fiscal years 1962 and 1963. Of these, four or 40% were assigned to ecology, which was the largest single allocation of any group. In addition, summer programs and an increasing number of graduate students added to the growing strength of ecology. AEC had also established a postdoctoral program, which was administered by ORINS (ORAU). Postdoctoral research was not then common in ecology as it was in molecular biology, but the timing was propitious. Auerbach began to cast about for possible candidates and approached various colleagues at universities, including his former teacher and mentor at Northwestern University, Orlando Park. Park advised him that he had a student, soon to finish, whom he considered to be the best student he had ever had. The student, an invertebrate ecologist named David

Reichle, applied for and received a fellowship and reported to ORINS in May 1964. After a month of radioisotope training, he arrived at ORNL to initiate research under Crossley. His work involved radiation effects studies on insects, and he also began work on decomposition of forest litter and the role of arthropods in that process. He established a number of unique field experiments in conjunction with the cesium forest project. Reichle used the data on cesium accumulation and movement within the plant components of the forest and initiated related experiments on forest arthropods. Eventually, this led to ecosystem process data on nutrient cycling and primary productivity of the forest, as well as on the food consumption energetics and secondary productivity of arthropods.



Marilyn Frank operating data-recording equipment during forest floor decomposition experiments in conjunction with the cesium forest studies (mid-1960s).

While new staff were joining the section, others were taking advantage of educational opportunities to advance their capabilities and future careers. A new program of AEC health physics doctoral fellowships was established that provided for full salary and tuition for qualified applicants. Steve Kaye, whose interests in mammalian radioecology had considerably broadened as a result of his research, applied for and was awarded one of these fellowships, and he left for the University of Rochester early in 1963 to earn a doctorate in radiobiology and health physics.

There were now several threads of ecological research well under way, all tending to converge toward a total systems approach to ecological problems. While the ORNL program was becoming large and varied and was already beginning to achieve national recognition for the advanced studies in ecosystems that were under way, it still lacked expertise in theoretical ecology, a field that Auerbach believed was essential to the development of ecology as a science. To remedy this, two ecologists, Bernard Patten and George Van Dyne, joined the unit in 1963 and 1964, respectively. Olson, Patten, and Van Dyne together helped to establish Oak Ridge's reputation in ecological modeling. One way was through graduate education. Collaborative efforts between the ORNL and UT biology departments had been under way since the initiation of the ecology program, and Olson had been teaching in the Botany Department. Given this background, the three proposed to organize and teach a l-year (3-quarter) course in what they called Systems Ecology. UT Botany Department Chairman Ray Holton was quite interested, and the necessary arrangements were made. This proved to be an outstandingly successful course, attracting new graduate students who would do their thesis research at ORNL. Within a few years it led to the development of a separate graduate program in ecology at UT and the

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Olson to Represent ESA at British Meet

To Present Invited Talk; Begin Guggenheim Study

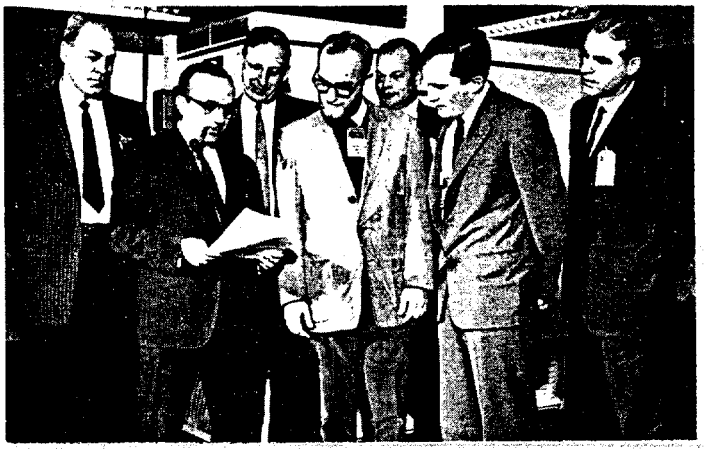
J. S. Olson, Health Physics Division, will present an invited paper before the Jubilee Meeting of the British Ecological Society, March 27-30, in London, England. He will discuss "Gross and Net Production of Terrestrial Vegetation."

Olson

Olson will attend the meeting as the official representative of the Ecological Society of America.

While in England, Olson will hold conferences at several installations, including University College, London; Nature Conservancy, Huntingdonshire; University of Bristol; and Atomic Energy Research Establishment, Harwell.

After attending the meeting and visiting the scheduled installations, Olson will begin a Guggenheim Fellowship at the University of London. Awarded to him last year, the Fellowship will begin April 3 and continue through December 2. 1963. He will be studying the development and maintenance of ecological systems.



RADIOECOLOGICAL COMMITTEE of the Ecological Society of America met at the Laboratory February 27-March 1. The committee selected candidates to attend the Summer Institute in Radiation Ecology to be held in Oak Ridge this summer. and laid plans for future symposia, meetings, and conferences for radiation ecology. Pictured from left are R. B. Platt, Emory University; S. I. Auerbach, committee chairman, Health Physics Division, ORNL; E. P. Odum, University of Georgia; Edward Clebsch, University of Tennessee; F. B. Turner, University of California; G. M. Woodwell, Brookhaven National Laboratory; and T. R. Rice, Fish and Wildlife Service, Beaufort, North Carolina. Another committee member, J. J. Davis, Hazelton Nuclear Science Corporation, Palo Alto, California, had returned when the picture was made.

Friday, January 29, 1965 THE NEWS

17 Habitats Covered **Year-long Search**

Herpetology Survey of Oak Ridge Area 'Turns Up' 372 Individual Specimens

By R. L. WESLEY

The herptiles, those creepy, crawly, slithery creatures that inhabit the waters, fields and forests of the Oak Ridge area, have been the subject of a survey conducted this past year for Oak Ridge National Laboratory.

The survey, described in a new ORNL report entitled "The Herpetofauna of the Oak Ridge Area," was conducted by R. M. Johnson for Health Physics Division's Radiation Ecology Section. Johnson is a member of the Department of Biology at Asheville-Biltmore College. Asheville, North Carolina.

The survey was made to ascertain the kinds of amphibians and reptiles occurring in the area, to evaluate habitat preferences of the herptiles, to evaluate Suitability of the various species populations for ecological studies and to prepare a reference collection of herptiles in the area.

S. 1. Auerbnch, **chief of the Radiation Ecology Section, and ecologist P. B. Dunaway assisted Johnson in setting up the routes to be followed in the survey. Specimens were co 11 e c t e d Johnson, two senior biology students from Tennessee Polytechnic Institute and by ORNL ecologists R. C. Early, Fred Taylor, J. A. Payne, B. E. Jacobs and T. P. O'Farrell.**

Seventeen types of habitats net were covered in the hunt — including various bodies of water, marshes, forests, fields and old, abandoned houses. The survey was conducted p e r i o d i c a 11 through spring, summer and fall.

Collection tools included a small garden implement. wrecking bar, dip net, cloth sacks, glass jars, polystyrene coolers, battery-powered headlamp, funnel traps and the most effective tool of all -the human hand.

The hunt turned up some 372 **individual specimens. These included 52 newts and salamanders (eight species), 158 frogs and toads (11 species), 65 turtles (10 species), 21 lizards (five species)** and 76 **snakes (17 species). Also found were 52 samples of newt and salamander larvae.**

Only five poisonous snakes were found during the survey. All of them were northern copper. heads, normally found in fields. forests or around old, abandoned houses.

Although timber rattlesnakes are known to live in East Tennessee, this survey found none. Several areas appearing suitable for rattlers were investigated carefully, but they were neither seen nor heard,

As for advice on capturing herptile specimens, indications are that such work is not for the squeamish. More species were collected by hand than by trapping. The notable exceptions were the aquatic species of turtle from the Clinch River, captured exclusively by traps.

Johnson reported that queen and water snakes are relatively easy to collect by wad in g or floating slowly in streams and by picking them off bushes as they bask over tbe water. Salamanders also are most effectively captured by hand, although a funnel trap placed in a spring, spring branch or stream might prove effective.

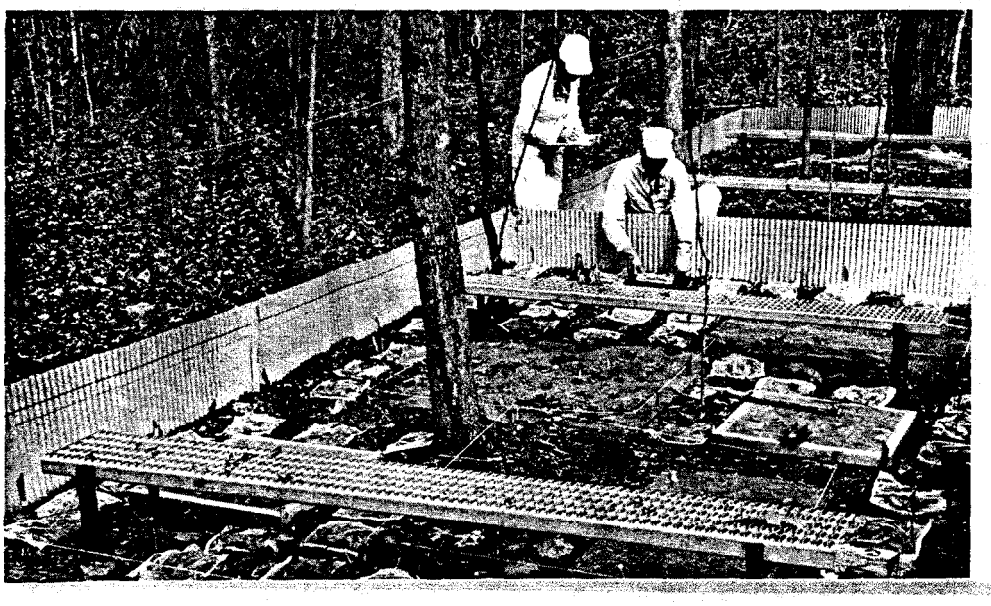
Frogs can be collected with dip net and seine more easily than by hand in water habitats, though hand collection is possible if a drift-fence installation is in a position to intercept one moving y through the water.

As might be expected, lizards were the most difficult of all to capture. A fast pair of hands is most helpful.

On the basis of abundance, ease of collection and ease of maintenance in a laboratory, Johnson recommended that the most suitable herptile species for field investigations in this area are the dusky salamander, eastern gray treefrog, northern cricket frog, pickerel frog, painted turtle, pond slider (turtle), queen snake and water snake.

establishment of a funding relationship between the ORNL ecology program and UT that would serve to provide graduate students, technicians, postdoctoral students, and research associates in increasing numbers during subsequent decades.

Radiation-related research still made up an important part of the ecology program. HPD had completed and put into operation a unique unshielded fast neutron reactor (HPRR) that also provided new opportunities for radioecological investigations. The effects on pine trees and other surrounding flora were investigated by John Witherspoon. Greg Brown, a tree physiologist who had joined the staff in 1962, also conducted studies at HPRR, in addition to his work on the physiological behavior of cesium within the tree systems. Small mammal research under Dunaway had moved from the White Oak Lake bed to a series of outdoor pens, and the emphasis was on increasingly sophisticated studies of blood chemistry. As part of the Clinch River Study, Nelson, in addition to conducting various studies of the fish populations, was pursuing new and, fundamental investigations in biogeochemistry of strontium and calcium using clams and other molluscs.



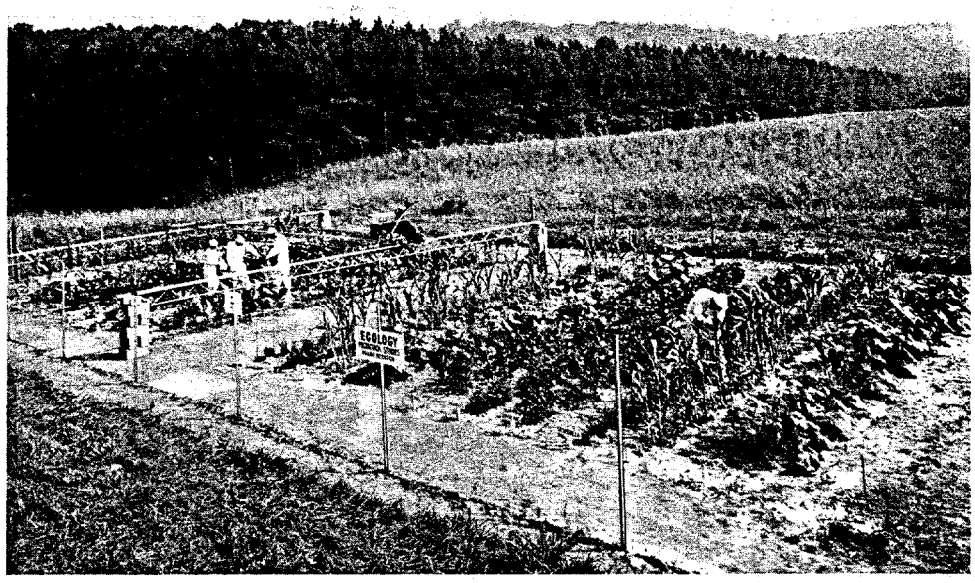
View of one of Dave Reichle's forest floor decomposition and secondary productivity experiments utilizing multiple isotopic tags and litter bags. Individuals shown are Gladys Dodson and Mar&Shanks (mid-1960s).

In the early 1950s ORO had been persuaded by some parties to initiate a forestry program that mainly involved planting all the *open* areas of the reservation with dense stands of pine. After a few years the program was discontinued, although some planting was carried out until 1956. By 1963 it was evident that the plantations needed thinning, and the AEC (ORO) Biological Medicine Program officer Sam Shoup approached Auerbach about the developing forestry problem. TVA, because of its program in forest resources, was also interested in becoming involved. What was needed was an inventory of the forest resources. AEC agreed to underwrite the costs, and TVA assigned one of its forestry scientists, Richard Doub, to carry out the effort in conjunction with Jerry Olson. A year later the folly of planting thousands of acres of pine monoculture was realized when the pine plantations were struck with an outbreak of the southern pine beetle. It also began to spread beyond the reservation. AEC authorized the Laboratory to hire a professional forester to cope with the problem. Fortunately there was a scientist named James Curlin at the TVA forestry unit in Norris who. was a trained forester as well as a research forest physiologist and who was interested in making a job change. Curlin joined the staff and, using members of the forest. research program, especially William Cate and

Hubert Waller, undertook a control program. This involved aerial reconnaissance to locate sites of infection, clearing and burning infected trees, and preventive spraying. Much of the cost of this effort was underwritten by the U.S. Forest Service. Within 2 years the major outbreak was controlled, although it took several more years before the problem was eliminated.

Curlin also developed a management program for the forests on the reservation that subsequently involved thinning and cutting the pines for paper pulp. A little later a lo-year program to supply hardwood was established by TVA, who brought in a logging and processing firm that located outside Oak Ridge. AEC signed an agreement with TVA and the firm to supply a designated amount of board feet of hardwood per year for 10 years. This effort proved to be a mixed blessing because the forestry effort increasingly began to conflict with the ecological research needs and with the concept of the reservation as an ecological research area.

The possibility of nuclear war with the Soviet Union was a major wncem during the 1950s and 1960s. Although atmospheric testing of nuclear bombs had ceased by 1963, the Cuban missile crisis and the continuing aggressive nuclear weapons programs of the Soviet Union stimulated much interest in civil defense and in the potential consequences of a nuclear war. ORNL, under the leadership of Eugene Wigner and Alvin Weinberg, had established a civil defense research effort that had been stimulated by a special summer study in 1961 at Woods Hole, Massachusetts, under the auspices of the National Academy of Sciences. Because of wncem about the ecological consequences of such a war, Auerbach had been an invited participant. He already had been in contact with the Office of Civil Defense (OCD), which had become interested in post-nuclear attack ecological problems. Likewise, John Wolfe had presented at a congressional hearing some years earlier (1959) a horrifying scenario of the ecological and environmental sequelae following a major nuclear attack on the United States. It was timely to consider developing some kind of research study that would provide insight into this kind of ecological problem.



View of a post-nuclear attack plant study plot established in the 0800 Experimental Area. Here John Witherspoon, assisted by Fred Taylor and others, conducted a series of experiments on retention of radioactive fallout by different kinds of crop plants. Note the spreader apparatus in left center. Three individuals in contamination clothing are collecting and bagging samples (1968).

White Oak Lake bed was no longer a satisfactory site for this research because of the closing of White Oak Dam, which had been necessitated by the completion of Melton Hill Dam

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A Most Common Insect Pest

Bagworm 'Bugs' Laboratory Ecologist; Studies Aimed Toward Solving Secrets

By R. L. WESLEY

The bagworm, one of our most common insect pests, is a mysterious creature with secrets yet to be discovered, according to D. E. Reichle, Radiation Ecology Section, Health Physics Division.

Reichle is attempting to determine some of these unknowns in a study involving the use of cesium-134, a beta-gamma emitter with a half-life of 2.07 years.

The cesium was injected into a red cedar tree on the AEC reservation near ORNL. Bagworm infestations on the tree have been imprisoned in wire cages so that they may be removed periodically for study.

By measuring the amount of cesium ingested by the bagworms (caused by eating leaves of the contaminated tree), Reichle hoper, to determine at what larval period the bagworm is the most destructive and, possibly, the specific time at which insecticides would be most beneficial in destroying it.

Reichle is concentrating his attention on the evergreen bagworm, Thyridopteryx ephemeraeformis, a common variety that infests forest areas in much of the eastern United States. It is also a constant plague to home owners who prize their trees and ornamental shrubs. This bagworm is known to feed on some 120 different plants.

The bagworm hatches from an egg in its mother's case-like nest in late spring, after foliage has appeared. Leaving home, the worm-like larva begins constructing its own bag of silk, leaves or twigs, which it will carry about like a mobile home for most of its life, depending on its sex.

There are reports that the tiny larva may transport itself to a new location by the ballooning technique — spinning silken fibers that can be picked up by the wind and carried great distances.

As the larva continues to grow, so grows its bag or case. The case serves as a shelter, protecting the bagworm from predators. The head and forepart of the larva are outside the case when the larva is feeding and may be withdrawn when [illegible] **nemin threaten.**

At times the larva may spin a thread, attach it to, branch, close the case exit by a drawstring and withdraw from the world outside for a period of time. When it is ready to move into a new location, the larva head emerges from the case, bites off the thread and goes on its way, trailing the case behind.

It spends the summer months slowly defoliating the plant on which it lives. In early September, it withdraws into its case, after securing it to a branch, seals the front door, turns around to face the lower part of the case and begins to pupate — changing from a larval to an adult stage.

The sexes differ radically in their change. The female changes from a brown worm to a yellow grub-like form, loaded with eggs.

"The female is just a sack of eggs," Reichle said, "accounting

Continued on Page 2

SCREEN CAGES, placed around bagworm infestations on a red cedar tree injected with cesium-134, are inspected by D. E. Reichle of the Radiation Ecology Section, Health Physics Division. The cages, capped with a canvas sleeve, confine the larvae so that they may be easily collected for study. Bagworm consumption rates can be measured by the amount of cesium they ingest.

EVERGREEN BAGWORM is known to feed on some 120 different plants. Bagworm cases are pictured on (A) spruce, (B) ornamental juniper, (C) white pine, (D) cherry, (E) arbovitae, (F) honey locust, (G) aromatic sumac, (H) red cedar and (I) willow.

ORNL Ecologist Conducts Bagworm Experiments With Radioactive Source

Continued from Page 1

for over 80 percent of her weight. The specimens I have examined averaged about 650 eggs per female, and one specimen had over 800."

In the meantime, the male has grown wings and become a moth-like form. The forepart e t male pupa works its way out of the bottom of the case, splits, and the new form emerges. The male clings to the case for about an how, exercising and drying his wings before leaving home.

"We don't know whether the male adult feeds after he leaves the case," Reichle said, "but we assume that he probably lives on nourishment stored in his system. During the next few weeks he locates a female, probably by scent, enters the female nest and fertilization occurs within the case. It appears that the female mates but once, lays her eggs within the case and drops to the ground to die."

Despite the annual toll that bagworms take on forest areas and home owners' greenery, serious efforts are not applied to eliminate them. Reichle explained, "Since bagworm damage is more insidious and never seems to reach epidemic proportions in forest areas, its damage is not as glaringly apparent as certain other pests."

Bagworm population in forest areas apparently is held in check to some extent by birds, lizards, spiders and the wheel bug, which considers a bagworm a special delicacy. The bagworm also is parasitized by wasps and flies.

Around human habitats, th bagworm does not appear to be seriously bothered by natural the enemies If a bagworm infestation goes undetected, it can de. foliate . prize shrub or tree in a short time

Since the adult female bagwar," is "a, mobile, the eggs remain on the original tree, resulting in a repeated infestation the following year. Reichle recommends that home owners examine trees and shrubs during the winter months and remove the bagworm cases filled with eggs. The cases should be burned to prevent dispersal of larvae from the rubbish pile to surrounding plants in the spring. Spraying is most useful when applied between late June and early August.

(Reichle is anxious to receive any bagworm cases removed, provided they have not been warmed above outside temperatures. Call extension 3-6977, Radiation Ecology Section.)

January 29, 1965

PULPWOOD CUTTERS are salvaging pine trees such as this in an area southeast of ORNL which is heavily infested by the Southern Pine Beetle. Trees are sawed into lengths and shipped to plants which use the wood in paper-making. The men are Herschel (left) and Lonnie Herrell, employees of the Anderson County Pulpwood Company which **purchased the infested timber.**

Attack On Pine Beetle Begins; Some Trees Treated, Salvaged

ORNL's Ecology Section and the U. S. Forest Service have declared war on the Southern Pine Beetle, a small burrowing insect infesting forest areas 'of the AEC-Oak Ridge vicinity.

Salvage operations and chemical treatment are under way to halt the spread of the destructive pest. Between 250 and 300 cords of pulpwood already have been cut.

An aerial survey by the Forest Service revealed that the heaviest infestation was in pine stands southeast of ORNL and in the forest areas to the north and (south of Bethel Valley Road between the Agricultural Research Laboratory and ORNL. Infestation has not spread extensively into Oak Ridge residential areas, although evidence of the beetle has been found in the Black Oak Ridge and Gamble Valley sections.

Ground crews have inspected areas of infestation found in the aerial survey. noted the number of trees affected and marked areas for the salvage operation Trees marked for salvage are being cut into lengths and shipped to pulpwood plants. Pines around the perimeter of the salvage areas suspected of being brood trees for the insects Will be cut and sprayed with larvae-killing chemicals.

Treatment and salvage. to be effective, must be performed during winter months while the beetle is i" the larval stage.

The pine beetle burrows through the bark of shortleaf. loblolly and Virginia pines common to East Tennessee. deposits its eggs in tree tissue. and causes irreparable damage which results in killing the tree.

Symptoms of an infested tree are the discoloration of pine needles — from yellow-green to a reddish-brown — small pm holed in the bark. and winding channels beneath the bark on the wood surface.

J. W. Curlin, Health Physics, Ecology Section, sad crews hope to have the beetle under control before winter broods beg in to emerge in the spring.

upstream on the Clinch River. After, numerous planning sessions, the concept of contaminating a large area (approximately 5 acres) with artificial radioactive fallout stimulant was conceived. The site chosen, adjacent to the Clinch River, was cleared of the resident pine plantation and designated as the 0800 Experimental Research Area. The dose was to be sufficiently high to require remote control. application. The field would have to have several barrier fences, and collections of organisms would have to be carefully carried out with great speed to minimize exposures to the staff. Dunaway planned the mammalian research effort. Van Dyne came up with new sampling designs and an apparatus for sampling vegetation productivity. Most of the terrestrial staff were involved in some aspect of the proposed effort. A research proposal, including a detailed hazard analysis, was prepared and submitted to AEC with first-year costs of approximately $75,000. The Division of Biology and Medicine accepted it and included it in their proposed budget to Congress. The project was then included in the, hearings of the Joint Committee on Atomic Energy, which had total oversight over AEC. However, it turned out to be a year of'stringent budgeting, and the Committee would not recommend the project for funding. This proved 'to be fortunate; if the project had been approved and the group had been successful in contaminating over 5 acres of river-adjacent bottom land with ^{137}Cs, the remediation problem that would have to be dealt with today would be enormous Nevertheless. the idea was, a good one and OCD encouraged continued consideration of a smaller scale project. This was done, and some years later (1967) a series of plots (still extant) were established in the 0800 area under OCD funding. Each of the experimental units received 2 Ci of ^{137}Cs coated: on fallout-size particles of weapons. This project involved new staff member , Roger Dahlman as well as many of the regular staff, plus Clarence Styron on assignment from the U.S.

Crew removing a cask containing 2 curies of ^{137}Cs-tagged sand from shipping container prior to unloading it into spreader at right center. Crew in this picture include Roger Dahiman, Paul Dunaway, Stanley Auerbach, Jay Story, and one unidentified person.

Creation of the post-nuclear attack ecology study plots in the 0800 Experimental Area. At top, the remote-controlled fallout spreader is moving along the track distributing 2 curies of ^{137}Cs-tagged sand. Person crouching at left is controlling spreader.

Army. It turned out to be the last major field experiment in which radionuclides were applied experimentally on a significant scale to test for effects, although radiotracer studies in previously contaminated areas as well as in new sites would still be done.

The Radioactive Waste Research Section entered the new decade with an ambitious array of research activities under way. Cowser, Jacobs, de Laguna, Tamura, and Lomenick were in the process of completing their detailed studies of ORNL waste pits 2, 3, and 4. Since the pits did not represent satisfactory approaches to ground disposal, there was little justification for carrying out more research on them. Work was shifted to the solid waste burial grounds, especially Nos. 4 and 5. No records were available on the contents of burial ground 4, but it was known that some thousands of curies of radioactivity were disposed of with the solid materials in the trenches. A program to define the geologic and hydrologic conditions by means of wells was initiated. The data soon revealed that high water table conditions prevailed in part of the burial ground and was a cause of radionuclide leakage. Although this represented fairly early identification of the problems, it would be almost a decade before effective corrective actions were carried out to lower the water table at burial ground 4.

In his studies of deep well disposal, de Laguna had become aware of the process of rock fracturing (hydraulic fracturing) used in oil fields to augment the flow of oil. The concept of hydraulic fracturing as a means for waste disposal was both novel and to a certain degree contentious because basic theory on rock fracture mechanics was lacking. Nevertheless, the idea of-using the process in reverse, that is, creating a fracture system that would inject waste under high pressure and fix it in place deep underground, had considerable appeal for the Oak Ridge situation.

Under de Laguna's leadership, a set of fracturing experiments was designed and carried out in the Melton Valley area. A critical element in this process was the cementatious grout that would serve as the carrier of the wastes and the filler for the voids created by fracturing. The grout had to meet critical flow parameters and yet have a fairly rapid setting time. Tammy Tamura was assigned the responsibility for developing a grout based on Portland cement. The first tests proved to be successful. A wide fracture pattern was established and the grout set quickly in the voids. Furthermore, ground distortion appeared to be slight, and structural analyses made by Bill McClain illustrated the efficacy of the disposal process. As a result, plans for more realistic experiments using radioactive materials were made early in the 1960s.

Oak Ridge National Laboratory

NEWS

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ORNL Ecologists Study Radiation Effects On Wild, Native Mammals

By ANNE POWELL

What is the radionuclide turnover and the effect of irradiation on the ever-hungry moles, the primitive opossum, the foxes, raccoon, skunk and rodents our most numerous mammal?

In addition to studying basic ecology, the interrelationships among a population of organisms and their environment, finding these answers is the task of the vertebrate ecology group in the radiation ecology section of Health Physics.

wild, native species is that these animals are similar to the populations living near radioactive disposal areas. By placing the animals in large pens, the environment to which they are accustomed is approximated thus eliminating any biological changes due to the stress of confinement.

Dosimeter readings whole-body counts and blood work are made at 30-day intervals. Rather than simply show how much radiation the animal was exposed to, these

Continued on Page 2

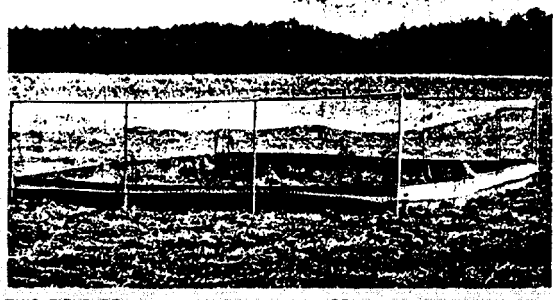
Current research includes a study of cotton rats living in field enclosures containing the fallout simulant, tagged cesium-137. Simulant ingestion and excretion rates, cesium-137 turnover rates in various tissues, radiation doses received by the rats, and radiation effects are measured quarterly.

Cesium-137 Tagged Sand

To conduct these studies, eight 1,000 square feet enclosed pens are used. Sand tagged with cesium-137 is spread over the vegetation in the pens.

Native, wild animals are trapped and records are made of their age and health conditions. Two dosimeters, one on the underside and one on the back, are placed on each animal, and eight animals released to a pen.

The obvious necessity for using



THIS FIELD PEN is one of eight used by ORNL ecologists to study the radionuclide turnover in native vertebrates. Comparisons are made before and after small animals are exposed to sand (fallout simulant) tagged with cesium-137.

SAND CONTAINING the fallout simulant (tagged cesium-137) is spread over the enclosed pens with the mounted spreader. Changes in the animals placed in the readied pens are studied by the ecology group in Health Physics.

Ecologists Conduct Mammal Studies

Continued from Page 1

methods show the actual uptake, the overall distribution, the tissues in which the isotope concentrated, the body shielding and any consequent changes.

Body Shielding Important

As would be expected, the dosimeters placed on the underside nearer the ground register more radiation than those on the back. Body shielding (water) also plays an important part. For example, a mouse will show a comparatively even distribution throughout the body while a cow receives very little radiation in the center of the body.

Similar studies are determining whether the metabolism in three species of free-ranging rodents can be measured by radioisotope tagging.

Another study is attempting to determine food consumption and energy flow in populations of small animals feeding on irradiated white-pine seeds.

Energy Flow Studied

Determination of food consumption, metabolism and energy flow have always been problems to ecologists. These studies will help provide answers as to whether radioisotope techniques can be used to answer these questions.

Comparisons of radiation effects in systems with rapidly proliferating cells, particularly the gastrointestinal tract (a radiation-sensitive system), are being made using a thymidine analog. Incorporated into forming cells, this will be used to determine and compare cellular proliferation rates in nine species of small mammals.

Another important advantage in using wild animals is that biological measurements can be made on a basis of taxonomy.

Consequently, experimental data for closely related and even distantly related species can be compared as to how specialized or how general a particular biological response may be.

Red-Cell Count Varies

For instance, the vertebrate ecology group discovered that the seemingly random differences in red-cell count and size among many species of mammals actually were related to the size of the species, but this relationship was true only with a given taxonomic family. The blood-forming tissues of vertebrates are sensitive to radiation. Recent analyses of radiation and blood studies of many species has helped to predict radiation effects in untested species.

Radioisotopes Measure Metabolism

Similar studies are determining whether the metabolism in three species of free-ranging rodents can be measured by radioisotope tagging.

Recent analyses of work with toads reveal that adults are more resistant to radiation than mammals in terms of morality. However, tadpoles and juvenile toads succumb to low levels of radiation, especially in the late stages of transformation.

As a result toad population may be vulnerable in an irradiated environment, even at relatively low-radiation levels, if the radiation is present during the transformation stages.

Hemoglobin Synthesis Unrelated to Size

A recently completed study of iron-59 elimination rates in 13 species of mammals shows that iron turnover, unlike most elements tested, is not related to the size of the animal. Since iron is utilized in hemoglobin synthesis, this finding indicated that hemoglobin synthesis and red-cell production rates are

Chapter 4

Oak Ridge National Laboratory

NEWS

A Publication for the ORNL Employees of Union Carbide Corporation

Vol. 22 — No. 8 OAK RIDGE, TENNESSEE Friday, August 15, 1969

Ecology Group Gets Wolverine To Maneuver On Rough Terrain

By BARBARA LYON

You take the high road and I'll take the low road, but the ORNL ecologists will get there before either of us.

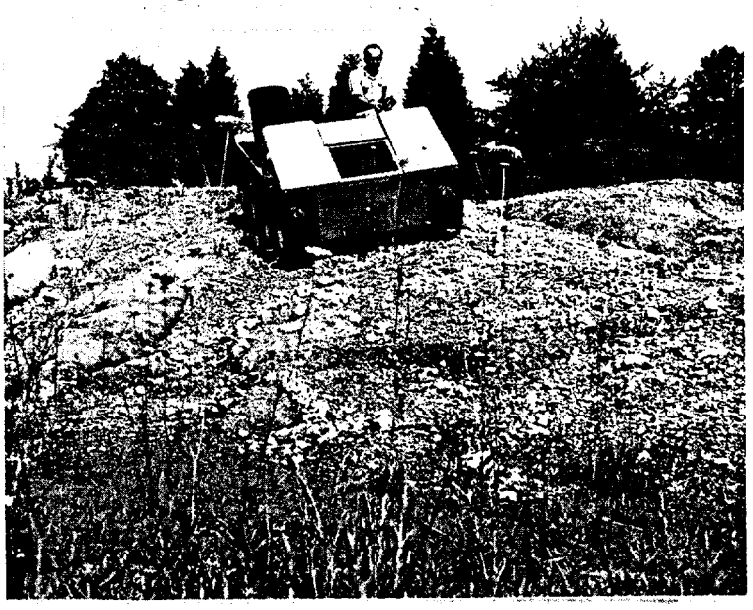
For the Ecology Section has a new way of getting from here to there, and it hasn't anything to do with where the road is.

A Wolverine rough terrain vehicle has been added to the equipment on hand for studying terrestrial and freshwater ecology at ORNL, and it travels with ease across ridges, ditches, and Melton Hill Lake. A small, S-wheel amphibian, the Wolverine is built to maneuver the rugged and steep terrain that must be covered in the section's Watershed Project and Forestry Management.

It has no steering wheel, nor do the wheels steer. The driver turns the machine by applying one or the other of the two hand brakes, each of which controls all four wheels on either side. It has a climb gradability of 75 percent, and a side slope capability of 40 percent, and when it is afloat, it propels itself by the turning of its heavy-tread, 12-inch tires.

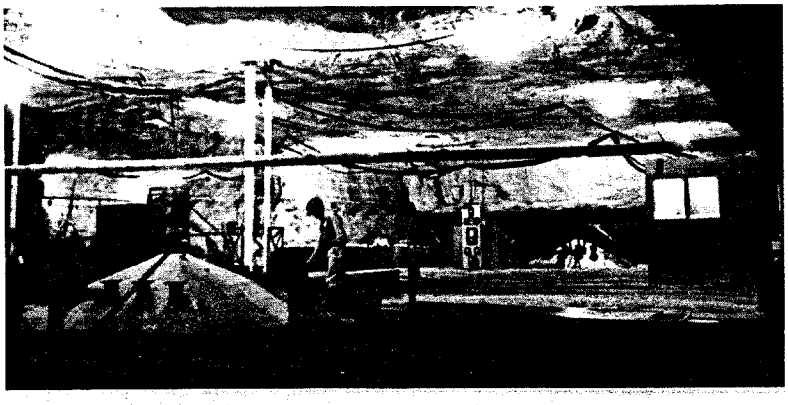
Its engine is a V-4,55 hp Ford industrial, with a 4-speed forward and a reverse transmission. All mechanical components are contained within the watertight hull.

Since its arrival, two changes have been made on the Wolverine: It has been fitted with roll bars, as an added safety feature; and it has been painted a conservative gray. When it came from the factory, it was brilliant orange.



THROUGH THE FOREST AND OVER THE HILL S. I. Auerbach, head of Radiation Ecology Section of Health Physics Division, guides the department's new Wolverine rough terrain vehicle. A 1,975-lb. amphibian machine, it consists of a watertight hull on eight wheels, topped by two fiberglass bucket seats. It will be driven principally by Tom Grizzard in the department's Watershed Project.

Another research endeavor under way in the waste disposal research area dealt with the sorption of different radionuclides by minerals. Most of this research was carried out by Tamura and Don Jacobs. Their work was pioneering and provided our first major insights on the physical-chemical mechanisms governing the behavior of cesium and strontium, as well as other radionuclides, in soils of differing chemical and clay compositions.

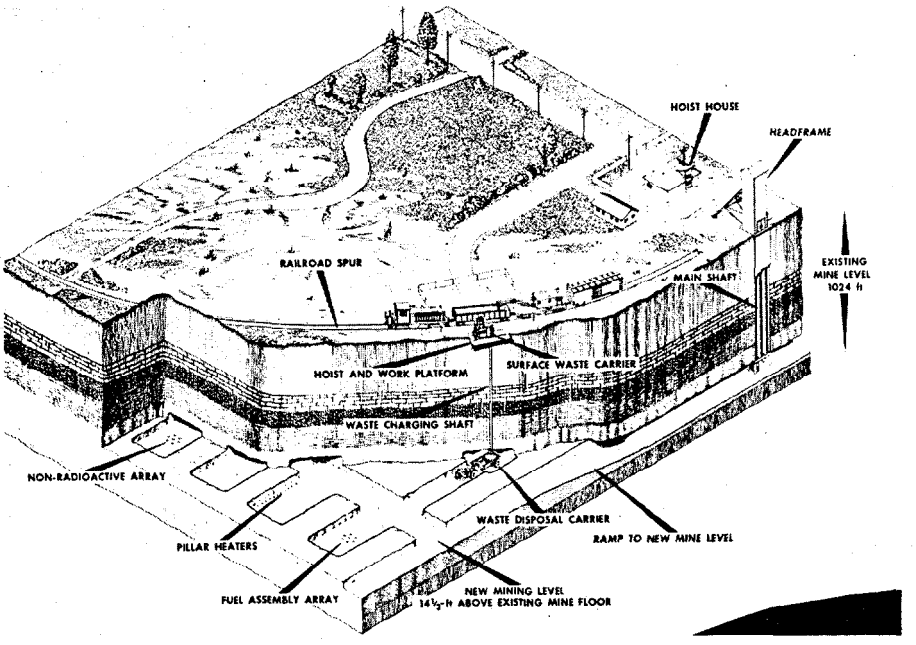


Experimental test area for measuring plastic flow in the Carey Salt Mine, Hutchinson, Kansas. The pyramidal shields covered a test cavity in which simulated liquid wastes were emplaced and heated to simulate fission product temperature buildup (1960).

Meanwhile, salt mine experiments continued in Lyons, Kansas. Once the contract with the Carey Salt Mine Company had been finalized, Struxness assigned Fleming Empson, to be assisted by technician Ben Houser, to initiate work at the mine. Both of these men were hard working, dedicated, and yet unassuming in manner and action. They moved to Lyons with their families and established excellent rapport within the Lyons community-a factor that helped neutralize community concerns about having a major experiment dealing with radioactive wastes carried out in the area. In fact, as reflected in local newspaper stories, the community saw considerable potential economic benefit in becoming a major, high level waste repository location.

By 1962, experiments in the mine and other studies had progressed sufficiently to enable planning to begin on experiments in salt that would simulate the actual disposal of canned wastes into holes drilled in the mine floor. This demonstration experiment, which was called Project Salt Vault, was to begin in 1965 and would involve emplacing very high-level radioactive sources. However, instead of actual wastes, 14 canned test reactor fuel assemblies from the Idaho Engineering Test Reactor would be used to simulate the heat generation and radioactivity of solidified high-level wastes. To prepare for Project Salt Vault as well as to provide additional data on salt formation behavior, elaborate testing facilities to measure changes in plastic flow of salt were designed by Bill McClain and installed in the mine at Hutchinson, Kansas. Other kinds of experiments and physical test measurements also were started in anticipation of larger scale tests later on.

While the production and testing of bombs was a major preoccupation of AEC in the 1960s, there was a new direction being considered under the Atoms for Peace program that had been promulgated by President Eisenhower at the First Geneva Conference on Atomic Energy. As part of this effort, AEC began to investigate the use of nuclear detonations for constructive purposes, e.g., excavating harbors, moving land masses, fracturing underground natural gas formations, and building canals. The Soviets undertook a similar program about the same time. AEC dubbed this program Project Plowshare. HPD was given the responsibility for assessing the potential radiation exposures and doses to the public that might result from the use of such devices. It was already recognized that such explosions could result in movement of radionuclides along environmental pathways into human food chains. Au assessment group was established under Ed Struxness that included Ken Cowser, Don Jacobs, Charles Burton, Paul Rohwer, and Steve Kaye (who had successfully completed his doctorate). This group undertook the development of new systems models that were based in part on the ecosystem transfer models that had been developed in the ecology program.



Schematic diagram of the proposed demonstration of radioactive solids in salt, based on Project Salt Vault in the Carey Salt Mine, Hutchinson, Kansas (1963).

One of the major proposed Plowshare projects was a plan to create a second transisthmian canal in Central America by exploding a string of nuclear bombs. A special canal commission was established to direct the planning and environmental assessment of this proposed action. Recognizing that the majority of people in the proposed canal zones were members of primitive native tribes who subsisted on dietary items that were exotic by our usual standards, the commission funded teams of radioecologists from a number of universities and laboratories to. collect field data on food habits, quantities, and any other information on dietary and single and group behavior patterns that would be needed in a dose assessment. The ORNL group was to determine how soon the evacuated people could return to areas that had been exposed to 18–21 nuclear explosions per site and more than 200 radionuclides from each explosion. Kaye and his collaborators developed a transfer model based on the ecosystem compartment transfer models that had been developed by ORNL radioecologists. The radioactivity transfers from one compartment to another were represented by rate coefficients or transfer factors. In addition, the model was designed not to simulate cycling of radioactive materials within each component of the environment, but to predict its accumulation in a single compartment, a human being. The Canal Commission recommended against the proposed project. Their decision was based in part on the ORNL analyses, which predicted that the native populations would be exposed to an unnecessary risk from the radioactivity. Similarly, the work of Jacobs and Burton on estimates of dose to humans from gas reservoir stimulation assisted in the government's decision to forego such development.

In spite of all these activities, planning for new projects was always under way in the Radiation Ecology Section. Because of the dynamic status of overall Laboratory planning and Director Weinberg's interest in "big science" approaches to major issues, there was continuing emphasis on scoping out new ideas for major environmental or ecological research projects. Dan Nelson's aquatic programs on the Clinch River were due to terminate, and White Oak Lake presented only limited possibilities for major aquatic ecological research. Nelson had studied stream ecology while a student at the University of Georgia and had worked particularly on land-water interactions and the influence of allochthonous materials on stream ecosystems. He and Jim Curlin proposed that we should initiate a major land-water interaction study

Hutchinson, Kansas, Thursday, June 1, 1961

AEC Tests in Salt Mines Called 'Very Successful'

(Picture, Page 1)

By STU AWBREY

Two years of tests at the Carey Salt Mine have shown that rock salt formations may offer the best natural storage facilities for atomic waste, a nuclear energy expert said here Wednesday.

Initial tests recently concluded at the mine were "very successful," said Edward G. Struxness, senior scientist at the Atomic Energy Commission's Oak Ridge National Laboratory.

He indicated that tests of solid waste disposal would probably be conducted in the Lyons or Hutchinson area within the next three years.

Faced with the problem of disposing of various high-level elements produced by atomic reactors, the AEC contracted for an area of the Carey mine in 1950 to see if the intense heat generated by the radioactive materials could be dissipated within natural salt formations.

Struxness listed the following results:

1. Heat can be dissipated in rock salt formations. Heat transfer is the most critical factor in the disposal problem.
2. The effect of heat on the movement of salt cavities is almost negligible.
3. Noxious gases produced by the interaction of waste solutions and salt can be controlled easily.

Effective Shield

The high density of rock salt makes it an effective shielder of radiation, Struxness said.

Owing to related progress in the conversion of liquid nuclear waste to solid waste, it is unlikely that any liquid waste will ever be stored in a salt mine, he said.

"A waste disposal facility in a salt mine might handle relatively small packages of solid waste with very high heat generation rates, rather than the larger volumes of liquid waste forecast a few years ago," Struxness said.

"For this reason, we are shifting the major emphasis in our field research to a study of the problems related to disposal of high - level, radioactive solids," he added.

Struxness cited "great strides" made in converting to solid waste at the Idaho Falls, Ida., pilot plant, which is expected to go into production of solid waste by the fall of 1963.

This will eliminate the risk of spillage and make storage much safer and easier, and will also cut waste to one-third its present volume, Struxness said.

Laboratory work and design of test facilities for further experimentation in Hutchinson and Lyons mines might be completed within the next year or two, he said.

Only at Lyons

Union Carbide Nuclear Company, which does much of the waste disposal work for the AEC, has agreed with the Carey Salt Company to use actual radio-active materials in the Lyons mine only.

It is possible that nuclear waste will be tested within the Lyons mine within three years.

Strong mineral solutions similar in effect to radioactive waste have been used in the experiments to date, without danger of contamination.

"We're trying to put radioactive waste away so it will never come back to haunt us," said Struxness.

To this end the government has spent about $250,000 for the Carey mine tests, which began March 9, 1959.

About 95 per cent of the present nuclear liquid waste is stored in underground steel tanks at Hanford, Wash., Idaho Falls, Savannah River and Oak Ridge. Over 65 million gallons have accumulted since 1945.

Another problem, in addition to the pyhsical potential of contamination is the need to cut cost of nuclear production, much of which stems from disposal overhead.

Limiting Factors

There are two limiting factors involved in rock salt waste storage, both of which are greatly minimized by the anticipated shift to solid waste.

First, salt was found to be penetrative in the recent tests. In other words, the tremendous heat generated by hot fission waste might dissipate through the earth, spreading radiation to the soil, underground water supplies and food that comes from the soil.

"We'd hoped rock salt would be an impenetrable tank," Struxness said. "But it will leak."

That is the reason waste simply can't be buried anywhere. And even rock salt, with its high density and poor conductivity, would not be a 100 per cent barrier against the "migration" of radiation.

For that reason, Struxness said he doubts seriously that liquid waste will ever be put into a salt cavity.

A second limiting factor is that liquid decomposition into hydrogen and oxygen produces an explosive solution. Again, this factor would be negligible in solid waste.

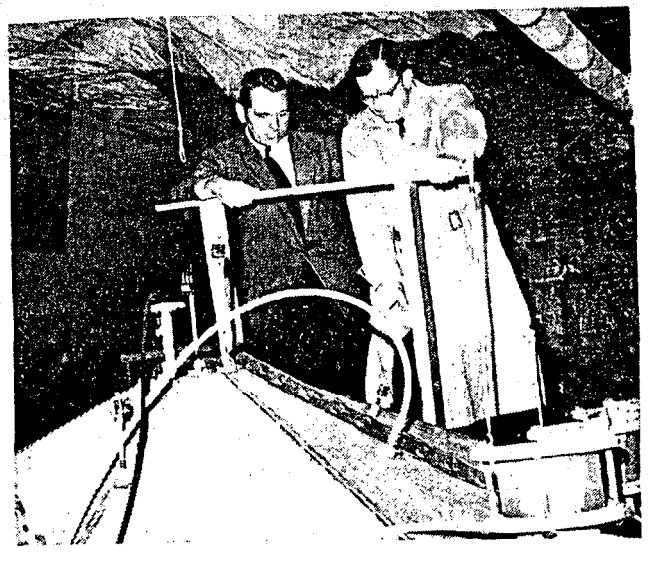
There is no indication that nuclear waste will be stored permanently in this area, even if salt formation storage proves feasible. Presumably, waste would be stored in salt mines nearest the reactors.

Praises Firm

Struxness praised the Carey Company for making a "great contribution to the success of our program." He cited the work of Leo Reid, mine superintendent, who complemented a device for measuring shifts in floor and ceiling by the invention of what was named the "Reid guage."

Visitors at the mine site Wednesday included Fleming M. Empson, Oak Ridge, superintendent of the field experiment; Dr. Frank Foley, Kansas state geologist; Gerald Hanson, supervisor of radiation hygiene, sanitation division of the State Board of Health; Don Cowen, information officer, Oak Ridge National Laboratory, and John A. Harris, information officer, AEC.

Struxness is a brother of Dr. E. B. Struxness of Hutchinson.



ONE OF CAVITIES in Carey Salt mine, where simulated atomic waste was stored, is inspected by Edward G. Struxness, Oak Ridge scientist, right, and Howard J. Carey Jr., president of the salt company. (Story, Page 1.)

Daily Leased Reports of Associated Press
OAK RIDGE, TENNESSEE, TUESDAY, FEBRUARY 18, 1964
Published Every Evening Monday Through Friday

Two Oak Ridge National Laboratory researchers are shown at the site of the hydrofracturing experiment. Standing in front of storage tanks are E. G. Struxness (right) and Wallace de Laguna.

Unique Experiment In A- Waste Disposal']

Full-scale testing d a unique new method for disposal of radioactive waste — by pumping thousands of gallons of grout into man made fissures hundreds of feet underground — began last week at Oak Ridge National Laboratory.

The procedure was developed by a team headed by E. G. Struxness, associate director of ORNL's health physics division. Others in the group include Wallace de Laguna; R. C. Sexton; Tsuneo Tamura; and H. 0 . Weeren.

The tests were announced today by ORNL and the Atomic Energy Commission.

"The hydrofracturing method involves mixing the waste material with concrete and other additives, then pumping the 'grout' into a well about 1000 feet deep. The well extends into shale which is made up of thick horizontal beds. The shale is extremely impermeable to water." says the announcement.

Under pressure, the water mixture creates a horizontal crack in the shale and the crack then fills with the mixture, forming a tin horizontal sheet several hundred feet in diameter.

The mix hardens and permanently holds the wastes in the formation. Test borings are made in the vicinity of the well to determine characteristics of the horizontal sheet.

In the initial run, which was conducted last week, no radioactive material was used. The waste was simulated. If the hydrofracturing procedure proves successful. the system ultimately will be used for disposal of intermediate level wastes containing less than 10 curies per gallon," says officials.

The test being conducted this week is part of the final checkout d mixing and pumping equipment. The injection consisted of a concentrated solution of synthetic waste with a colored dye tracer.

Another test is scheduled before experimental injections of actual wastes begin. The first "hot" test injection will involve Ithe "se of gold 198 as a tracer lfollowed by experiments with actual wastes containing about .015 curies per gallon. About 40,000 gallons of liquid will be used in each test.

The same will may be used repeatedly with horizontal sheets being formed at vertical intervals of 10 to 20 feet,

About 4,000,000 gallons d intermediate level wastes are generated at ORNL each year, and one well could accommodate ORNL's wastes of this type for several years.

"If the process is successful for dsiposal of ORNL wastes, ft has potential application at other atomic energy sites where suitable geological conditions exist," AEC r a y s :

using a watershed on the reservation for an.. ecosystem study. After a reservation search, they chose Walker Branch, a stream about 1 mile east of the 7000 area, as the proposed site. Their timing was propitious as ecologists were beginning to give more attention to watershed research. , The Hubbard Brook ecosystem and watershed study in New Hampshire was just beginning to produce results, and several months earlier American planners of the International Biological Program (IBP) had chosen total drainage basins or watersheds as their main research focus.

In their 1966 proposal to ARC, Neison and Curlin pointed out that a watershed study was valuable because of the. influence that the terrestrial system has on the aquatic ecosystem. A stream continually imports both energy and elements; water quality and biological productivity, therefore, reflect production and elemental cycling in the surrounding terrestrial ecosystem. In addition, such a study could provide a basis for dealing with pollution and other problems of the aquatic environment by focusing particularly on studies of water quality rather than quantity. The latter had been the focus of many experimental watershed studies during the previous three or four decades. John Wolfe of ARC immediately liked the idea, and capital funds were made available for the next fiscal year to design and construct the two weirs on the twin tributaries of the stream. The V-notch steel and concrete weirs, complete with their stilling basins and gaging system for measuring water height and flow, were state-of-the-art systems, in total contrast to the weirs then being used by the Laboratory Operations people to monitor radioactivity on portions of White Oak Creek; those weirs consisted of pieces of cut plywood inserted into the stream bottom. This project marked the beginning of a process of educating pertinent operating and engineering staff about the requirements of large-scale environmental research and about the sophisticated devices and instrumentation that were already being utilized in the various disciplines that were involved.

By 1967 Crossley and Patten had gone to the University of Georgia and Van Dyne had gone to Colorado State University, but their niches were shortly to be more than adequately filled. Dave Reichle, who was already demonstrating his outstanding scientific leadership abilities, took over the leadership of the terrestrial research projects, and Robert O'Neill and Henry Shugart, who would have major and significant roles in modeling and ecosystem research, joined the staff.

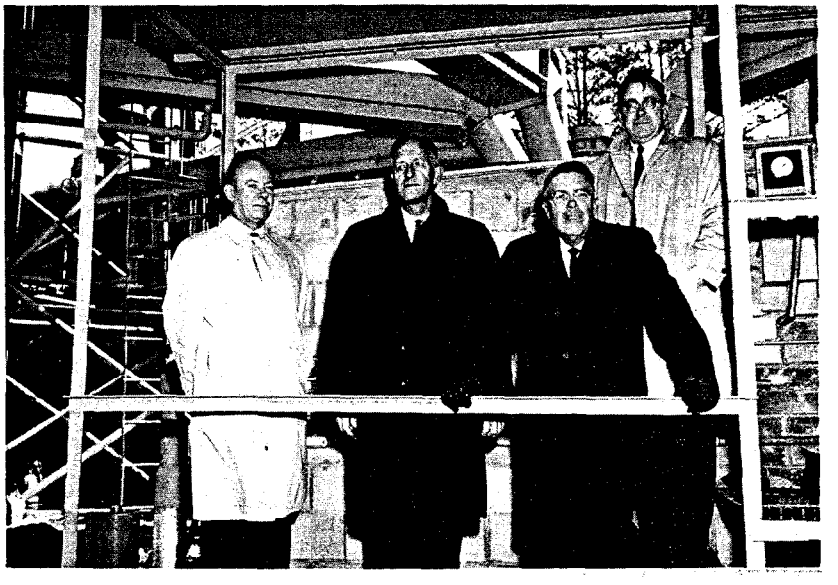
In 1967 O'Neill was at the University of Illinois, writing his doctoral thesis on the energetics of millipede populations. Hearing of Olson's and Reichle's use of mathematical models of radioisotope behavior, he was eager to try these methods himself. Reichle encouraged O'Neill to come to ORNL, but all that could be offered at that time was half of a postdoctoral fellowship. O'Neill came immediately, and within a year became a permanent member of the staff. In the following decades, he would become a major contributor not only to ecosystem research and modeling but to many new concepts both in theoretical ecology and in environmental science.

Henry Shugart had been one of Patten's first doctoral students at the University of Georgia. When he first joined the staff, he was involved in some White Oak Lake research, but he quickly became involved in the q-quarter core Systems Ecology course at UT and soon became responsible for teaching all three quarters. In addition to becoming a major contributor to ecosystem modeling, he and his graduate students were widely recognized for their contributions to the development of forest growth models covering a variety of global forest ecosystems.

There were many doctoral students, some of whom would assume key leadership roles later in their careers. One of these was W. Frank Harris, a graduate student from UT, who worked on radiation effects on plant productivity. After getting his degree, Harris was recruited by Reichle to join the staff, and he contributed significantly to IBP research efforts; he would eventually lead the terrestrial research program until he joined the National Science Foundation (NSF). Another graduate student, R. I. Van Hook, who majored in entomology at Clemson University, studied radionuclide turnover by arthropods, especially spiders, and the role of these arthropods as invertebrate predators in ecosystem energy flow.

After completing his doctorate under Reichle, Van Hook joined the staff, and his leadership abilities soon became manifest. Although he remained in the ecology unit, where he would eventually become the leader, he also became involved in other laboratory environmental programs over the next decade.

The Radioactive Waste Disposal Section also underwent changes. Frank Parker took a leave of absence to teach at Vanderbilt University for a year. He was offered a professorship after that period and chose to remain at Vanderbilt, where he has had an outstanding career leading to membership in the National Academy of Engineering and joint professorships at Vanderbilt and Clemson universities. Ken Cowser took over leadership of the Section.



Viewing a *hydrofracture* test operation. Left to right are Gale Young (ORNL assistant director), Karl.Z. Morgan (HPD director), Walter Jordan (ORNL assistant director), and Ed Struxness.

Also by 1965, after nearly 8 years of work, the seventh and last experimental injection by hydraulic fracturing was completed in the Melton Valley test area. By this time a complete and operational hydraulic fracturing plant had been built in this location. As a result of several test injections, staff were able to work out operational procedures and arrive at a satisfactory grouting mix, as well as test such things as grout fixation within the fractures, geologic uplift, and radionuclide fixation based on experimental injections using curie quantities of ^{137}Cs and ^{90}Sr. Following the seventh injection, the facility was put on standby, and in 1966 the Operations Division took over responsibility for the plant to use it for the routine injection or disposal of the Laboratory's intermediate-level wastes.

Project Salt Vault (Lou Bradshaw, Fleming Empson, Bill McClain) was initiated on schedule with installation of the Engineering Test Reactor fuel assemblies. These assemblies consisted of used fuel elements whose radioactivity would simulate high-level wastes; the elements were sealed in canisters, two per canister, and lowered 1000 ft into the salt mine through a completely redesigned and reconstructed hoist facility. They were then placed on a shielded underground transporter, which moved over the previously prepared test holes and hydraulically lowered each canister, together with a shield cover, into one of the holes. A typical test set consisted of 14 fuel assemblies, which contained a total of 1.5 million curies; therefore, each canister represented approximately 200,000 curies of radioactivity. During the 19-month operation of the radioactive demonstration, the average dose to the salt was about 8×10^8 rads, with a peak dose of 10^9 rads. By the end of 1967 the remainder of the mine experiments had been terminated and arrangements were made to place the test mine on a standby basis. On the basis of these studies and demonstration tests, the staff in radioactive waste disposal believed that they had demonstrated the feasibility and safety of handling highly radioactive materials in an underground environment. The stability of the salt under the effects of heat and radiation was shown, as well as the capability of solving minor structural problems by standard mining techniques. Moreover, an economic analysis carried out in conjunction with the Chemical

THE OAK RIDGE NATIONAL LABORATORY NEWS

A Publication *for* the ORNL Employees of the Nuclear Division of Union Carbide Corporation

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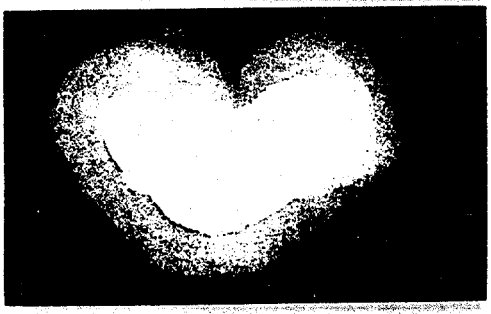
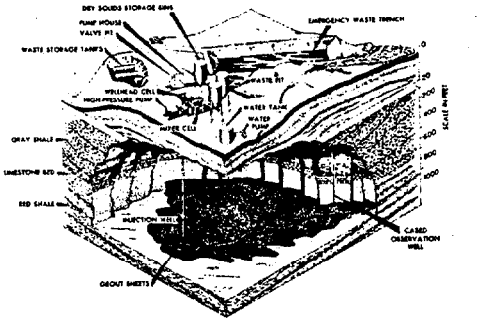


A BELATED VALENTINE, formed by an erratic carbon coated uranium carbide fuel particle, is offered to readers of the News by members of Metals and Ceramics Division who made the discovery while scanning low-voltage microradiographs of thousands of the normally spherical particles. This particle, magnified 200 times, reveals an irregular clustering of fuel during preparation of the particle, and would have been rejected as a reactor loading. Jackie Cook and B. C. Leslie, both Metals and Ceramics, made the unusual and timely find.



DISPOSAL of intermediate level radioactive waste by hydraulic fracturing, a technique developed by ORNL with assistance from the Halliburton Company, Duncan, Oklahoma, is depicted in this cutaway drawing. The technique involves mixing the radioactive wastes with concrete mix and other additives and pumping it into bedded shale about 700 to 1000 feet underground. One such well might accommodate ORNL's wastes of this type for several years.

Final Hydraulic Fracture Test Series Is Initiated by Health Physics Division

By R. L. Wesley

The Laboratory's Health Physics Division has begun the final test series of a new disposal method for intermediate level radioactive waste.

The method, disposal by hydraulic fracturing, involves mixing the waste with concrete mix and other additives and pumping it into a bedded shale formation about 700 to 1000 feet underground.

The procedure was developed by a team headed by E. G. Struxness, and includes Wallace de Laguna and Tsuneo Tamura, all Health Physics; R. C. Sexton and R. E. Lampton, Plant and Equipment; and H. O. Weeren, Chemical Technology.

ORNL was assisted in the development of this disposal method by representatives of the Halliburton Company, Duncan, Oklahoma. Dan Hathorn, Max Togner, Knox Slagle, and John Cook are the Halliburton staff members assisting with the project.

The test site contains thick beds of shale in almost horizontal position and extremely impermeable to water. The waste mixture, injected under pressure down the well, creates a horizontal crack in the shale. The crack is then filled with the mixture to form a thin, horizontal sheet several hundred feet across. The mix sets to permanently hold the radioactive wastes in the formation.

Initial Run

In the initial run, held last week, no radioactive material was used. The injection consisted of a concentrated solution of synthetic waste with a colored dye tracer.

Another test is scheduled before experimental injections of actual wastes begin. The first "hot" test injection will involve the use of gold-198 as a tracer, followed by experiments with actual wastes containing about .015 curies per gallon. About 40,000 gallons of liquid will be used in each test.

The same well may be used repeatedly, with horizontal sheets being formed at vertical intervals of 10 to 20 feet.

About four million gallons of intermediate level wastes are generated at the Laboratory each year, and one well could accommodate ORNL's wastes of this type for several years.

If this process proves successful, it has potential application at other atomic energy sites where suitable geological conditions exist.

The mixes used in this disposal system are cement based and contain a retarder (to delay time of setting), and an extender (to keep the cement in suspension). These mixes can be pumped for as long as 30 hours, will retain more than 98 percent of the associated water when they are set, are usable with waste solutions with a wide range of concentrations, and are relatively cheap.

Storage Tanks

Several days prior to an injection the waste solution will be transferred to three underground storage tanks at the hydrofracture site.

The contents of each tank are sampled. The samples will be taken to a laboratory, mixed with the cement mix that is planned for the injection, and tested on a special device that will measure the pumping time of the grout. This test is to verify that pumping time of the planned mixture will be adequate.

Solid constituents of the mix are mixed by being pneumatically transferred back and forth between the blending tanks. When mixing is complete, the blended solids are discharged, to the bulk storage tanks.

The casing will be slotted prior to each injection at the desired depth by pumping a slurry of sand and water through a jet at the bottom of the tubing string. The sand's erosive action will cut a hole in the casing and the surrounding formation. The spent slurry is brought back to the surface through the annulus between the tubing and casing. The tubing string will be rotated slowly during this time to make a complete cut of the casing.

At the end of the slotting operation the addition of sand is stopped. Flow in the well is reversed to pump water down the annulus and back up the central tubing. This reversed flow dislodges the jet from the bottom of the tubing string and pumps it up the tubing and into the jet catcher.

Rotation of the central tubing is not necessary during the fracturing and injecting operations, and a simplified arrangement of the wellhead piping can be used during these operations. This permits all piping that will carry radioactive waste solutions to be contained inside the wellhead cell.

Formation Fracture

The formation is fractured by pumping water down the tubing string and letting the wellhead pressure increase until the formation fractures. The formation of the fracture is indicated by a sudden sharp drop in wellhead pressure.

After the fracture has occurred, the injection will be started. Waste solution will be pumped from the waste tanks to the mixer, and solids fed to the mixer from one of the bulk storage tanks. The resulting mix will be discharged into the sump tub, then pumped down the tubing string and out into the formation. One operator controls the rate of solids addition while a second operator controls the rate of grout injection. The proper ratio of solids to waste solution is automatically controlled by measurement of slurry density.

An injection will require several hours to complete. At the end of the run, a small quantity of cement-water mix will be pumped down the well by the stand-by pump. The cementing plug will then be released and pumped down the well with water. The well will be kept under pressure until the grout has had time to set and seal the injection.

THE OAK RIDGE NATIONAL LABORATORY NEWS

A Publication for the ORNL 'Employees of Union Carbide Corporation

Vol. 19 — No. 24 OAK RIDGE, TENNESSEE Friday, December 9, 1966

First Pumping Set Next Week

Deep Well Radioactive Waste Disposal System Readied For Routine Operation

By BILL FELKNOR

Oak Ridge National Laboratory will put the world's first permanent intermediate-level radioactive waste disposal system into routine operation next week.

The Laboratory will dispose of 80,000 gallons of wastes containing approximately 20,000 curies of radioactivity. Several tracer test runs were successfully completed in 1964-65, but this operation is the first with radioactive wastes.

The system, known as hydraulic fracturing, involves mixing the radioactive waste with cement and other additives. This grout is pumped into a bedded shale formation 700-1,000 feet deep.

The technique has been adapted from that used by the petroleum industry to increase oil well yields, according to project head E. G. Struxness, Health Physics Division.

"We have experimented for years with various systems of permanent disposal of radioactive waste," he stated. "Hydraulic fracturing shows great promise. To my knowledge, the operation set next week is the first routine use of a permanent, ultimate system of disposal."

A 16mm color motion picture, "Waste Disposal by Hydraulic Fracturing," describing this system, is available from ORNL's Public Information Office, or from U.S. Atomic Energy Commission film libraries in the United States and abroad.

The injection, slated in a valley adjoining the Laboratory's main research area, is into a geologic formation which contains thick, horizontal beds of shale extremely impermeable to water.

The grout, injected under pressure down a well, creates a horizontal crack in the shale. This crack fills with the mixture to form a thin sheet several hundred fee, across. The mix permanently sets to hold the wastes in the formation.

Preliminary large-scale tests indicate that the grout sheets will follow the horizontal inclination of the beds. "nd not migrate vertically.

Considerable development work was necessary to achieve a grout mix with the desired characteristics. These mixes contain a retarder to delay setting time, and an extender to keep the cement in suspension. The mixes can be pumped for as long as 30 hours. They will retain at least 98 percent of the associated water when set; they are usable with waste solutions having a wide range of concentrations, and they are relatively cheap.

Next week's injection will be done in two stages. The first will be made Monday, consisting of 40,000 gallons. On Wednesday, an additional 40,000 gallons will be injected. This two-stage **operation will not be necessary in the future, as additional storage tanks now under construction will bring capacity up to a desired** minimum **of 80,000 gallons.**

Over four million gallons of intermediate-level wastes are generated at ORNL each year. They come from 24 collection tanks located a, Laboratory hot cells, reactors, and chemical laboratories.

These wastes are piped to the main tank farm for storage (maximum capacity of about one million gallons). As the wastes run to these tanks, the solids settle to the bottom in the form of a sludge.

The top liquid is pumped off through an ordinary steam evaporator, which effects further separation between radioactive constituents and bulk. The recondensed liquids are then pumped to low-level storage. The bottom wastes (concentrated or intermediate-level wastes) are the solutions being injected at the hydraulic fracture site.

The test site facilities include two waste solution transfer pumps, four dry solids storage bins for the cement mix. a jet mixer, a high-pressure injection pump. and the injection well.

The mixer, pump and wellhead are in cells to reduce the spread of contamination if a leak occurs. Other facilities include a water tank, two pressure tanks for blending the dry solids, an asphalt-lined waste trench capable of retaining 100,000 gallons of grout in an emergency, a waste pit, **and several prototype, cased observation wells to determine the depth of the grout sheet.**

Before an injection, the waste solution is piped from the storage farm to three underground storage tanks at the site. Samples from these tanks are blended with the proposed cement mix to verify the pumping lime of the grout.

The cement and other additives are conveyed to the blending tank by a portable screw conveyor.

These materials are blended by blowing them between the two pressure tanks. The blended solids are then blown to the storage bins where they are retained until the injection begins.

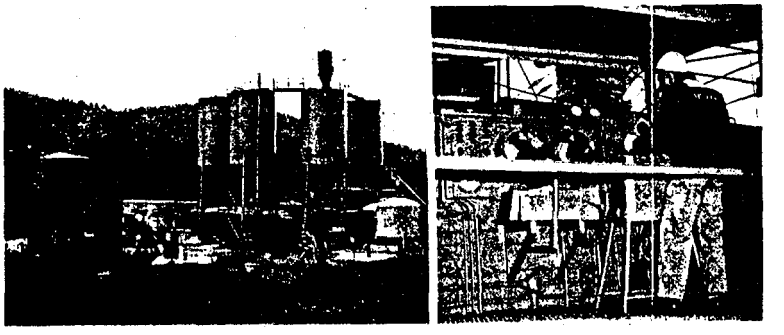
When the injection operation starts, the waste solution is pumped from the storage tanks to the mixer while the solids are fed simultaneously from the storage bins.

As the waste solution passes through the mixer, it draws the cement from the hopper. Both streams, thoroughly mired in the outlet pipe, are then discharged into a surge tank. From there, the grout is pumped down the well and into the fracture.

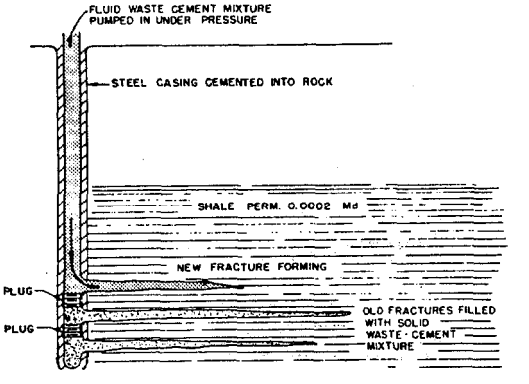
Separate operators regulate the rate of injection, and the flow of solids into the mixer hopper. A densometer automatically proportions the solids and waste solution.

When the injection — which takes several hours — is completed, a cement-water mix is pumped down the tubing string to force the last of the radioactive slurry into the fracture.

A rubber plug is then pumped down the well tubing with water to wipe the excess cement from the tubing and to force the grout-water level to within a few feet above the fracture. The well is then kept under pressure until the grout has set.



HYDRAULIC FRACTURING TEST SITE-Oak Ridge National Laboratory will make its first permanent intermediate-level radioactive waste disposal at this surface plant next reek. Facilities include bulk storage bins for dry solids and several block houses containing a wellhead cell, a mixer cell and a high pressure pump. The system involves mixing the radioactive waste with cement and other additives and pumping it into a bedded shale formation 700-1,000 feet deep. At right is the facility operating panel.



THIS SCHEMATIC DIAGRAM illustrates the concept of radioactive waste disposal by hydraulic fracturing. After the well is drilled, cared, and cemented, injections of waste slurry are forced into comformable fractures in the shale formation beginning at the bottom of the well and working up to the top. The fractures produced and the grout sheets formed extend radially out from the injection well. The broken horizontal liner represent the natural bedding plane of the shale.

Drilling ahead today ... Lyons Daily News Tues, June 30, 1964

New mine shaft nearing completion

Sterling Drilling company should be finished by tomorrow evening with the drilling of a new shaft into the old Carey Salt mine at the northeast edge of Lyons.

The deep-well rig was contracted by the Carey Salt company of Hutchinson to drill the shaft, which will be used by the Oak Ridge National laboratories to carry out experiments regarding storage of solidified nuclear wastes in salt beds. Slender test cells will be lowered down the bole, directly from a specially equipped railroad carrier.

The first 300 feet of the shaft was drilled out to 32 inches and a large surface casing was set to that level. A 13-inch bit was used to go On down to the 1,020-foot level. Now the last 720 feet of the small shaft is in the process of being reamed out with a 24-inch bit.

Nineteen-inch casing win then be set from the surface to the bottom. The room into which the shaft will enter still remains to be excavated. It is hoped that when The salt is removed from a. certain area that the casing will be encountered.

Government surveyors from Washington D. C. spent a week in and around the mine, during April determining where drilling on the surface must take place if entrance into the mine is to be at the desired position.

The engineers planned not to be more than a foot off the desired point. However, when asked, what the final step of the surveying project would be, one of the experts smiled and replied, "Leave before drilling starts."

THE BIG EIGHT-FOOT "shive" wheel, one of two at the top of the new head frame recently constructed over the old Carey Salt Mine shaft at the northeast edge of Lyons, will lower as much as 10 tons of weight 1,000 feet into caverns under the community. Fleming Empson, supervisor of the nuclear waste storage project being carried out in the mine by Oak Ridge laboratories, stands beside the south wheel. Probably the heaviest weight it will carry will be a unit that is similar to the large dirt moving machinery seen so often in road construction. The tractor-trailer vehicle will support a heavy, lead-shielded container, into which test fuel cells will be lowered. The driver will pull the trailer under the new shaft presently *being* completed by Sterling Drilling company and the fuel cell will be lowered into it from the surface. Then the trailer will be pulled over a test hole in the salt beds and the cell will be lowered into it through a hole *in* the bottom of the container.

E ORNL Lab News Friday, May 26, 1967

Performed By ORNL Research Team

Major Phase of Project Salt Vault Is Nearing Conclusion

The radioactive phase of Project Salt Vault — performed in an unused Carey Company salt mine at Lyons, Kansas, by an Oak Ridge National Laboratory Health Physics Division research team— will be completed in June. Other phases of the project, which is a demonstration of methods and techniques used in disposal of highly radioactive solid wastes in salt mines, will continue through 1967.

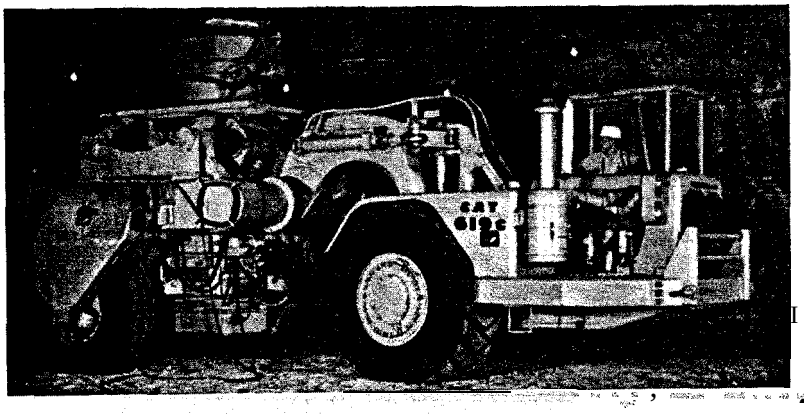
Salt mines may be the answer to one of the most important problems facing the development of nuclear power — the disposal of solid wastes — because salt mines are dry and assure positive isolation of the radioactive material from man and his environment.

Several uncertainties had to be resolved before advancing from the original suggestion by the National Academy of Sciences to a practical method for waste disposal. These included ways of handling the hazardous material safely and cheaply underground, possible harmful chemical reaction between salt and the containers which hold the radioactivity, and radiation damage to the salt itself.

Results of all of the experiments to date are very encouraging and should provide a basis for designing an actual facility for radioactive waste disposal in salt. Some kind of facility for permanent disposal of radioactive wastes will be needed in the future to handle the large volume of waste material which will result from processing of used nuclear fuels.

Three sets of radioactive fuel assemblies from the Engineering Test Reactor (ETR) at the National Reactor Testing Station near Idaho Falls, Idaho, were used as radiation sources to obtain handling experience and to simulate the effects of heat and radiation on the salt. Starting in November 1965, a set was placed in holes 'of the mine floor where it remained for six months before being replaced with fresh fuel from the ETR. The third change-out of fuel assemblies occurred last November.

Other phases of the test, such as the effects of heat on structural behavior of salt, will continue to the end of the year.



Underground transporter for moving highly radioactive engineering test reactor fuel assemblies within the Carey Salt Mine in Hutchinson, Kansas. The device was designed for use in Project Salt Vault. The transporter was powered by a standard Caterpillar two-wheel diesel tractor, connected to a special trailer and a vertically mounted cylindrical radiation shield. Casks containing fuel assemblies were lowered from the surface directly into the transporter, then moved to the experimental chamber and lowered into test holes in the mine floor (1964).

Technology Division (CTD) indicated that this disposal method would be compatible with competitive nuclear power. So, as the decade was ending, HPD and CTD began to work toward designing an actual prototype disposal facility to be established in a salt formation; it was hoped that it would be in Kansas.

The last major activity of the 1960s in which ORNL ecology was involved was the International Biological Program (IBP). Oak Ridge ecologists first became involved in this program in 1964 when Jerry Olson attended its first General Assembly in Paris. Two years later he attended the Williamstown meeting that established the study of drainage basin (watershed) ecosystems as the central objective of the U.S. component of IBP. By 1966 Reichle, with Olson's encouragement, had also become involved. That summer Reichle traveled to Poland for a symposium on the productivity of terrestrial ecosystems, where he was elected cochair of the Woodlands Working Group of the Terrestrial Productivity Section. Auerbach, who was then Secretary of the Ecological Society of America and an active member of its public affairs committee, was working for the political acceptance of IBP and for its funding on a national basis.

In 1967 IBP was approved by Congress and given an initial funding of $15,000,000-a substantial sum for an ecological research program then. Under NSF and NAS leadership, the major organized research effort would be the Analysis of Ecosystems Program. The national committee selected Fred Smith, an outstanding ecologist at the University of Michigan, to lead it. The new program would consist of five major subprograms based on the major biomes of the United States. Smith was charged with selecting the directors of each of the biome programs. The ORNL staff was eager to become involved because it would enable them to maintain the momentum of their ecosystem research projects such as the one at Walker Branch Watershed which needed additional funds to carry out the planned program. In 1968, after much discussion prior to and at a biome organizing meeting at Emory University in Atlanta, Auerbach was appointed director of the Eastern Deciduous Forest Biome Project of IBP. The first year was one of intense organizational effort. A totally new program was being initiated that would establish Oak Ridge as the managing center for a regional network of four major research groups (University of Wisconsin, Madison; University of Georgia, Athens; Rensselaer Polytechnic University, Troy, New York; and Duke University, Durham, North Carolina) that were to carry out ecosystem and related modeling and process studies at two lakes, two watersheds, and two forest sites. This effort was to be coordinated and directed from a separate headquarters unit at ORNL. Auerbach proceeded to organize a small team to manage the program, which consisted of himself, Robert L. Burgess as deputy director, Bob O'Neill as modeling coordinator, F. Glenn Goff for regional and landscape studies, and Alfred Brooks (K-25) for data processing and information storage.

At the same time the Oak Ridge research site was created under the directorship of David Reichle, who organized the forest ecosystem studies based on the Walker Branch Watershed and the *Liriodendron* (tulip poplar) forest sites. Reichle was strongly motivated to have Oak Ridge named as a fifth IBP research site. He wrote a proposal and convinced the Biome directorate to add Oak Ridge in the second year. Reichle then recruited a research team that included both old (ARC-supported) and new members of the Division, including Martin Witkamp, Roger Dahlman, Nelson Edwards, John Witherspoon, Jim Curlin, Linda Mann, Blaine Dinger, Frank Harris, Robert Goldstein, Phil Sollins, Gray Henderson, James McBrayer, Henry Shugart, Fred Taylor, Bob Van Hook, and many others, including graduate students. To provide space for this burgeoning effort, Building 3017, which was located across the hilltop from Building 2001 and which formerly housed a now defunct HPD program, was made available by the Laboratory. Reichle and much of his now sizeable group were relocated there. Thus began a major effort in basic ecology at ORNL, an effort that would bring a great number of students and investigators. Many of these individuals would contribute significantly to the research and subsequently move off to other institutions where they would become well known for their contributions to ecosystem science or become leaders of new programs in ecological research.

As the decade of the 1960s came to an end, interest in environmental problems and issues were growing in the United States. The success of the IBP reflected the wisdom and concern of both scientists and key members of Congress about the growing damage to the earth's ecological systems. On other fronts, public concern was growing about radiation and environmental contamination from radioactivity and chemicals, especially insecticides. Stream pollution, air pollution, and habitat destruction were beginning to cause larger and larger public rumblings of concern, and the federal government would soon respond.

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Fast Neutrons More Damaging

Ecologists Observe Effects of Radiation On ORNL Forests Surrounding HPRR

By R. B. DAVENPORT

Forests in the ORNL area have come alive in recent weeks with the beauty of spring plant growth — the bright redbud, flowering dogwood and the dark green foliage of hardwood trees.

But in one small forest area of the Laboratory, buds are slower to open and leaf growth is retarded, as if some invisible force was holding back the growing season. This unseen force is radiation emitted by the Health Physics Research Reactor, located two miles southeast of the main Laboratory area.

For the past two years, J. P. Witherspoon of Health Physics Division's Radiation Ecology Section has been observing the effects of radiation on forests surrounding the HPRR. This spring, the third growing season since the reactor began operation, much new information is expected to be obtained.

Observations made thus far by Witherspoon and F. G. Taylor, Health Physics, correspond closely with findings in previous studies. Trees closest to the reactor suffer more damage than those at greater distances; smaller trees generally receive more damaging effects than larger tees; and deciduous trees (hardwoods) are more resistant to radiation than conifers (pines).

Witherspoon pointed out, however, that previous studies at other reactor sites and atomic weapon target areas utilized either gamma radiation or mixed gamma-neutron radiation, while the HPRR study uses primarily fast neutron radiation.

"Completion of the HPRR in the spring of 1963 offered a unique opportunity for studying not only effects of low-level radiation on forests, but also primarily fast neutron radiation," Witherspoon said. "In addition to increasing our general knowledge of effects of ionizing radiation on forests, information from this study can be used to assess the relative biological effectiveness of fast neutron radiation and lead to better interpretations of studies using mixed radiation."

More information is currently available on high-level radiation effects on plants than for low-level radiation, giving added importance to the HPRR study.

Before the HPRR went into operation, Witherspoon and Taylor set up a grid reference system consisting of 32-by-32-foot plots laid out on the south side of the reactor. Trees were mapped and records made of their size and general vigor.

Species include pine, sassafras, dogwood, persimmon, black gum,

Continued on Page 2

J. A. Auxier To Aid With ICRU Report

J. A. Auxier, Health Physics Division, will attend a meeting of the International Commission on Radiological Units (ICRU) Task Group on neutron instrumentation in Sutton, England, May 10-11.

Widely recognized for his work in radiation dosimetry, he has been asked by the ICRU Task Group chairman to assist in drafting the Group report.

TERMINAL SHOOTS COLLECTED from Virginia pines growing at various distances from the Health Physics Research Reactor are examined by J. P. Witherspoon, Health Physics Division Radiation Ecology [illegible] 50 percent growth reduction between shoots growing 25 meters (82 feet) from the reactor and those grow-

BUD LENGTHS of a persimmon sapling, growing near the Health Physics Research Reactor, are measured by J. P. Witherspoon, Health Physics Division. The tree is growing about 50 feet from the HPRR. Note the absence of buds on-the smaller sapling in foreground.

Health Physics Reactor Area Studied For Radiation Effects

Continued from Page 1

red maple, sourwood, yellow poplar and sumac. The edge of the forest is located about 80 feet from the reactor, but some smaller saplings are as close as 30 feet.

The reactor began operation May 31, 1963, and the first indications of radiation damage to vegetation were observed one year later after 1964 spring growth had begun. No visible radiation effects were observed in trees at distances greater than 82 feet from the reactor, where cumulative fast neutron doses were less than 154 rads. However, early spring growth of small hardwood trees growing within 65 feet showed serious growth defects in areas receiving from 265 to 996 rads. Most severely damaged were persimmon and black gum saplings growing from 30-50 feet from the reactor.

Plants growing 50-80 feet from the reactor, with the exception of several pine seedlings, exhibited less damage

Near the end of the first growing season, cumulative doses to vegetation had increased about 66 per cent over those of the spring. Pine trees out to 125 feet from the reactor showed foliage discoloration and poor needle growth.

By the end of the 1964 growing season, almost all trees within 125 feet of the reactor showed needle mortality (brown foliage) while trees from 150-250 feet had needles of normal color.

Compared with previous studies involving gamma radiation, Witherspoon has found that, in general, fast neutron irradiation is more damaging to forest areas. But several more growing seasons will be required before complete information is available.

Because it is difficult to separate radiation damage from influencing environmental factors such as rainfall, type of soil and length of growing season, a controlled laboratory program is being conducted to help correlate results. This program for maintaining constant environmental conditions is set up in Building 2001.

An interesting sidelight of the study concerns the southern pine beetle, an insect which has recently infested pine forests surrounding ORNL. Witherspoon has found that in the HPRR study area, pine beetles will attack radiation-damaged, or weakened, trees before attacking healthier ones. He attributes this to the fact that damaged trees are less capable of resisting the predator.

As HPRR continues operation and radiation effects extend deeper into the forest, Witherspoon hopes to learn much additional information on fast neutron effects. He will report on the study next week at the Second National Symposium on Radioecology at Batelle, Northwest, Hanford, Washington.

Chapter 4

CAVE SPIDERS in the Tennessee region are fairly well documented, according to Jerry Payne, Health Physics Division. But, occasionally one is found that is unknown to science. The above specimen has been sent to the National Museum of Natural History to see if it has a name. A previous spider sent to the museum turned out to be unknown and was later labeled *Nesticus paynei*—after Jerry.

Hobbies On Parade — **Last of a Series**

Scientific Data In Local Caverns Lures 'Ecology-Type' Spelunkers

By BILL FELKNOR

Located within a few minutes drive of Oak Ridge National Laboratory are dozens of entrances to one of the most exciting unexplored worlds left to modern man — underground caverns.

Spelunkers Jerry Payne and Jay Story, both of ORNL's Health Physics' Ecology Department, have formed a two-man caving team that regularly explores area caves for pleasure and in relation to their work at the Laboratory.

Jerry is primarily interested in the ecological aspects of caves, specifically the animal life inside, and Jay, the geological aspect.

At present, Jerry is taking a series of blood samples of bats for various hematological studies. "Bats are a most interesting cave animal," he said. "Science has much to learn about them. Recently, Knox and surrounding counties had quite a serious rabies epidemic that still hasn't completely abated. A State health official feels that bats are the reservoir for rabies in Tennessee.

"This has not been proven," continued Jerry, "but in certain parts of the country, observers have come up with a minimum of 10 percent incidence of rabies in bat studies. Bats won't usually die with rabies, but are only carriers." In a recent article in **ORNL News**, Dr. T. A. Lincoln, director of Health Division, recommended the rabies vaccine for all spelunkers in the State.

According to Payne, some observers feel that it is entirely possible for rabies to be transmitted when bats bite foxes or when foxes eat the bats.

In one experiment in Texas, animals were isolated in cages with wire screens between them and the bats to avoid any physical contact — yet the animals contacted rabies. This led to the theory that rabies might be airborne.

"There is a case on record where a spelunker died of rabies without being bitten by a bat," Dr. Lincoln stated.

Payne became interested in caving about eight years ago and Jay, two years ago. "Jay is becoming quite an adept caver," commented Jerry. One of Story's big interests is in the history of caving. "Tennessee caves played a big role in our country's history," he reported. "During the War of 1812 and again during the Civil War, large deposits of bat excrement rich in nitrates of calcium, sodium and potassium were used in the manufacture of gun powder.

"I've explored several East Tennessee caves containing evidence of these old mining projects," he continued. "The water was piped in for use in dissolving the nitrate deposits. Then, the concentrated solution was channeled or pumped back outside the cave where the water was evaporated. Some of the mining crews were kept underground so long that they practically became cave life themselves.

"In the Carlsbad Caverns of New Mexico, bat droppings or 'guano' has been mined during more recent times. Starting in 1930, exploiters found deposits 50 feet deep. The miners used a windlass to haul some 100,000 tons of guano 180 feet to the surface. No one has calculated how long it took for this highly nitrogenous bat excrement to accumulate, but its use for fertilizing citrus groves earned fortunes for the enterprising operators in a relatively few years," Jay commented.

Very little scientific work has been done on animal life and geological evolution of caves in Tennessee," the pair emphasized. For this reason, they feel that all caves should be protected from vandalism. "Take nothing but pictures, leave nothing but footprints" is their motto. "Once the beauty and scientific data is destroyed, it might take a million years to replace," said Payne.

Some of the cave fauna (animal life) Jerry is studying include rats, fish, bats, crayfish, salamanders, beetles, spiders, millipedes, and centipedes. "The life in caves is rich and varied if one knows where to look," he said.

Occasionally, a lonely cave can reveal an unknown species to science, reported Jerry. "Once, on a trip to an Anderson County cave, I found a spider completely unfamiliar to me," he continued.

SPELUNKER JAY STORY carefully descends into a cavern located near Oak Ridge National Laboratory. Jay, interested in the geological aspects and the history of caves, has found many instances of mining activities carried on during the War of 1812 and the Civil War. These miners were in search of nitrates for use in the making of gunpowder.

A GLOVED JERRY PAYNE carefully snares two bats off the roof of an area cave. He is presently taking a series of blood samples of bats for hematological studies. According to Jerry, a State health official feels that such bats are the "reservoir" for a current rabies epidemic in Tennessee.

"I collected a series of them to send to the spider specialist at the American Museum of Natural History in New York. He wrote back saying the spider was a new species. He had named it 'Nesticus paynei.' So far as I know, I'm the only man at ORNL with a spider named after him," chuckled Payne.

Jerry and Jay urge all prospective spelunkers to be aware of several vital safety rules before venturing into a cave. They gave the following as "musts": (1) never cave alone, (2) carry at least two sources of light, (3) leave word of caving plans and an expected time of return, and (4) beware of passages bearing signs of past flooding (flash floods can fill caves with water in a matter of minutes).

Although dislodged rocks have been known to trap cavers, the formations in caverns are usually remarkably stable. The dangers lie in human negligence and in faulty equipment. The most serious danger is loss of light, and the major cause of injury is unsound rope. "I personally don't use ropes because I'm not properly trained," said Jerry.

Much recent effort has gone into the design of lightweight, strong, functional gear for caving. Such hardware — wire ladders, ropes, mooring pins, carbide lamps, canteens, hard hats, matchboxes — has been jokingly termed "spelunk junk." Snagproof clothes and tasty food concentrates have also relieved the caver of weight and worry.

"For those who approach caving with the proper attitude regarding conservation and safety, spelunking can be a most rewarding experience," agreed Jerry and Jay.

OR Nondestructive Test Section To Meet Tuesday

Oak Ridge Section of the Society for Nondestructive Testing will hold its June meeting Tuesday, 8 PM, at the Holiday Inn.

The program will be an address by W. D. Kiehle of Eastman Kodak Corporation entitled "The Future of the Society for Nondestructive Testing." Dinner will be at 6:30 PM.

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War Against Pine Beetle Turns 'Hot'; *Infested Trees Cut, Stacked, Burned*

ORNL ecologists began escalating the war against the Southern Pine Beetle on the government reservation this week by burning infested trees at selected sites.

J. W. Curlin, Health Physics Division, and forest ecologist in charge of the project, said the extreme temperature change which occurred on the weekend of January 30 offered a possible turning point in the control efforts. The 10-degree below zero temperature apparently killed a great percentage of the beetles and Curlin believes their population can now be brought under control if most of the survivors are destroyed.

The beetle population suddenly expanded two years ago in the Oak Ridge area, resulting in the damaging of many acres of timber. Despite vigorous efforts in spraying and salvage cutting, an estimated 84,000 trees were infested by January of this year. Once infested, a tree dies and its ultimate market value is lowered considerably.

The approximately 40 sites selected for the fires are scattered throughout the 30,000-acre forested reservation. Timber at these locations will be cut, piled and burned under the close supervision of the ORNL fire department and work crews. Fire fighters from the Y-12 Plant, Oak Ridge Gaseous Diffusion Plant and the City of Oak Ridge will be available if needed, although all precautions are being taken to prevent the fires from spreading. The burnings are expected to continue through the latter part of June.

Curlin said population explosions of the Southern Pine Beetle are a cyclical occurrence. Although never completely absent from the forest, they are kept in check by natural predators, such

Continued on Page 3

Pine Trees Burned As Battle Against Beetles Escalates

Continued from Page 1

as woodpeckers and forest mites, and extremely cold weather. Occasionally, however, their numbers reach epidemic proportions and special efforts are necessary to control them.

The beetle burrows through the bark of shortleaf, loblolly, and Virginia pines common to East Tennessee to deposit its eggs in tree tissue. Developing larvae feed on this tissue. Symptoms of an infested tree are the discoloration of pine needles—from yellow-green to reddish brown — small pin holes in the bark and winding channels beneath the bark on the wood surface.

When broods emerge in the spring, they fly for several miles or may be carried by the wind to other locations for further infestation. One season's brood may produce up to six or seven broods.

Curlin cautioned that burning is not recommended for private owners, unless fire control equipment is at the scene.

THIS 10-TON U.S. ARMY surplus vehicle, formerly servicing the now-defunct Corporal missile, is used by the ORNL Ecology Section in environmental studies concerned with radionuclide cycling in forest systems. S. I. Auerbach, Health Physicians Division, at the controls, lifts W. A. Thomas, an ORINS Fellow, and H. D. Waller, Health Physics, high among the branches in the cesium-137-tagged forest near the Laboratory.

Solves Ecology Problem

Surplus 'Corporal' Missile Equipment Acquired by ORNL

A platform truck formerly used by the U. S. Army to service its Corporal missile is now being utilized by ORNL to aid ecologists in their forest studies.

Insect and vegetation sampling in the forest canopy is part of the experimental routine conducted each of the radioisotope-tagged forest experiments. Until the acquisition of the Army vehicle, however, this job presented problems.

Since the trees are tall enough to make climbing and the use of ladders inefficient and very dangerous, ecologists found it necessary to borrow a ladder truck from the Oak Ridge Gaseous Diffusion Plant. But the truck was not routinely available.

Faced with the question of a heavy investment in a new vehicle, the Laboratory turned to Army surplus for the answer. The Army was phasing out its Corporal missile system and disposing of much of the equipment. The platform truck was one of the available items.

The lift platform, operated by one man at the controls, can be raised to a maximum of 70 feet. The lift arms can be turned in a full circle. The 10-ton vehicle has six-wheel-drive enabling it to maneuver through the rough forest roads with ease.

In Memoriam

Graveside services for Lovell Lewis were held Tuesday morning at Greenwood Cemetery in Knoxville.

Lovell, a popular member of Health Physics Division's Radiation Ecology Section, was fatally injured in an automobile accident nine miles east of Kingston while driving from her home near Watts Bar Lake.

Lovell Lewis

A native of Memphis, she celebrated her fifth anniversary as a member of the ORNL staff last June 1. One of the highlights of her career at ORNL came in February 1964 when she was crowned "Miss ORNL" at the annual Girls' Club-sponsored event.

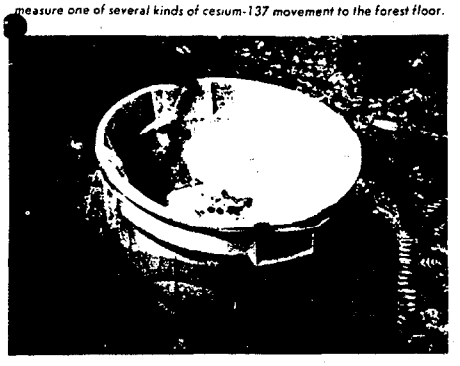
She graduated from Memphis' Whitehaven High School and later received the B.S. degree in chemistry from Memphis State University. She had worked for Abbott Laboratories in Oak Ridge prior to joining ORNL.

Lovell is survived by her husband, T. A. Lewis, an engineer in Instrumentation and Controls Division; mother, Mrs. Ophelia Lawrence of Memphis; and brother, Rev. Archie Lawrence of Arkansas.

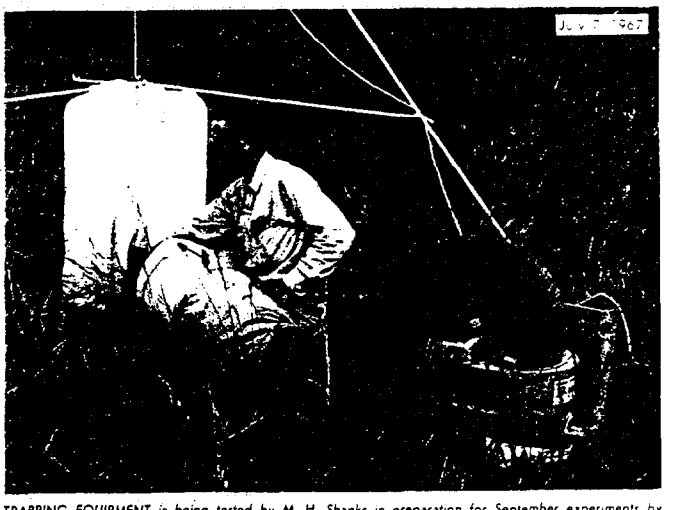
Rev. Lawrence conducted the services and Martin's Funeral Home in Oak Ridge was in charge of arrangements.

July 1, 1966

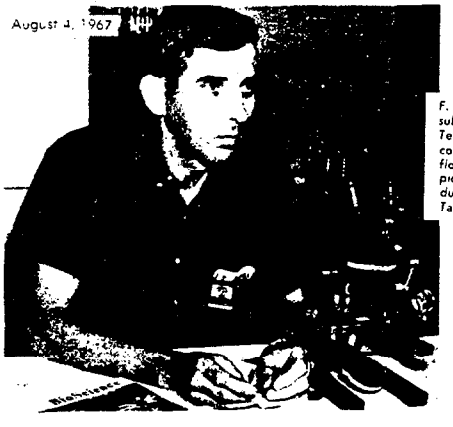
"CHERRY PICKER" — A lift (right), recently surplused from a defunct missile program, is used in the regular collection of leaves from a cesium-137 tagged forest area. The program is a five-year interdisciplinary Health Physics Division study on the movement of radioactive materials in terrestrial ecosystems. Tagging (which began in late May 1962) and checking are under the direction of Radiation Ecology Section. Plastic baskets (below) are used for trapping fallen leaves and other litter to measure one of several kinds of cesium-137 movement to the forest floor.



HEALTH PHYSICS DIVISION'S J. D. STORY proudly displays this month's issue of BioScience which carries on its cover his photograph of a millipede. Story, who keeps a photographic record of much of the wild life studied by the Ecology section, submitted the photo along with a brief description of the Laboratory's work with the millipede to the American Institute of Biological Sciences, publisher of the journal.

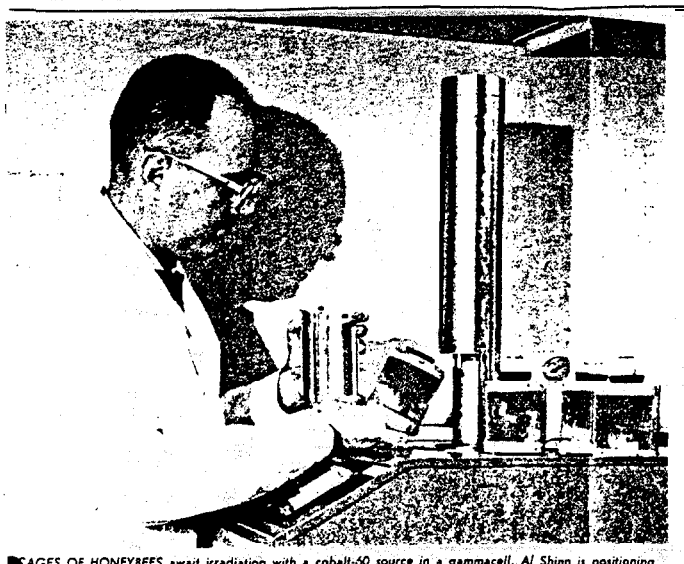


TRAPPING EQUIPMENT is being tested by M. H. Shanks in preparation for September experiments by Health Physics Division's Radiation Ecology Section. The project, under the direction of D. A. Crossley, proposes to quick-trap insects in fabric bags and irradiate them with cesium-137. Each bag can be released from its tripod by a rope. A steel ring around the bottom of the bag will hold the released trap in place. The insects will be removed from the bag by a vacuum. The low-level irradiation of the insects will be studied in cooperation with the Civil Defense Project. Success of the experiments will depend on the mobility of the insects.



F. G. TAYLOR JR. (Health Physics Division Radiation Ecology Section) submitted 20 of his 35-mm prints of wild flowers which bloom in East Tennessee to "Bioscience" magazine. Two were chosen to appear as cover photographs. Taylor has been taking pictures of Tennessee wild flowers over a three-year period. The May, 1967 issue of "Bioscience" pictured flowers of the black-eyed susan (Rudbeckia hirta) which bloom during July and August in Tennessee. Also chosen for a cover was Taylor's photo of Indian Pink (Spigelia marilandica).

Vol. 20 — No. 29 OAK RIDGE, TENNESSEE Friday, January 12, 1968



CAGES OF HONEYBEES await irradiation with a cobalt-60 source in a gammacell. Al Shinn is positioning one of the cages. Each cage contains approximately 200 bees and houses the water supply and bee candy.

Field Tests Prove Important

HP's Ecology Section Conducting Radiation Experiments With Honeybees

By MARTHA GOOLSBY

Honeybees pollinate approximately 50 agricultural crops and thus are a major factor in the growth of many fruits and vegetables for the diet of man. Health Physics' Radiation Ecology Section is researching the effects of ionizing radiation on honeybees to determine what constitutes a lethal dose of radiation to them and how different levels of radiation will affect their behavior.

Among the crops which honeybees pollinate are alfalfa, clover, apples, oranges, pears, cherries, grapes, berries, melons, cucumbers, cotton, onions, asparagus, celery and many others. The cash value of these crops is about three billion dollars a year.

For the project, W. H. Cale Jr. of *Dadant and Sons, Hamilton*, Illinois, produced hybrid queen bees which he gave to the Lab. He mated line G queen bees with line F drones by artificial insemination to produce GF hybrid. These hybrid bees (hereafter referred to as "GF hybrid" bees) converted all the colonies to the same genetic composition. Having similar genetic strains cuts down on variations in the data.

Life Span Data

Stage one of the project was a laboratory experiment in the mortality rates of the bees. Ten colonies of honeybees were rented from a commercial beekeeper. The hives were placed in Ecology Area 0800 in a natural environment. When the colonies were converted to the same genetic constitution, samples of bees were taken from the field hives. Twelve cylindrical, screen cages, designed for the least disturbance from post-irradiation handling were filled with approximately 200 bees each.

The cages were separated into three groups. One group was not irradiated, another group was irradiated with 5,000 rads of cobalt-60, and the remaining group was irradiated with 15,000 rads of cobalt-60. A gammacell was used to irradiate them. The cages were kept at a constant 93 F (the normal temperature maintained by the bees in the hive) with 12 hours of light and darkness. The bees were fed water and bee candy made from powdered sugar and invert sugar. Results indicate that bees are definitely affected at lower levels of irradiation than had previously been reported.

In addition to this experiment with GF hybrid bees, similar experiments were carried on with regular stocks used by Tennessee beekeepers. Other experiments were conducted with life spans of unirradiated bees at various temperatures ranging from 70°F to 93°F. It was shown that temperature makes a big difference in the life span in bees.

For the laboratory tests conducted, about 3,000 ordinary stock bees used by Tennessee beekeepers and 10,000 GF hybrid bees were used.

In still other tests, GF hybrid bees were irradiated with the same gamma source at levels of 1,000, 5,000, 10,000 and 15,000 rads and with fission fast neutrons of an average energy of 1.0 MeV at levels of 50, 400, 4,000 and 5,000 rads. Results showed that a neutron dose of 5,000 rads has a Relative Biological Effectiveness (RBE) of little more than 1 compared with gamma radiation at 5,000 rads. This is surprising, since neutron irradiation has usually given an RBE of from five to 20, depending on the organism involved. Presently researchers have not been able to determine why the honeybee has this relative resistance to neutron irradiation. In comparison, results showed that either gamma or neutron irradiation of 5,000 rads reduced the average life span of GF hybrid bees about 21 percent.

Thus with these indications, it was decided to irradiate the field test group. *Five hives were exposed* to 5,000 rads cobalt-60 gamma radiation in the Large Animal Irradiation Facility at the UT-AEC farm.

100,000 Bees

Five unirradiated (control) hives along with the five irradiated were returned to Ecology Area 0800 along the Clinch River. This began the second stage of the experiment — determining changes in behavioral patterns after irradiation. Observed were the weights of pollen collected by each hive and the flight activity of the bees.

Following the laboratory indication of a 21 percent decrease in the life span of honeybees irradiated with 5,000 rads, the researchers were surprised with the field results. By 14 days, the

Continued on Page 2

Next Summer

More Honeybee Experiments Set

Continued from Page 1

flight activity as indicated by a Gary funnel counter and daily weight of pollen collected dropped rapidly to zero while that of the control group stayed about the same. Within 21 days the irradiated hives were completely eliminated as functional units. Only a few bees remained alive and these few could not carry out the usual activity of honeybees. These few were all that were left from at least 100,000 that began this experiment.

This surprising result demonstrated the importance of using field experiments to reach ecological conclusions rather than depending on data secured from laboratory conditions. The laboratory experiments using 5,000 rads indicated a slight reduction in the life span of worker bees (about 29 percent). Yet when an entire colony was irradiated, the species perished.

Following last year's results, plans began for further tests using smaller doses of radiation. Approximately 20 acres of sweet clover, white Dutch clover, and crimson clover have been planted on Burial Ground 4 for use as a field area. Honeybees will be irradiated with much lower levels to predict the non-lethal effects on behavioral activities.

Al Shinn, Health Physics, Radiation Ecology Section, heads the project. He is assisted by Alan Jenkins, Health Physics, and Everett Oertel, former honeybee researcher with the United States Department of Agriculture. Advisement was given by S. E. McGregor, USDA, chief of Apicultural Research.

HONEYBEE COLONIES in an ecology area show a change in activity and behavior after being irradiated with a cobalt-60 source. Al Shinn (left) examines pollen balls contained in drawer of a pollen trap. The pollen, carried on the legs of the bees, is scraped off by mesh which the bees must crawl through to enter the hive. Everett Oertel (center) counts bees emerging from a Gary funnel counter while Alan Jenkins times the counting interval.

Friday, August 18, 1967

First Sponsored By A National Laboratory

Sixteen Scouts Graduate From Nation's Only Technical Ecology Specialty Post

By CAROL GROVE

The first group of boys to join ORNL's Ecology Explorer Scout Post in 1964 recently graduated after completing a three-year advanced scouting program.

The 16 boys, recruited as high school sophomores, are graduates of the only technical ecology specialty post in the nation and the first to be spons

Chartered under the Boy Scouts of America, the post was origi-ly conceived in 1963 by J. A. artout, former ORNL Deputy Director; W. D. Manly, formerly of Director's Division; and B. B. Klima, Chemical Technology Division. It was organized to provide a limited number of boys the unique opportunity of working with the largest assemblage of ecologists at any one research facility.

Purpose

Purpose of the scientific explorer program is not to convert the participants to ecologists, but rather to acquaint them with the inter-relationships of the sciences and to provide an understanding of the contributions ecology can make to man's general welfare.

The three-year program was designed and directed by post advisor, A. F. Shinn (Civil Defense Research Project); institutional representative, S. I. Auerbach (Health Physics Division); post committee chairman, P. B. Dunaway (Health Physics Division); and eight other members of Health Physics' Radiation Ecology Section.

Under their supervision, the post met bi-monthly at the Laboratory where they conducted 'd and laboratory experiments, died various aspects of ecology, and this year culminated work with the development of individual research projects.

Awards

These activities make up three progressions of study within the ecology post. Three merit bars, the field and laboratory bar, the research bar and the master ecologist bar were offered to explorers who successfully completed each sequence of the program.

At graduation, two of the boys received the post's highest achievement award, the master ecologist bar. This bar is earned by the senior explorer who completes an ecological research project suitable for publication.

One such project, conceived to help speed work in research, won fourth prize at the Southern Appalachian Science Fair this year. Results of the experiment provided a more efficient method for the extraction of minute beetles, mites, and other microarthropods from forest floor leaf litter.

Program of Study

In addition to laboratory work, the post traveled extensively for dy programs in surrounding as. At Copper Hill, they saw the effects of copper smelter fumes on the plant and animal life of the region.

The group spent a weekend inside Cumberland Caverns near McMinnville to study such cave organisms as blind beetles and cave crickets.

Several field trips were made to the Great Smoky Mountains National Park for studies along 70 miles of the Appalachian Trail.

The post's most recent long trip was to Virginia Institute of Marine Science at Gloucester Point, Virginia, where they were invited for a day's survey work aboard the Institute's research vessel in the Chesapeake Bay.

Members

Membership in the post was expanded to 17 this year with the addition of Oak Ridge's foreign exchange student, Nguyen-huu Cuong from South Vietnam. Other members include: Richard Macklin, son of R. L. Macklin (Physics Division); Claude Francke; John Ergen, son of W. K. Ergen (Reactor Division); John Hutton; and Richard Dyer.

William McIlwain; James Baker, son of J. E. Baker (Reactor Chemistry Division); Dale Todd, post president; Richard Rohrer, son of E. R. Rohrer (Neutron Physics Division); Dudley Smith, son of A. N. Smith (Reactor Division); Byron Trauger, son of D. B. Trauger (Reactor Division); William Anderson and John Harmon.

Applications are now being reviewed for membership in the post beginning this fall.

POST EMBLEM AND MERIT BARS are worn as a patch on the right sleeve of the explorer uniform. The emblem, designed by post advisor A. F. Shinn (Civil Defense Research Project) symbolizes the science of ecology as the lamp of knowledge that illuminates the web of life.

At Meetings Abroad

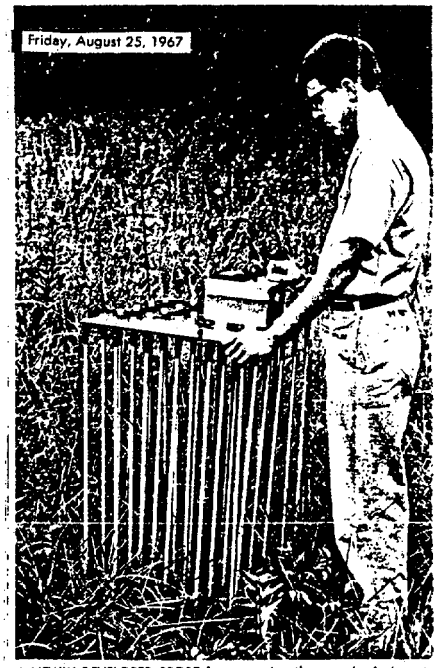
Uppuluri Has Busy Speaking Itinerary

V. R. R. Uppuluri, Mathematics Division, last week presented a paper entitled, "On a Sequence of Random Variables with Decreasing Mean Residual Time," at a meeting of the Operations Research Society of India in Delhi.

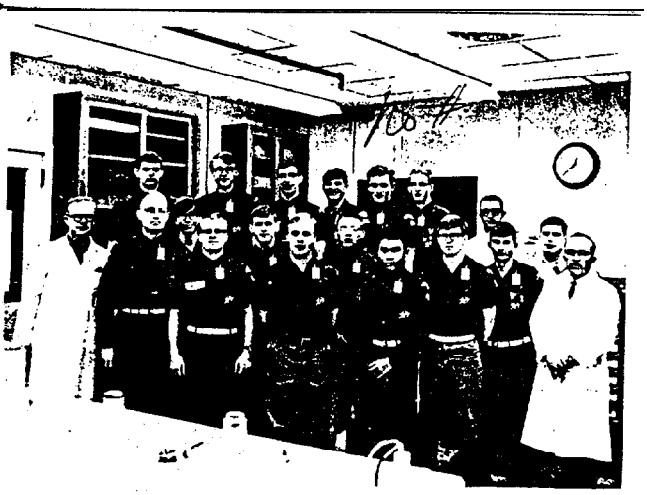
This week he participated in panel discussions at the Tokyo-Kyoto meeting of the Operations Research Society of Japan. He will also present an invited paper, "A Statistical Model of Evolution," at the Sixth International Biometric Conference in Sydney, Australia, August 20-25.

Before returning to ORNL, Uppuluri will participate in the 36th session of the International Statistical Institute, also in Sydney

Friday, August 25, 1967



A NEWLY DEVELOPED PROBE for measuring the growth of plants in the field is operated by T. A. Opstrup of Health Physics Division's Radiation Ecology Section. The device consists of 36 vertical rods connected to a meter and attached in grid fashion to a board two feet square. When placed in vegetation, the instrument will indicate changes in fiber mass and water content among plants by measuring changes in capacitance between rods. Although the present ORNL model is designed for one type of vegetation, the probe can be adapted for additional ranges of sensitivity.



ECOLOGY EXPLORER SCOUTS — Fourteen of the 16 graduates who completed the three-year advanced scouting program, sponsored by Health Physics Division's Ecology Section, are pictured at a recent post meeting in Building 2001. Supervising the group's activities are (front row) Health Physics Division's D. A. Crossley, far left; A. F. Shinn, second from left; and S. I. Auerbach, far right; (back row) J. R. Reed, second from right, and D. E. Reichle, far right.

Vol. 20 — No. 46 OAK RIDGE, TENNESSEE Friday, May 10, 1968

Ecologists Test Radiation Effects of, Carp Egg Hatchability

By MARTHA GOOLSBY

THE FOURTH YEAR of experiments on the hatchability of carp is just being concluded by the Radiation Ecology Group of Health Physics Division. These tests, conducted during the April-May spawning period, have been carried out to determine the effect of ionizing radiation on carp reproduction — comparing groups from White Oak Lake with control groups from Fort Loudon Lake. White Oak Lake is a test area at ORNL for Marine Ecology experiments.

Carp were chosen for the experiment because of their spawning habits and because they are easily caught.

Ecologists use two types of nets, the hoop net and the gill net, to catch the fish. The hoop net is comprised of seven hoops strung together by net which makes a long trap for the fish. The gill net is composed of different sizes of net which catch fish as they try to swim through it. Net openings are too small for certain sizes of fish to swim through and trap their heads by the gills as they try to wriggle backwards out of the net. It is held nearly vertical in the water by floats.

When the fish are caught they are brought to the lab for radiation counting, spawning and egg hatching.

A radiation counter determines the amounts of radioactivity stored in the bodies of the tested fish. Fish used in the experiment range from those which have absorbed only natural background radiation in Fort Loudon Lake to those receiving almost chronic doses from released waste radioisotopes in White Oak Lake. It is estimated that a five-year-old carp in White Oak Lake may have accumulated a dose of approximately 800 rads.

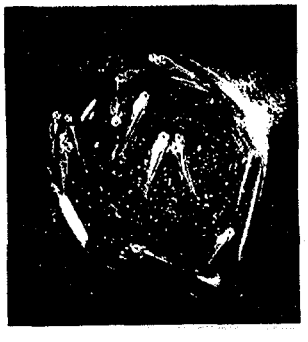
By artificially spawning the fish in the laboratory, dishes of carp eggs are obtained for the hatchability tests. The eggs are incubated in dishes. When all the eggs in a dish hatch, each fingerling is removed from the hatching dish to a beaker and counted (see related picture page two). Ecologists estimate that over 200,000 fingerlings have been counted during the four-year test.

Studies during the past three years indicate that the carp which have stored larger quantities of radionuclides produce eggs which have a lower hatchability rate than others. Past experiments show at least a 15 percent reduction in egg hatchability of carp from White Oak Lake as compared with carp from Fort Loudon Lake.

Tests were extended to this spring when ecologists felt more data was needed from White Oak Lake. Also, hatching tests were planned from from crosses between the two groups to determine some immediate results of mating them. Data from this year's experiment is being processed, and the fingerlings are being placed in an ecology storage pond for further experiments.

Present experiments have already created local interest by attracting WBIR-TV News cameramen to film short features during the past two weeks.

FINGERLING (above) whips away from its egg in a group of carp eggs being incubated during an ecology study. Below, newly-hatched carp fingerlings swim in a spot of water as they await counting. White particles in both pictures are fish excreta. (See related picture page two).



NEIL GRIFFETH (Radiation Ecology Section) removes carp fingerlings with an eye dropper from incubation dish into a beaker as he counts some of the more than 200,000 fish hatched during the past four years. Inset shows fingerlings swimming in the incubation dish. Fingerlings are now growing in an ecology storage pond where other marine ecology experiments are conducted.

Friday, July 25, 1969

ORNL Ecologists Study Radiation Effects On Wild, Native Mammals

By ANNE POWELL

What is the radionuclide turnover and the effect of irradiation on the ever-hungry moles, the primitive opossum, the foxes. raccoon, skunk and rodents, our most numerous mammal?

In addition to studying basic ecology, the interrelationships among a population of organisms and their environment, find in g these answers is the task of the vertebrate ecology group in the radiation ecology section of Health Physics.

Current research includes a study of cotton rata living in field enclosures containing the fallout simulant, tagged cesium-137. Simulant ingestion and excretion rates, cesium-137 turnover rates in various tissues. radiation doses received by the rats, and radiation effects are measured quarterly.

Cesium-137 Tagged Sand

To conduct these studies. eight 1,000 square feet enclosed pens are used. Sand tagged with cesium-137 is spread over the vegetation in the pens.

Native, wild animals are trapped and records are made of their age and health conditions. Two dosimeters, one on the underside and one on the back, are placed on each animal. and eight animals released to a pen.

The obvious necessity for using wild. native species is that these animals are similar to the populations living near radioactive disposal areas. By placing the animals in large pens, the environment to which they are accustomed is approximated thus eliminating any biological changes due to the stress of confinement.

Friday, August 22. 1969

Outstanding Young People At ORNL

Dave Reichle Makes Career Decision After Two Weeks on Lake Michigan

By ANNE POWELL

Ever wonder how a field ecologist enjoys spending his leisure time? Dave Reichle (Ecology) can never find enough time for camping, hunting, fishing and swimming but he does manage to spend some of every afternoon working in his yard assisted by his three preschool children.

Dave received his B.S. fmm Muskingum College. New Concord. Ohio with a double major in biology and chemistry.

Third In Series

"Muskingum has one touch with fame: John Glenn went there. They've renamed all the buildings and the town's main street to reflect this."

Reichle tentatively decided to go into medicine but after over-sleeping his medical admission exam, he awoke deciding he wasn't really cut out to be a doctor.

From there "I went home to join the Army but after spending two weeks on Lake Michigan, I decided I would rather go to Northwestern (Evanston, III., and work toward a master's degree in biology."

He went on to receive both his master's and doctorate degrees in biological science from Northwestern.

After completing his master's degree. Dave came to a commendable decision. He decided to prepare for a career in what he thoroughly enjoyed doing, environmental biology (ecology), rather than enter some other field simply because at that time it looked more pmmising.

Makes 'Home' at ORNL

This brought him to the Laboratory to do post-doctoral work through ORAU. "Liking the area and the ecological approach at the Laboratory, I decided to make my home here."

Dave's introduction to ORNL had been several years before through a lecture given by Stan Auerbach (Ecology) at Northwestern as a result of ORAU's University Participation Program and ORNL's Traveling Lecture Program."

Dave feels the Laboratory has a more meaningful approach to environmental research than is found elsewhere.

"Generally an ecologist is a specialist on his favorite bug or bird and can answer any question about this particular animal. He knows what happens to this bird if he's fed, for example, cesium-137 tagged food, but what happens if the isotope was originally absorbed from the atmosphere by the trees, transmitted to insects feeding on the leaves, then eaten by the bird?

"Another example. Ecologists can't help seeing the worms in the ground and we know certain facts about these worms, but how will changes in the worm affect the ecological system — the composite forest he lives in or the lake he lives near?

Dave Reichle

"Every plant or animal in an ecological system (ecosystem) is a factor in the 'metabolism' of that ecosystem. The factors are interdependent.

"It is the ecologist's task to condense the complex by discovering how these factors, the pieces of the puzzle. fit together.

'This research is much more meaningful than amassing independent facts about specific birds or hugs. Instead we learn the consequences (environmetal quality) of using pesticides or radiation and. finally. the best use of the land on a regional basis. This removes the guesswork from conservation."

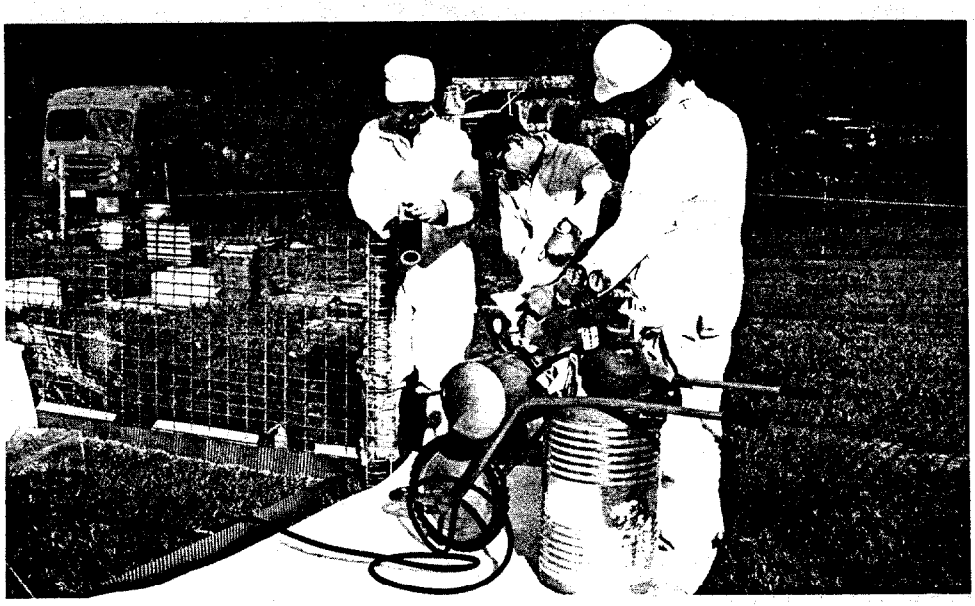
Reichle recently edited an international collection of scientific papers into a book for the International Biological Program (IBP). He is scheduled to go to Brussels to participate in an IBP symposium entitled "Productivity of Forest Ecosystems of the World."

Not Cosmopolitan

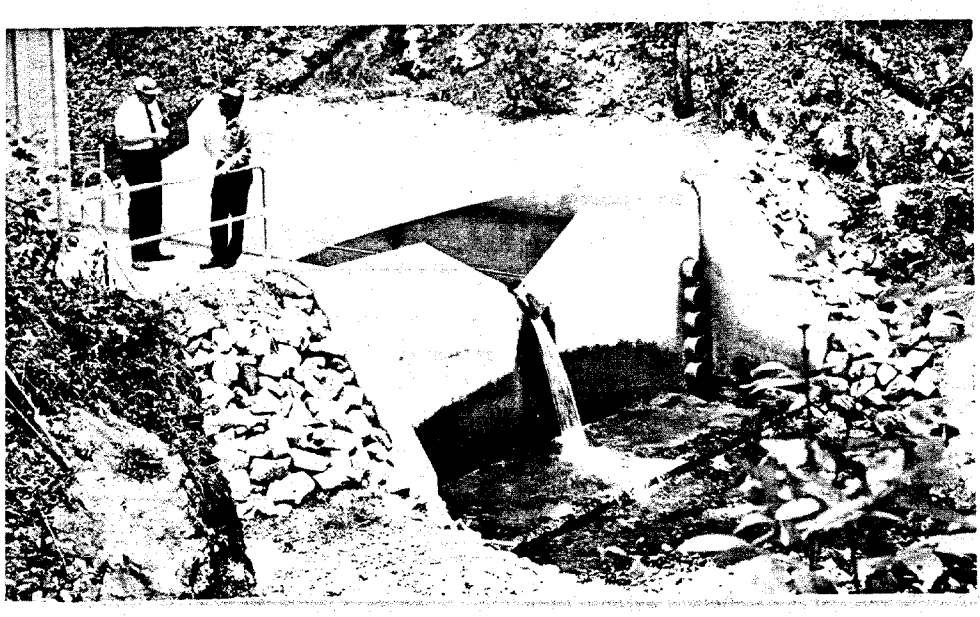
"Other than this, I'm afraid I'm not very cosmopolitan. Oh. I suppose I did start out in life determined to be a traveler. I always envied Tom Sawyer and wanted to build a raft and float down the Mississippi. but my mother hadn't read all the child psychology books so she would help me pack.

"By the time we'd packed everything she insisted I'd need. the pack was too heavy to carry and it was too late in the day to get started. Then she'd make me help her unpack everything.

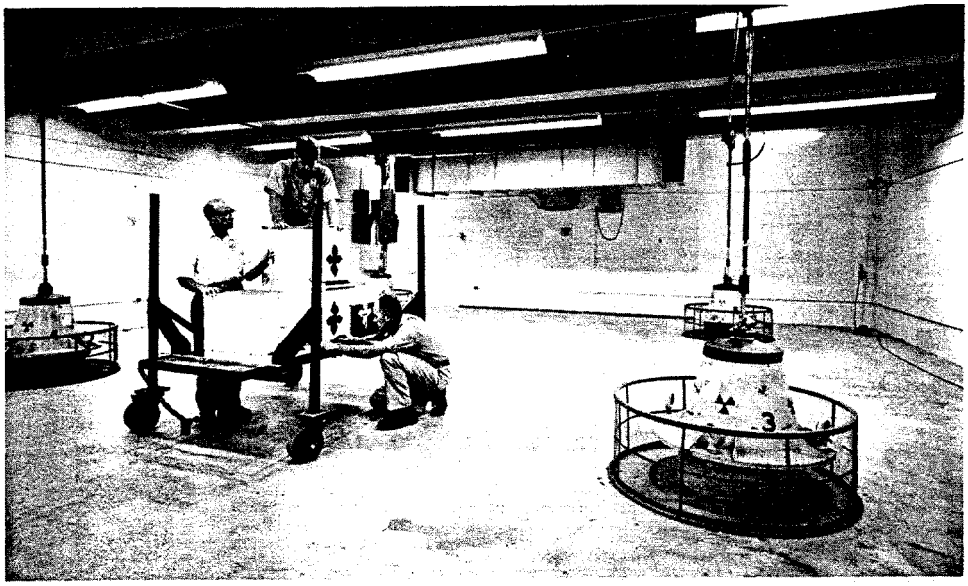
"I did successfully run away once when I was about three without anything, including any clothes on, and my grandmother couldn't catch me."



Tammy Tamura (center) assisted by Andrew Rogokski (left) and Bill Cate (right) readying ^{137}Cs solution for application to grassy test plots as part of runoff studies carried out In the late 1960s.



View of the newly completed weir and associated structures on the west fork of Walker Branch. Standing next to instrument house are Jim Curlin and Stanley Auerbach (1968).



Honey bee colony radiation effects research. Here hives are being prepared for radiation dosing using the Oak Ridge Associated Universities' large animal irradiator facility. Kneeling is Al Shinn, the principal investigator. To the left Is Everett Oertel, a retired Department of Agriculture bee expert, who was consultant to the project.

Honey bee colony radiation effects research. Following Irradiation, the 75 control and experimental hives were established in a flowering meadow area In the east end of the Oak Ridge Reservation and placed under large net tents to partially confine the bees. Here Al Shinn (left) is photographing a comb structure. Consultant Everett Oertel (center) is removing another comb, while technician is standing by with the next comb.

THE OAK RIDGE NATIONAL LABORATORY NEWS

A Publication for the ORNL Employees of Union Carbide Corporation

vol. 17 — No. 19 OAK RIDGE, TENNESSEE Lab-71551 Friday, November 6. 1964

Field Experiments May Tighten 'Web

ORNL Ecologists Discover New Clues In Mysterious 'Mud Dauber Episode'

By R. L. WESLEY

If Perry Mason was an ecologist, he might title a current ORNL ecology study "The Case of the Hot and Cold Mud-Daubers."

In this case, however, the villians are known from the beginning. They are the black-and-yellow mud dauber wasps which carry mud from the Laboratory's liquid waste pits to make their nests in health physics monitoring stations, abandoned buildings or any cozy place near the mud source that suits their fancy.

Although wasps have presented something of a problem by contaminating some Laboratory equipment, they don't range very far (about 700 feet) from the mud source to the site of their nests, they are not personally contaminated and their sting carries no radiation. The problem is to screen them out of the areas to which they may carry contamination. This is not easy, but it can be accomplished by carefully sealing all tiny openings in a monitoring station.

Unlike Perry Mason mysteries, the "good guys" are the real puzzlers in this case. They are the pipe-organ mud daubers, who do not like radioactive mud for construction material and apparently use only non-radioactive or very low level activity mud to build their nests. They do man no harm except to arouse his curiosity and incite the question: do pipe-organ wasps detect radionuclides in mud, or is some other selection factor involved?

Detective in the case is A. F. Shinn of Health Physics Division's Ecology Section. He is assisted by M. H. Shanks and Gladys Dodson.

As reported in an earlier **ORNL News** article (July 17, 1964), Shinn subjected the mud used in nests of both types of daubers to various tests. These tests attempted to determine possible differences in pH, odors detectable to humans, cation exchange capacity and X-ray diffraction. Shinn concedes the possibility of textural or smell difference, or some other factor, but tests thus far have shown no statistical significance in identifying the difference. It appears that both types of wasp use the same type of mud.

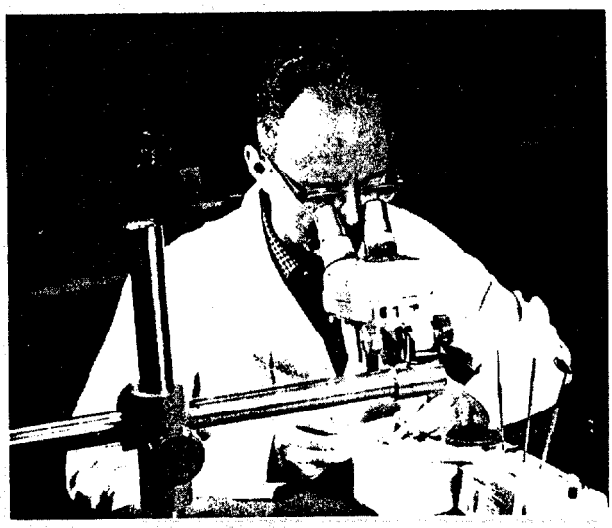
In recent months, Shinn and his assistants have captured and raised in a 32-cubic-foot, wire-screened cage a number of black-and-yellow and pipe-organ wasps. The purpose was to determine if it was possible to raise them under laboratory conditions and to find out if the pipe-organs would refuse radioactive mud while in captivity.

At the outset, one of the primary problems was that of supplying spiders for the wasps to store in their nests. The black-and-yellow dauber uses several kinds of orb-weaver, jumping and crab spiders, but the pipe organ makes almost exclusive use of only two kinds of the many orb-weavers. It will stubbornly refuse to nest without them. Moreover, the orb-weavers have to be only half-grown, because larger ones are difficult for the daubers to handle.

Shinn found that both daubers enjoy honey. Shanks developed a

Continued on Page 2

Lab-12641



MUD DAUBER wasps used in laboratory experiments are anesthetized and marked with tiny, colored plastic discs for future identification. A color and numerical coding system devised by A. F. Shinn, Ecology Section, Health Physics Division, records the sex of the wasp and when the experiment began.

12873 THE NEWS Friday, November 6, 1964

Study of Caged Mud Daubers Supports Field Investigations

Continued from Page 1

feeding station that the daubers avidly visit-four plastic red-and-yellow roses, each with a tiny vial of diluted honey in the center of the flower.

When the daubers appeared ready to build homes, two flat, shallow pans of mud were placed inside the cage. One of the mud samples had been obtained from the waste pit area and had a radiation level of 200 milliroentgens per hour. The mud in the other pan had been obtained near the waste pit but was not radioactive.

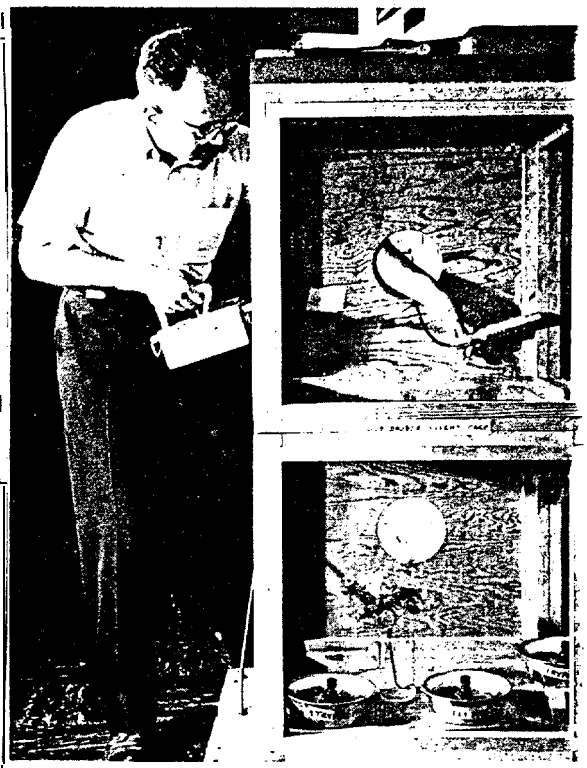
The pipe-organ wasps avoided the radioactive mud — refusing even to alight on the **pa". Just as in the field, they chose only the "cold" or non-radioactive mud. The black-and-yellow wasps used both mud types indiscriminately,** just **as they had in the field.**

In another test the cage containing the wasps was taken inside a cobalt-60 radialion chamber and subjected to 100 to BOO roentgens per hour. Shinn noticed no unusual behavior on the part of the black-and-yellow daubers. but he said the pipe-organ wasps appeared nervous and seemed to spend less time feeding on the small vials of honey.

In a later test, out side the source chamber, four pans of non-radioactive mud were offered to the wasps. Mud in two of the pans was composed of old nests made by black-and-yellow daubers, while the other two contained mud from old pipe-organ nests. The black-and-yellow daubers used both types. while the pipe-organ daubers used only the pipe-organ mud. Shinn then placed a bottle. containing a radioactive source with a reading of two roentgens per hour, in the center of the pipe organ wasps' mud pan. Both wasps ignored it and continued to use the mud.

A field experiment involving the Laboratory's waste pit is expected to provide further answers. A number of boxes **have been constructed and strung** in **clothesline fashion over the waste pit. The radiation level at that point is about eight roentgens per hour. Dauber nests collected in the field will** be **placed in these boxes to test wasp mortality rates.**

Shinn has learned how to induce the over-wintering grub-like larva to transform to an adult wasp months ahead of its usual summer date. He expects to hatch several such lots in mid-winter, maintain them in laboratory cages and test their behavior responses to ionizing radiation.



A. F. SHINN inspects nests made by pipe-organ mud dauber wasps in a laboratory cage. The tube-like objects above the probe are nests made with non-radioactive mud. Beneath the probe is a "hot" nest built by a black-and-yellow dauber. At the bottom of the cage are pans of mud made from old dauber nests. The clear glass bottle holds a bouquet of artificial flowers containing a thimble-sized beaker of honey mounted in each blossom.

5. A NEW DECADE—A NEW DIVISION AT ORNL

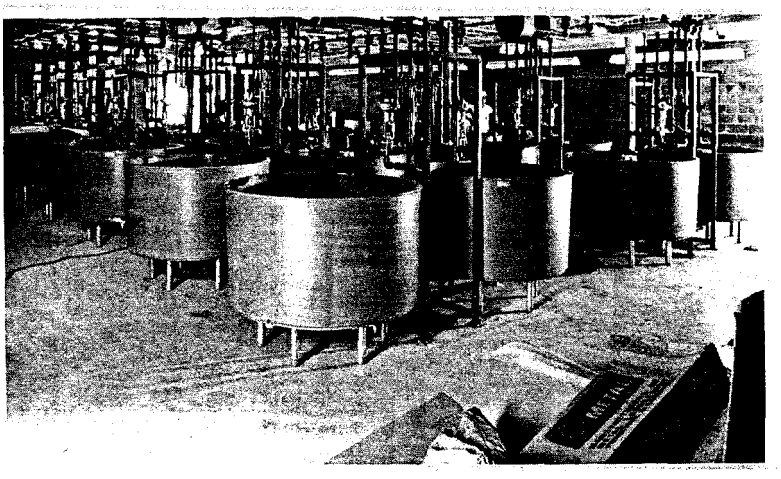
The beginning of 1970 was heralded in much of the media as the beginning of the "Era of Ecology." *Time* and *Newsweek* referred to ecologists as "The New Jeremiahs." The ferment over environmental pollution and ecological damage was producing new products in Washington. By Executive Order, President Nixon consolidated a number of federal agencies into a new Environmental Protection Agency (EPA). Congress began to pass numerous bills that mandated specific restraints, on pollution of air, water, and land. It also passed what seemed to be a rather innocuous piece of legislation entitled the National Environmental Policy Act of 1969, which had been drafted largely by ecologist and social scientist Lynton Caldwell of Indiana University. This act laid down a number of broad principles and policies for the protection of environments. One rather obscure section of the Act called for a formal assessment of potential environmental damage that might result from any federal action before such action could be undertaken.

At the Laboratory, ecologists were busy with the research thrusts that had been established in the previous 2 years. Walker Branch Watershed was being studied as part of the Biome Program of IBP, radiation studies were being carried out in the old. . . field plots under OCD, and radiation ecology studies were active, especially in White Oak Lake.

Associate Laboratory Director for Biomedical and Environmental Sciences James Liverman was particularly interested in the expansion of ecological research, especially on problems that had bearing on major national issues in the area of water pollution. Two such issues had surfaced in the last years of the previous decade. The first was the widely recognized problem of eutrophication resulting from excess nutrient inputs, especially from sewage systems and agricultural runoff. With Liverman's encouragement, Dan Nelson and a small team put together in a few weekends of intense effort a major laboratory and field research proposal that would get at the causal mechanisms and processes underlying eutrophication. This proposal was then taken to EPA, which had taken over the old Federal Water Pollution Control Agency. While agreeing that the proposal represented an innovative and scientifically imaginative effort, the 'Agency declined to fund it because of its scope and costs.

About this same time Nelson and Auerbach were also becoming aware of the growing concern about the potential impacts of the release of heated water from the cooling systems of nuclear power reactors into aquatic systems. The cooling systems of these reactor stations would require unprecedented quantities of water to carry off the excess heat. While a number of field studies were under way around the country, Nelson carried out a review that showed that little data were available on the interactions in aquatic systems of heat addition, nutrient enrichment, and radionuclide uptake and turnover in aquatic organisms.

With Laboratory management's full support, Nelson and Auerbach approached AEC with a proposal to establish a thermal effects research

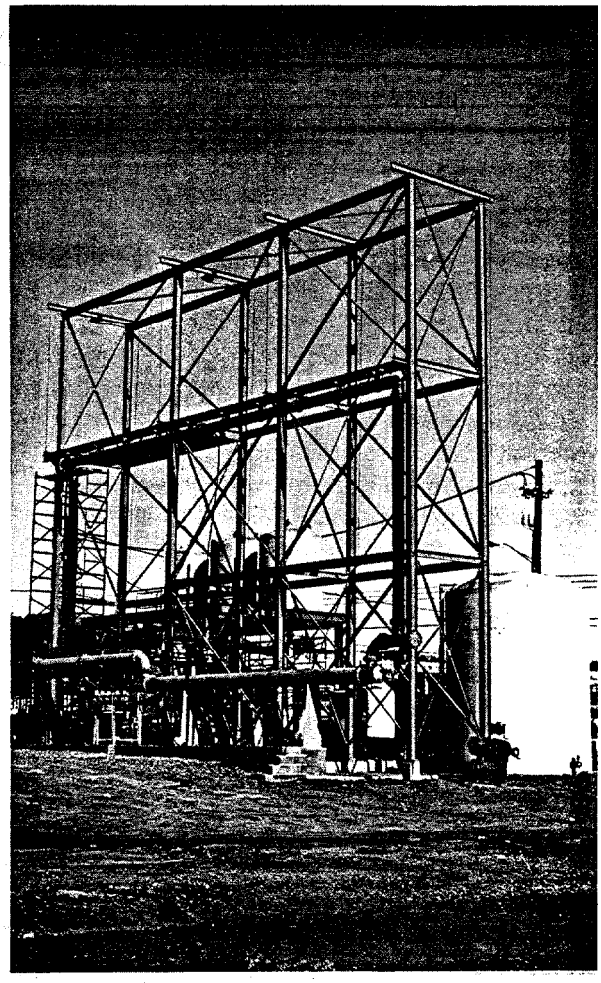


Interior view of the newly completed Aquatic Ecology Laboratory for the experimental study of thermal effects. Each tank received conditioned spring water through a special computer-controlled valve system. With this system and a central dedicated computer, water temperatures could be varied during a 24-hour cycle, simulating temperature changes similar to thermal outfalls from a power plant (1972).

program that would focus on detailed quantitative multifactorial experiments on the effects of heat and other factors on aquatic organisms. They pointed out that the results of such research would provide a rigorous complement to the field studies that were already under way at various institutions around the country. To carry out this effort they submitted a proposal and requested funds to construct a new aquatic ecology experimental research facility of advanced design near White Oak Creek AEC approved and funded both the new program and the new aquatic ecology research facility. To lead this new effort, Charles Coutant was recruited from Pacific Northwest Laboratory, where he had spent several years in thermal effects aquatic research. Coutant reported to the Laboratory in March 1970 and undertook the leadership responsibilities of the new program.

By the beginning of 1970 it was evident that environmental issues were going to play a large role at ORNL in the decades ahead, and both the opportunityand the need for a division that would give identity to that role in a major way was manifest. Finally, in the second week of March 1970, Laboratory Director Alvin Weinberg formally established a new Ecological Sciences Division with Auerbach as director and Dan Nelson as assistant director.,, It was timely and appropriate because the first Earth Day celebrations were being planned for April 1970 at many places around the country. Auerbach had already accepted an invitation to be a key speaker at the Earth Day celebration at the University of Illinois at Champaign-Urbana. Going there as the director of a new and first AEC national laboratory division dedicated to ecological research was an added satisfaction.

Who were the key staff members of the new division? In the last year as the Radiation Ecology Section of HPD, the senior roster included Gordon Blaylock, Jim **Curlin,** Roger Dahlman, Paul **Dunaway,** Steve Kaye, Jerry Olson, Bob **O'Neill,** Dave Reichle, Al Shinn, Bill Thomas, John Witherspoon, and Martin Witkamp. Approximately one year later the first annual progress report listed these new research staff members; Nelson Edwards, Robert Goldstein, Charles Malone, Bob Van Hook, Fred Taylor, Joan Hett, Jerry Elwood, Chuck Coutant, and Gerry Ulrikson. Most of these individuals were involved in AEC research programs. But there was also a new IBP staff that was divided into two components. One was the Biome director's headquarters staff and the other was the new Oak Ridge research site staff. Among the former were Robert Burgess, Glenn Goff, and Henry Shugart. The latter team included Dave Reichle, Blaine Dinger, Frank Harris,



View of the experimental condenser cooling apparatus designed to simulate the cooling systems of nuclear power plants. This apparatus, located adjacent to the Aquatic Ecology Laboratory (Bldg. 15041, was used to test the impacts of cooling operations on aquatic biota, especially young fish species (1977).

Oak Ridge National Laboratory

-NEWS

A Publication for the ORNL Employees of Union Carbide Corporation

'01. 22 — No. 32 OAK RIDGE, TENNESSEE Friday, March 20. 1970

Stanley Auerbach To Head Ecological Sciences Division

A new Ecological Sciences Division was formed this week at ORNL to place special emphasis on understanding the balances of nature and the dangers of pollution.

Alvin M. Weinberg, director of ORNL, said the new division will be directed by Stanley I. Auerbach, who has headed ecological studies since they first became a part of the ORNL program in 1954.

Auerbach

Until this week, ecological studies were a part of the Health Physics Division. Weinberg said the new division will report to James L. Liverman, newly pointed ORNL associate director for the Biomedical and Environmental Sciences.

Auerbach said the new division will have a key role in the International Biological Program. He said the division will have charge of analyses of ecosystems in the eastern United States.

Initially, he said, the new division will consist of approximately 50 persons, most of whom are specialists in various fields of ecology.

Auerbach said the new division will be divided into two general groups. those engaged in studies of thermal effects on water and the life in it; radiation and chemical effects on plant and animal life: use of large-scale computer systems in determining the balances of nature and the earth's ecosys-

continued on Page 4

New Ecological Division Formed

Continued from Page 1

tern: and the movement of pollution materials through food chains.

The new director said the division will also take a long. close look at the capacity of the earth's vegetation to consume carbon dioxide and produce oxygen. This study, he said, results from the opinion voiced by some scientists that we may be dooming ourselves by destroying too much of the earth's vegetation.

Chapter 5

Oak Ridge National Laboratory
NEWS
A Publication for the ORNL Employees of Union Carbide Corporation
Vol. 22 — No. 30 OAK RIDGE, TENNESSEE Friday. February 20. 1970

Charles Coutant

Charles Coutant To Direct Thermal Pollution Project

A new project in thermal pollution has been funded at ORNL by the AEC. The project will be part of the regular program of the Radiation Ecology Section of Health Physics Division. The director of this new project. Charles Coutant, will join the Laboratory March 1, after several years in aquatic-thermal- ecologic research at Pacific Northwest Laboratory.

Coutant received the B.S.. MS. and Ph.D. degrees from Lehigh University. He-is a member of several professional societies. Among them are American Association for the Advancement of Science. American Society of Limnology and Oceanography, Ecological Society of America, American Institute of Biological Science and American Fisheries Society.

The project has developed out of an ORNL review which indicated that much more data was needed about the interaction in our rivers and lakes of heat addition, nutrient enrichment and radionuclide up take and turnover in aquatic organisms.

Plans include the design anu construction of an experimental facility near White Oak Creek for multifactorial experiments on the effects of heat and other factors on aquatic organisms. The facility will contain tanks for still or flowing water experiments. The research will focus on the effect of temperature and chemical quality of water on assimilation and turnover of radionuclides importan' in waste releases. It will include elements which have fission or activation products or which influence organisms' responses to thermal stress.

Also. the facility will be designed to simulate conditions of a major nuclear facilitv and its release of heat and effluents on the environment. In addition. the facility could be equipped to receive effluents from ORNL's sewage treatment plant in order to provide organic and inorganic enrichment for data collection on the Interaction of radioactive and other pollutants.

Plans include arranging complimentary studies in cooperation with the Tennessee Valley Authority which also has a new thermal pollution program.

Data of this kind are needed to provide factual knowledge which could be applied to sites proposed for nuclear power plants. Presently knowledge on the subject is fragmentary. New, more complete data would provide a valid basis for justifying or criticizing nuclear power plant siting.

Oak Ridge National Laboratory

NEWS

A Publication for the ORNL Employees of Union Carbide Corporation

Vol. 23 — No. 7 OAK RIDGE. TENNESSEE Friday. September 18 1970

Auerbach To Head Ecological Society of America in 1971

Stanley I. Auerbach director of the Ecological Sciences Division at ORSL, has been named president-elect of the Ecological Society of America. His term of office as president will begin in September 1971.

Auerbach has headed ecological studies here since they first became a part of the ORNL program in 195.1. He was named director of the' new Ecological Sciences 'Division in March of this year.

When named director. Auerbach said the division would play a key role in the International Biological Program. He said the division would be divided into two general study groups: those engaged in the study of water and of land:

Auerbach received B.S. and MS. degrees in zoology from the University of Illinois. He received his Ph.D.-degree from Northwestern University. He has served on ad hoc ecology advisory committees which have been established periodically, has been associate editor of the journal Ecology. is on the editorial board of Radiation Botany, is an adjunct research professor of ecology at the University of Georgia. and is a lecturer in zoology at the University of Tennessee.

He is a Fellow of the American Association for the Advancement of Science and a member of many professional and technical societies.

The Ecological Society of America was established in 1915 for the purpose of giving unity to the study of organisms in relation to environment, of furthering communications between individuals who approach widely different groups of organisms from closely related points of view. of stimulating ecological research. and to assist the development of utilities which ma? be served by ecological principles.

The Society has a membership of approximately 4,400 scientists and others Interested in ecology.

Stanley I. Ausrbach

December 11. 1970

D. J. Nelson Named Assistant Director Of Ecological Sciences Division

Daniel J. Nelson has been appointed assistant director of Ecological Sciences Division. The ap pointment is effective immediately.

Nelson received the B.S. degree in zoology from Iowa State University in 194'7, the MS. degree in 1949 from Oregon State University and the Ph.D. degree in ecology in 1957 from the University of Georgia.

Before coming to ORNL in 1959 he was a research project leader for the Georgia Game and Fish Commission and an assistant professor of biology, limnology and fisheries at West Virginia University in Morgantown.

Since 1959 he has been limnologist group leader and assistant chief of the Radiation Ecology Section of Health Physics Division. The section was made a division in March 1970.

In other professional activities, he has been a member of the Radioactivity Working Group to advise with respect to environmental radioactivity in the proposed construction of a Transisthmian Canal with nuclear devices, a consultant to the Advisory Committee on Reactor Safeguards and a member of the U. S. National Committee for the International Quaternary Association sponsored by the Sational Research Council of the National Academy of Sciences — National Academy of Engineering.

D. J. Nelson

Nelson Edwards, Fred Taylor, Linda Mann, Gray Henderson, and Phil Sollins. In addition, there were many undergraduate and graduate research assistants, M.S. and Ph.D. students, and post-doctoral fellows. All of these were augmented by a number of technicians who played a key role in the development of environmental sciences.

Although thwarted in his attempt to change ORNL into a national environmental laboratory, Alvin Weinberg, with the encouragement of a number of key staff, strove to find new environmental programs for the Laboratory. NSF had recently established a new interdisciplinary program entitled Research Applied to National Needs (RANN), to which a comprehensive proposal developed by a multidisciplinary Laboratory team was submitted. The proposal was approved and funded, and a new project-the NSF-Environmental Program-was set up with John Gibbons as the program director. Emphasis was on the social sciences, which made ORNL the first atomic energy laboratory to have those disciplines on the staff. The focus included economics, regional studies, and other aspects of energy-related social problems. Reichle and O'Neill wrote and organized the regional program and were also involved in some of the planning and activities of this new unit. Thus began the Regional Studies Program, later to form the basis for socioeconomic studies in the Energy Division. This program would stimulate other environmental projects that would receive NSF support. Chief among these was another inter-disciplinary effort entitled the Ecology and Analysis of Toxic Substances Program. Three individuals were chosen by Jim Liverman to lead this effort: Bill Fulkerson, Dub Shults, and Bob Van Hook This project drew on the strengths of a number of divisions, especially Analytical Chemistry and Ecological Sciences. The project, which initiated a variety of energy-related studies, especially of problems associated with coal-fired electric generating plants, continued to receive NSF support for 6 years. Not only did it conduct pioneering studies and achieve outstanding results, but it also helped to establish the successful career tracks of the three leaders.

In 1970 the National Environmental Policy Act came into effect, It required assessment of the environmental impacts of new, federally sponsored developments or actions. Moreover the Act called for this information to be used in determining if the proposed project should be modified or canceled. For the growing environmental movement, this portion of the Act provided a major opportunity to intervene in the licensing process that all proposed nuclear power plants had to undergo. In complying with this section of the Act, AEC prepared short, almost cursory impact statements, written by a staff composed of a few individuals at AEC headquarters

Ecologist Robert O'Neill and Joan Hett using a portable analog computer as part of a regional *modeling* study in the Tennessee Valley Region (1973-74).

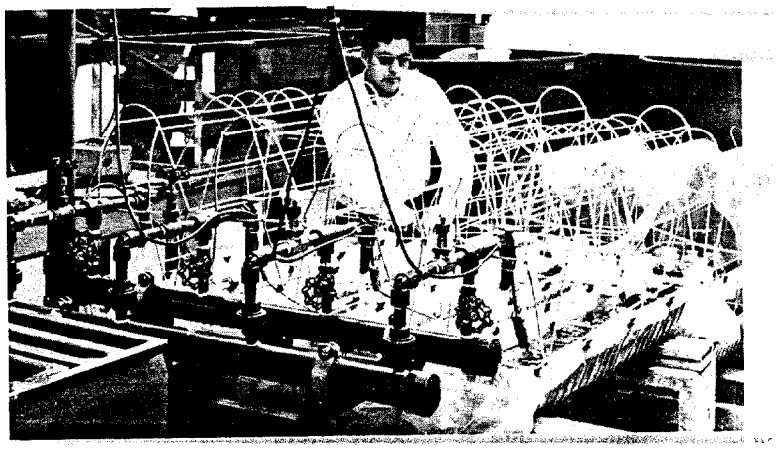
in Washington. Moreover, these statements were limited to the radiological impacts of the plants. In July 1971 a Maryland court, after hearing the arguments of intervenors against the proposed Calvert Cliffs nuclear power station, issued a decision strongly criticizing the inadequacy of the government's impact statement and ordering AEC to prepare statements that were strictly in conformance with the aforementioned Act, soon to be known as NEPA. This judgment required AEC to analyze and assess *all* possible or potential environmental impacts of nuclear power plants.

For AEC, the decision created a major emergency. It threatened to slow down, even halt the expansion of nuclear power, because new plants could not be licensed until they fulfilled NEPA requirements. To meet this crisis, AEC took the unprecedented step of ordering three national laboratories [Argonne National Laboratory (ANL), ORNL, and Pacific Northwest Laboratory (PNL)] to begin preparing these new and expanded assessment statements. ORNL management, in turn, ordered Auerbach to mobilize his division to take on these assessments. It was quickly determined that the writing tasks went beyond ecological issues and would have to deal with all the environmental aspects of a plant. Accordingly, the decision was made to organize a multidisciplinary Environmental Impact Report Project under the leadership of Ed Struxness, who was in the process of joining the Ecological Sciences Division as assistant director. Struxness sent out a call for interested volunteers in the Laboratory and received an overwhelming response. He and his new assistant for the project, Tom Row, who had been with the Reactor Engineering Division, selected and organized about 60 staff into several writing groups and teams.

Initially the Laboratory was faced with the preparation of 20 statements, each with its own licensing requirements and each presenting ecological challenges. To cope with this unprecedented demand, Auerbach reorganized the Division, establishing new sections responsible for impact statements and launching the most intensive search and recruitment activities in the Division's short history. During the 1971-72 year, 12 scientists were added to the Division mainly to assist in the impact statement work, which was beginning to demand 60- to SO-hour work weeks from the staff. At first, the key leaders in the ecological aspects were Dan Nelson, Paul Dunaway, Gordon Blaylock, and Chuck Coutant, all of whom helped mightily to meet the crisis demands of this effort. Soon joining them were Carl Gehrs, Webb van Winkle, John Trabalka, Phil Goodyear, John Huckabee, Ernie Bondietti, Jack Mattice, Dean Eyman, Gerry Ulrikson, and others. It was an exceedingly difficult time for everybody. Most of the AEC-supported radioecology research had to be curtailed because of the crisis. Yet the AEC headquarters ecology program officers, refusing to acknowledge that an agency-mandated crisis situation existed that bore directly on AEC environmental issues, wanted to cut the research budgets in some cases. This was paradoxical, not only because of the relevance of radioecology research to AEC missions, but also because, in spite of the turmoil in the organization, research projects were still being carried out, albeit at a reduced pace.

The staff were determined to maintain what they perceived as their leadership roles in these areas of research. Dan Nelson, prior to the impact crisis, had made plans for the Third National Symposium on Radioecology in Oak Ridge. This was to be a milestone effort with widespread participation by ESD researchers. The symposium was'held in May 1971 in Oak Ridge and was the first large scientific conference to make use of the then relatively new Civic Center facilities in Oak Ridge. It was well attended and the staff presented a large number of papers. However, although the conference preceded the impact statement crisis, publication of the proceedings was delayed because of staff involvement in these other matters

During this period another, totally different activity was established in the Division. Some years before, Alvin Weinberg had written a seminal article dealing with the idea and need for scientific information centers. Within the IBP programs a preliminary start had been made, but with funding pressures and a somewhat hesitant sponsor, there had been little progress until a center was established at the biome headquarters, with Nancy Ferguson as the first staff member. The system was



Technician David Cox examines, aquatic insect-rearing streams. The streams were supplied with water at different temperatures to simulate the thermal discharges of nuclear power stations. The screen covers trapped adult insects that emerged at different times, depending on water temperature (1973).

designed to provide numeric and bibliographic services and to receive and store data sets from the several participating research sites. It operated effectively for the few years that it was supported.

The concept of information centers also was being pushed within the Laboratory, and a number of centers were started in 1970. These centers were initially conceived to provide information services to investigators and especially to assist them in coping with what was already a vast literature. This diversity of literature was then and even more so today typical of the ecological and environmental sciences. Accordingly, an Ecological Sciences Information Center was established in the Division in 1970 under the management of Carol Oen. It turned out to be a major source of support, especially for the impact statement writers who needed quick access to a vast variety of ecological literature related to the local fauna and flora and ecological conditions around proposed reactor sitesthat were being located in many of the major habitats of the United States.

The emergence of the environmental movement, the diversity of disciplines that were needed to address complex ecological/ecosystem problems, not to mention the related environmental problems dealing with the physical and chemical components of the ecosystem all supported the premise of an environmental division at the Laboratory. A research division focused only on the biological aspects of ecosystem science (i.e., ecology per se) would find itself limited in its capacity to address major problems at the national laboratory scale. It was this reasoning that led Auerbach to argue for the establishment of such a division during much of this 1970–71 period. Early in 1972 the decision was made, and on May 15, 1972, Director Weinberg issued a formal announcement changing the Ecological Sciences Division to, the Environmental Sciences Division.

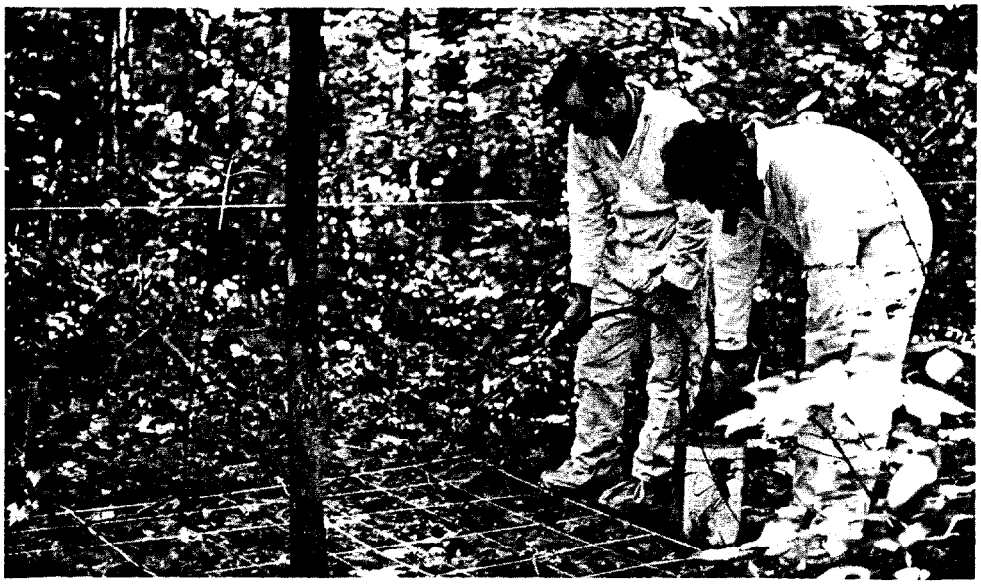
The new decade found the, Radioactive Waste Disposal Section in HPD pursuing several lines of investigation. Among these were the continuation of pioneering research in high-level waste disposal, namely, hydrofracturing and disposal in deep salt formations; radiological dose and hazard

Technician David Carroll holding a largemouth bass in which an electronic tag monitor has been surgically implanted. Monitoring and recording apparatus provides a printout of data on location, conditions, etc. (1971).

assessments related to the use of nuclear explosives for peacetime activities (Project Plowshare); and a research endeavor that focused on the behavior of trace elements and radionuclides in the terrestrial environment.

As a result of the success of Project Salt Vault and the related studies of the salt deposits in Kansas, the Laboratory was authorized to carry out a complete study that would lead to the development of a conceptual design of a high-level waste repository plus an additional component to handle packaged low-specific-activity alpha-contaminated materials. This was to be a joint effort of HPD and CID with the actual design work carried out by what was then the General Engineering and Construction Division. A preliminary conceptual design for such a facility was prepared that was based heavily on the data derived from the Kansas studies and was predicated on the assumption that the repository would be located in Kansas. The following year, on the basis of these conceptual design studies, AEC announced the tentative selection of a site near Lyons, Kansas, for an initial salt mine repository for the demonstration of long-term storage of solid high-level and long-lived low-level radioactive wastes. The control of the project was now centered in Washington. Unfortunately, resistance to this project began to build in the state of Kansas, especially in the Kansas Geological Survey and among emerging environmental groups, although not among the people in the vicinity of the proposed facility, who saw it as a potential economic benefit. For reasons that are not readily apparent, no compromise (assuming such was attempted) could be reached between AEC and the state of Kansas. As a result, the demonstration project was cancelled and 14 years of careful effort that would have gone a long way toward solving the major and limiting nuclear energy problem of the United States came to naught.

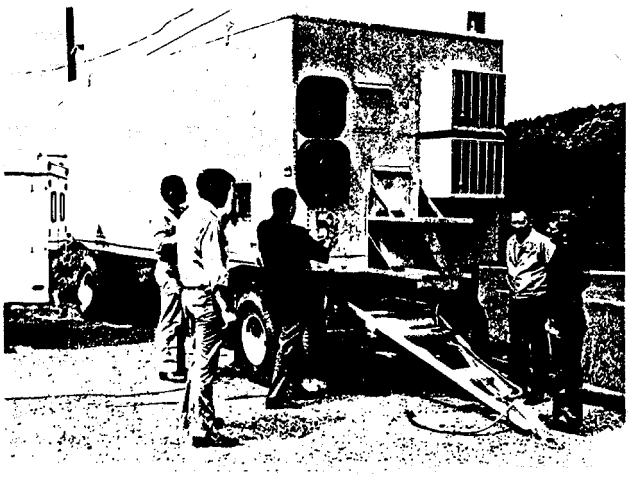
Hydrofracture activity was limited to studies of the results of the operational use of the facility in Melton Valley by the Operations Division. One of the last injections that HPD was involved with disposed of almost 100,000 curies of fission products. The operation was successful. The hydrofracture research group, which then consisted of de Laguna, Cowser, and Tamura, also assisted the state of New York, which was interested in the process as a means of disposal. A number of fracture tests and related studies were carried out by this group at West Valley, New York, in collaboration with the state.



Researcher Frank Harris, assisted by Fred Taylor, applying selective chemical treatment to a litter decomposition study plot es part of the International Biological Program–Deciduous Forest Biome Project studies on decomposition processes (1971).

In the autumn of 1971 the possibility of establishing an in-house environmental training program for interested staff was raised by Laboratory management. Motivated by the growing interest in the

AIR CONDITION A TREE BRANCH? This may never be your problem, but if it is, Blaine Dinger, of ORNL's Ecological Sciences Division, has the answer. Conducting studies on photosynthesis, he encounterad the problem of the "greenhouse effect" of overheating whenever he triad to measure the respiration of a branch of leaves by enclosing the system in plastic. Thereupon he turned to his field engineer, Charles Abner, who acquired a collection of spare parts including two fan-evaporator coils from unserviceable drinking fountains, a water pump once used to provide spring water to the Ecology Laboratory, a borrowed portable refrigeration system. and a water reservoir in the form of a MD-gallon institutional cookpot picked up on surplus by Sam Croft of Plant and Equipment Division. Shown is the tree cooling system as it was finally installed last summer in the Cesium Forest.



READY JO TRAVEL—Prior to removal of the mobile facility lo the ecology field site. preparations were made for connections fo a source of electrical power Left to right, Francis Rau, Blame Dinger, Jed Newman. Tom Duif and Charles Abner

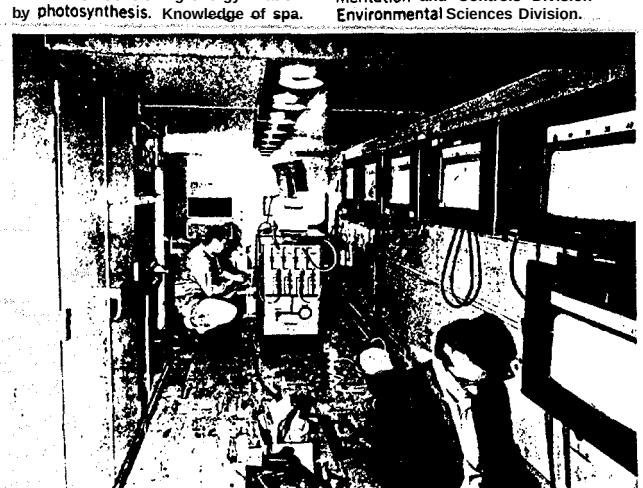
Mobile lab developed at Laboratory to monitor forests in Oak Ridge area

As part of ongoing research within the Analysis of Ecosystems section of the U. S. International Biological Program. a mobile laboratory is being developed by Blaine E. Dinger of ORNL's Environmental Sciences Division. The facility is planned to allow monitoring of photosynthesis and related *physio*logical processes, such as transpiration and related growth processes, in various forest trees in their natural habitat in response to fluctuations in environmental conditions.

Studies of this type are carried out in ah attempt to understand those factors and conditions which are limiting in terms Of Controlling energy fixation by photosynthesis. Knowledge of spa. cies response to various conditions can be used in predicting the impact of changing climatic conditions and atmospheric contaminants. as well as conventional timber management practices upon forest productivity.

Presently the laboratory IS set up in ORNL's cesium forest. The mobile laboratory is unique in that it allows comprehensive field investigation of plant processes which previously had to be conducted oh seedlings in a laboratory environment.

The mobile laboratory was built as a cooperative effort primarily am o n g Plant and Equipment Division. Instrumentation and Controls Division and Environmental Sciences Division.



PREPARING THE INTERIOR—Housed within trailer are an infrared gas analyzer and sample selector assembly being adjusted by Francis M. Rau (left) of Instrumentation and Controls Division. Ted Newnam, Plant and Equipment Division, connects power outlets for a series of recorders which will monitor Solar radiation temperature and various other environmental parameters which influence plant carbon dioxide exchange processes

Chapter 5

Oak Ridge National Laboratory

NEWS

A Publication for the ORNL Employees of Union Carbide Corporation

Vol. 23 — No. 25 OAK RIDGE, TENNESSEE Friday, May 28, 1971

Cooperative Project Begins in OR To Attract Wildlife Under TVA Lines

A new cooperative environmental project has been started to attract more abundant wildlife and to enhance the *scenic* beauty of vegetation growing under high-voltage electrical transmission lines crossing Government-owned property in Oak Ridge.

The long-term project *involves* the combined efforts of the Atomic Energy Commission. the Tennessee Valley Authority and ORNL's Ecological Sciences Division. which expects to gain valuable ecological research data.

TVA work crews have just completed planting some 2.000 pounds of an experimental mixture of western grassland seed on approximately 55 acre's underlying TVA's 00,000-volt Bull Run Steam Plant-o-Nashville transmission line where it crosses AEC-controlled property in Oak Ridge.

Multiple-Use Approach

The project is an outgrowth of TVA's new multiple-use approach to transmission line management. By clearing to ground level and planting in grass. the rights of way become productive for agriculture and wildlife habitat is improved. At the same time. the new procedure holds to a minimum both the use of herbicides and the need for repeated clearing.

Except where the nature of the terrain *makes* it impracticable, the entire 18%mile Bull Run-Nashville stretch will be treated in this way. The AEGTVA-ORNL experimental program involves the 9½ miles that pass through the AEC properties.

The Oak Ridge program is being coordinated by Roger C. Dahlman and Paul Dunaway, both of Ecological Sciences Division, and by E. V. Raffalovich of TVA's Power Construction Division and Dale K. Fowler of TVA's Fisheries. Forestry and Wildlife, Division.

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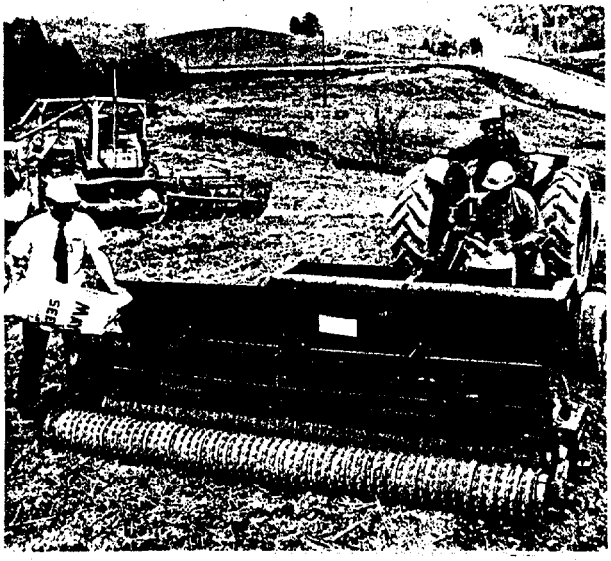


AN EXPERIMENTAL GRASS SEED mixture (approximately 2,000 pounds) has been planted under high-voltage transmission lines in Oak Ridge in a cooperative environmental project to attract wildlife and beautify the power line right-of-way. The research project involves the combined efforts of the AEC, ORNL, and TVA Above, Roger Dahlman (left) of Ecological Sc...

Radioactive Effect on Environmental Studies Urged by ORNL Ecologists

Auerbach Kaye

Ecologists from ORNL urged the world nuclear community to continue development of techniques for predicting what ultimately happens to radioactive materials released to the environment.

Stephen V. Kaye, radioecologist, pointed out at Geneva that the emphasis of his profession in the past decade has been on collecting data on the environmental behavior of small amounts of radioactive materials. The future thrust, he said, must be on finding ways to use the data to help ensure continued public health and safety as the role of nuclear electric power expands. Senior co-author of the paper with Kaye was Stanley Auerbach.

The report stated no detectable biological effects on wild plants and animals in 15 years of intensive study, when subjected to radiation in amounts permitted by law to the general public.

Joining Kaye and Auerbach in the paper's preparation were ecologists David J. Nelson, David E. Reichle and Paul B. Dunaway and systems analyst Ray S. Booth, all of ORNL.

ISION NEWS November 7.1971

ORNL's Reichle appointed to environmental studies board

David E Reichle has been appointed to a three-vear term on the Environmental Studies Board of the National Academv of Sciences Reichle is program director for Ecosystem Analysis in the Environmental Sciences Division at Oak Ridge National Laboratory

The ESB is part of the National Research Council's Commission on Natural Resources The Commission is the principal operating agency of the National Academv of Sciences and the National Academv of Engmeering. Under supervision of the Commission, analytical and advisory studies in the broad areas of natural resources and environmental quality are carried out by panels of experts with diverse backgrounds. viewpoints and affiliations

David E. Reichle

Responsibilities of ESB

The Environmental Studies Board has a wide range of responsibilities It supervises scientific studies and evaluations on different topics in different areas The ESB also serves both the Congress and Executive Branch of government as an advisory body on important and often controversial subjects. During the next few years, the Board will be deeply involved in studying the decision-making processes of the Environmental Protection Agencv It will also continue work in the fields of water pollution and air quality.

As a member of the ESB, Reichle will serve on the Committee for International Environmental Programs The IEPC was established in 1970 in response to a need for scientific advice on environmental problems having international implications

He also will be involved in other activities of the Board, including study on pert control problems, committee on water quality policv, protocols for chemicals in the environ- , men,. and principles of decision-making for regulating chemicals in the environment

Was AEC postdoc fellow

Reichle. a native of Cincinnati, Ohio, has a B S degree from Muskingum College and M S and Ph D degree, in ecology from Northwestern University He joined the ORNL staff in 1966, after conducting research there for two years under an AEC postdoctoral fellowship

Reichle has served on a number ot professional advisory committees for the AEC. National Academv of Sciences, The Institute of Ecology. and most recently the National Science Foundation's Science Research Advisory Committee

Reichle has authored or coauthored approximately 50 technical publications, and is editor of a book, Analysis of Temperate **Forest Ecosystems.** He also serves as a lecturer in the Graduate Program of Ecology at The University of Tennessee

He is a fellow of the American Association for the Advancement of America, Society for Environmental Geochemistry and Health Health Physics Society. INTECOL Association of Southeastern Biologists the Nature Conservancv Audubon Society and the Society of Sigma Xi

Reichle resides with his family at 112 Newcrest Lane in Oak Ridge

Thermal effects on aquiculture studied at ORNL

Charles C. Coutant, project supervisor of the Thermal Effects Program.

The Aquatic Ecology Laboratory (AEL), part of ORNL's Environmental Sciences Division, is called many names. Some of them include "the wet lab," "the iish hatchery" and "the fish tank building." What the AEL is called is not important, but its purpose is. Experiments are being conducted at the AEL to determine thermal effects on aquatic organisms.

The Atomic Energy Commission authorized construction of the AEL so that ecological question) raised about nuclear power plants could be answered. The principal objective of the studies is to determine the biological limitations which can be used as design criteria for power plant siting, construction and operation.

Charles (Chuck) C. Coutant is project supervisor of the Thermal Effects Program, which is conducting these studies. Before joining ORNL in 1970. Coutant conducted both laboratory and field studies on the effects of thermal discharges to the Columbia River ecosystem while employed by Battelle Memorial Institute, Pacific Northwest Laboratories.

Experiments conducted at the AEL were started in Building 2001, where most of the Environmental Sciences Division is located. The present location offers additional space and facilities for more precisely regulating temperatures.

Facilities deserved

The Laboratory consists of the main building, which has offices and houses the large experiment room: the service annex or pump house, which contains the controls and supports the large drums through which rhe water circulates; and six quarter-acre experimental ponds located in back of the main building.

The 50 x 100 ft. building has circulating water supplies of constant-temperature heated and chilled well water, and ambient-temperature well water. Twenty mixing valves are operated on a manual basis to blend these water sources to produce desired temperatures in tanks Of firh or other aquatic organisms. The tanks, which hold up to 200 gallons of water, have temperatures ranging from 5 to 43°C. The automatic valve control will enable investigators to program experimental temperature fluctuations in the tanks to match natural temperature cycles created by thermal discharges from a power plant. The computer system will

Expandable experiment room

The experiment room was built so that it could be easily expanded. The right wall can be removed, as it gives no support to the roof of the building.

In addition to the 20 large circular tanks, the experiment room contains four compartmental rectangular tanks and four small artificial streams. The compartmental ranks are being used to test growth responses of fish at varving temperatures. 'The primary purpose of rhe artificial streams is to study acclimation of stream invertebrates. Screens are king mounted over the streams to contain the emerging adult stream organisms. Algae and other plants will bc studied. and the rate of decay oi leaves dropped into the streams at different temperatures will be determined.

Facilities are also available for simultaneous addition of chemicals for studies of interactions with fluctuating water temperatures.

The six outside ponds will be used for holding experimental stocks, for breeding purposes and for setting up field experiments.

Type of experiment

Same of the experiments which are currently being conducted include: survival of fish and other organisms at elevated temperatures; growth rates of fish throughout the range of tolerable temperatures these studies also determine the best temperatures for aquiculture in heated water; predation rates on fish exposed to rapid rises or drops in temperature; preferred temperatures of fish, using temperature-sensing (sonic) fish tags developed by ORNL engineers; and the mechanical deformation of fih eggs and larvae as they pass through pumps and piping of condenser cooling systems.

The latter studies illustrate redirection of scientific talents at ORNL once devoted to reactor development. Hydraulic engineers, using experimental facilities designed to study particles flowing in the salts of the Molten Salt Reactor, are now doing similar studies to determine the physical design factors that will protect living "particles" as they pass through condensers.

Other staff members

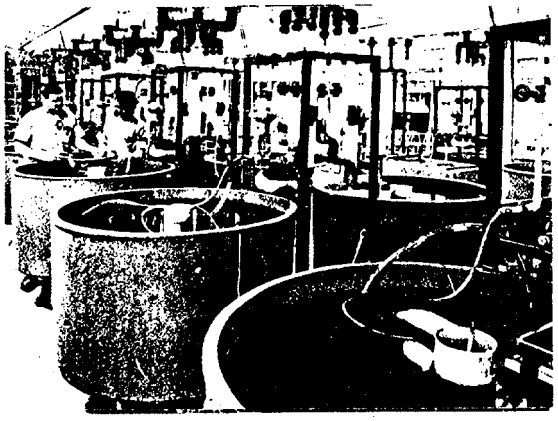
Other staff members involved in the Thermal Effects Program include Patrick Ryan, jack S. Mattice, C. Phillip Goodyear, Carl W. Gehrs, Webster Van Winkle, David S. Carroll. David K. Cox, Joe W. Gooch and L.M. Stubbs.

The Aquatic Ecology Laboratory is the first facility of its kind to be built in this area. Data obtained from the studies conducted at the AEL will be available to other organizations upon request. The ORNL staff currently has cooperative information exchanges with the Tennessee Valley Authority, the Tennessee GIN and Fish Commission. the U.S. Bureau of Sports. Fishery and Wildlife, the U.S. Environmental Protection Agency and the International Atomic Energy Agency.

Coutant and his staff are also assisting AEC Regulatorv in preparing environmental impact statements for power plant licensing under the National Environment Policy Act.

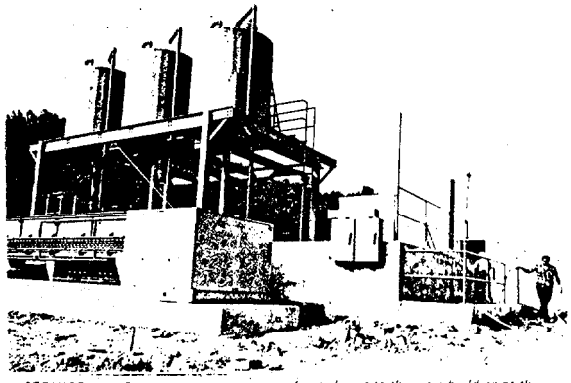
ALMOST HALF BUY BONDS

More than 49 percent of all Nuclear Division employees are saving through the [illegible] savings bonds with payroll



NOW YOU SEE THEM . . — The large circular tanks are used to study fish and other aquatic life at the Aquatic Ecology Laboratory. The tanks hold up to 200 gallons of water, and have temperatures ranging from 5 to 43°C.

HOT ENOUGH? — David Cox (hand), technician in charge of the AEL building, measures the water temperature in one of the artificial streams. The streams will be used to study acclimation of stream invertebrates.



SERVICE ANNEX — The service annex is located next to the main building of the Aquatic Ecology Laboratory. It contains the controls and pumps. Drums through

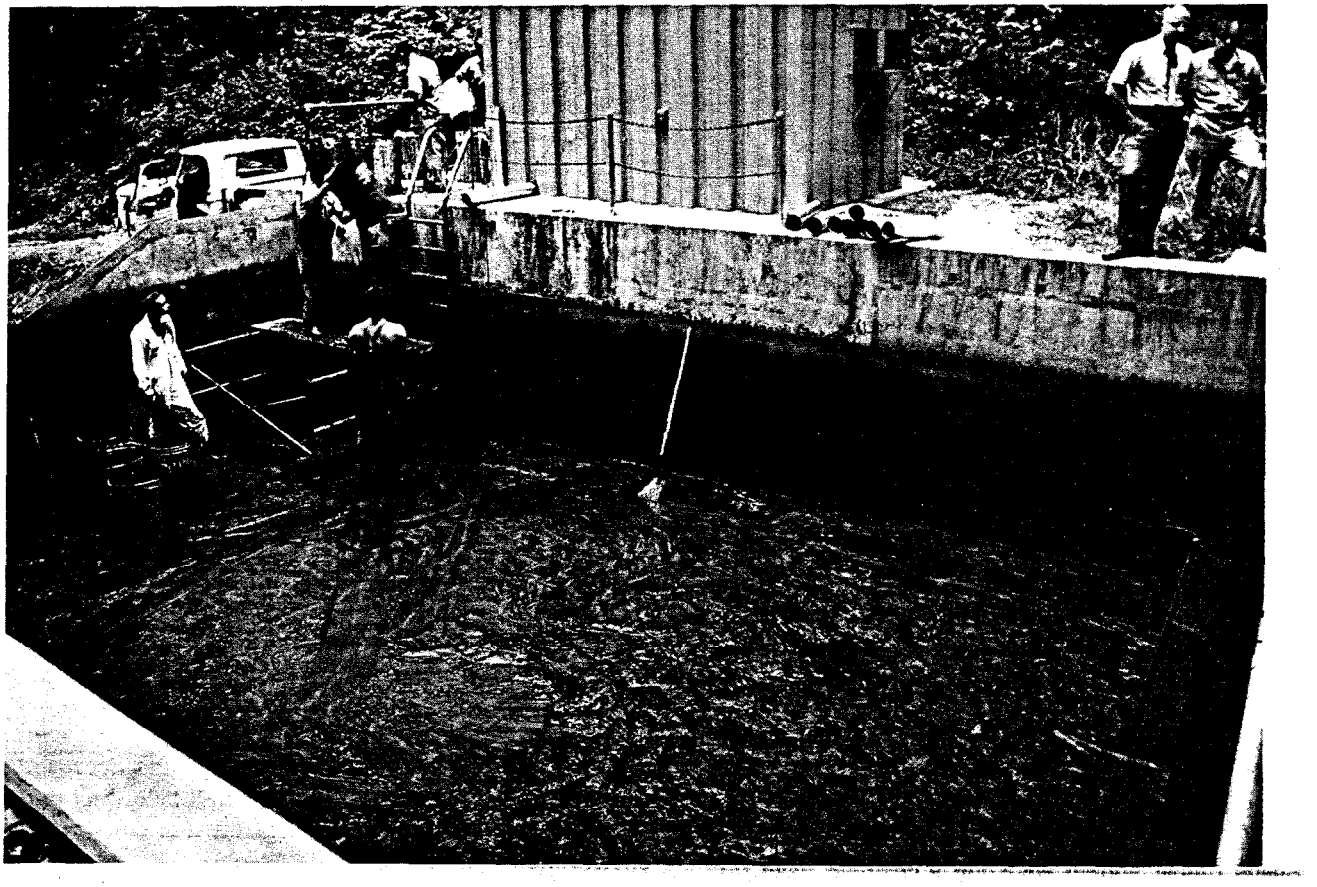
environment as well as by the likelihood of major program changes and budget shifts, Laboratory management saw this as a possible means of retraining scientists to take on new roles in a changing situation. As a result of these informal discussions, a Panel for In-House Education in Environmental Sciences and Ecology was assembled; the panel met in December of that year and prepared a proposal. During the following February and March the group worked out a plan that would incorporate the ideas of the ecologists and the needs of the impact statement group.

Blaine Dinger shown adjusting 'a chamber used for monitoring gaseous exchanges by tree trunks on Walker Branch Watershed as part of the International Biological Program-Deciduous Forest Biome Pioject (1972).

It became apparent during the summer of 1972 that many divisions would be required to reduce their staffs. 'It did seem likely, however, that funding for the writing of environmental impact statements would not be impacted. On the basis of these considerations, it was decided to go ahead with the training program. The original goal of 12 students was pushed to 20 (including auditors) when funding problems became even more severe and the need for retraining more pressing. The school began in October 1972 and held its 'final class meeting on June 28, 1973. Five courses were offered. These were Ecology (taught by Bob Burgess of ESD, who was subsequently rated by the students as the best teacher), Economics, Energy in Society, Hydrology and Thermal Hydraulics (taught by Jim Duguid, Tammy Tamura, and Patrick' Ryan-a new staff member in ESD), and Meteorology. In mid-course (February 1973), severe programmatic cutbacks at ORNL led to a need for a large staff reduction. Twelve of the students in the school received reduction-in-force notices, which affected the students' morale. Nevertheless, classes continued, and the termination date for those students was delayed until after the school term. Of the 14 persons trained in environmental impact statement writing and available for new assignments, only 3 (2 at ORNL and 1 at AEC headquarters) were used for the project. Three of the remaining persons obtained jobs in private industry more or less related to impact statement work, While everybody attested to the viability of the-in-house training concept, the fiscal support and perhaps the institutional motivation were no longer there.

The end of 1971 also witnessed the retirement of Karl Z. Morgan, the founding director of HPD and the individual whose vision and broad approach to science had early on recognized both the need and the importance of ecology for understanding the potential impact of atomic energy on the environment and on humans. Essentially, it was his early leadership that set into motion a set of actions, events, and individuals that culminated in the establishment of ORNL as the major environmental laboratory that it is today.

After Morgan's retirement it was decided to reorganize HPD. Some members of the radioactive waste disposal group that had been *involved* with high-level waste repository research moved to the Chemical Technology Division. Ken Cowser and Don Jacobs remained for a. time in HPD. Soil scientists Tammy Tamura and Chet Francis, who had been involved with low-level waste disposal problems, joined the new division, as did the late Bill Boegly. The radiological assessment group that had been working on Plowshare projects and developing new approaches to radiological assessment had been operating under the leadership of Ed Struxness, now in ESD. Steve Kaye, who had remained in Ecological Sciences while working with the radiological assessment group, took over its leadership and was joined by Paul Rohwer from Health Physics. Under Kaye's leadership, the group undertook to provide the radiological analyses of all the environmental impact statements prepared at ORNL. They also prepared estimates of the dose to biota that would be found in the vicinity of proposed nuclear power stations. Additionally, they pioneered the development of computer techniques for estimating radiological doses that might result from the use of nuclear explosives to stimulate the production of natural gas by fracturing the gas-containing rock formations. Members of this interdisciplinary group came from a number of divisions. Some of them-in particular



ESD crew cleaning out accumulated sediments in the settling basin of one of the Walker Branch Watershed weirs. The accumulated sediments" were weighed and analyzed for key constituent elements as part of runoff and mass balance studies in the watershed. Standing at right watching part of the operation are Dan Nelson and Frank Harris (1971).

Katy's Kitchen was 'super secret' storage facility

by Ruby A. Miller

There have been many stories told about a facilitv which dwells in the woods of the area between ORNL and *Y-12.* This facilitv is best known as "Katy's Kitchen." Hopefully, this article will clear up some of the misconceptions, and disclose the true story of what Katy's Kitchen was and is.

In the fall of 1947. a young draftsman in the department of public works of rhe newly organized Atomic Energy Commission in Oak Ridge was asked to work on a special project. The draftsman. Luther Agee, who still works for AEC-ORO, was told that he was to design a "secret" facilitv according to specifications, but he was never told what the facilitv would be used for. He war instructed to discuss this project with no one.

Facility described

Agee's design included a concrete building which was partiallv under. ground, a barn-type structure and a farm silo. The idea war to camouflage the facilitv so that it could not be distinguished from the other old farms which dotted the area.

The outer walls of the building were of 12-inch-thick reinforced concrete. The building *contained* a long room which was designed so that a truck could be driven into it, a pump room, and a "room within a room." This innerroom was of standard bank vault construction, with l&inch-thick walls, ceiling and floor. It was a vault in every sense of the word. It even had the heavy combination-lock door.

The barn was used to cover the outside entrance to the building, which was actually built into the ride of a hill. The barn was a plain wooden structure with large swinging doors. It was designed to fit on the hill and down over the entrance to the building. From the ground it looked a little funny, if one bothered to look closely enough. But from the air it looked like an ordinary barn.

Silo adds authenticity

To add to the authenticity of the scene, the farm silo was built on the left ride of the barn. The walls of the silo were of reinforced, %-inch concrete pipes stacked one on the other, and surrounded by wooded staves Rusted metal bands held the staves in place. The top of the silo was used as a watch tower for, the guards. It was constructed of ¼ inch thick armor-plated metal and bullet. proof glass.

Construction of the facility was completed in the spring of 1948. William T. Sergeant, chief of AEC-ORO's Security Division. raid the facility was known but only by a few as "Installation Dog." Sergeant headed the AEC's Security Patrol which was in charge of protecting the facility.

Alarm systems

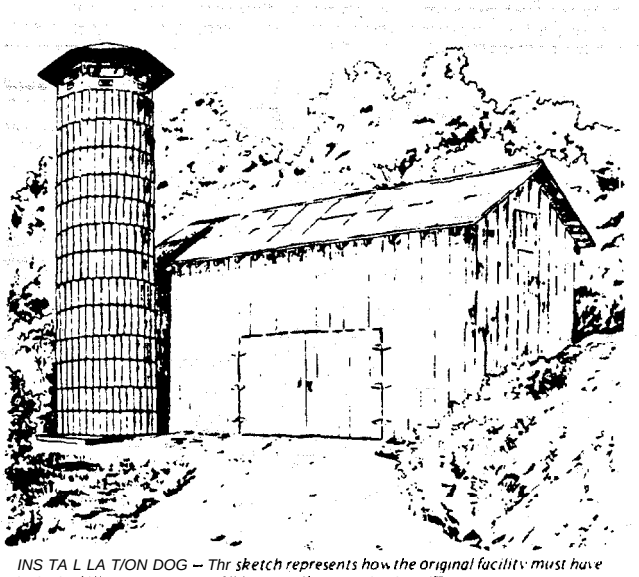
The *entire area* was surrounded by a GI combat-type barbed wire fence. and was rigged with a very elaborate alarm system. The alarm panels and controls were located in ihc Y-12 area, and responses were sent out from there. A series of coder had to be used in order to gain entrance to and exit from the area Howard E. Rosser, who was a guard in the Security Patrol. recalls several occasions when the alarms were set off by foxes or other animals in the woods.

Sergeant explained that there were two main reasons why such elaborate security precautions were taken and, why so few people knew the facility existed: ORCDP was the only facility engaged in the production of U-235, which made it very valuable. and the United State5 was the only country with a nuclear weapon at that time.

Original purpose

Installation Dog served as a temporary storage facilitv for enriched uranium after it was processed at Y-12, and before it was shipped to the weapons site. The uranium war taken to and from the facilitv by truck. No people actually worked in the building, except to unload and load the trucks. The only personnel present at the facility at all limes were the two security guards

Sergeant said that no one was allowed into the area unless authorized. Agee and the other personnel Involved in the design, construction or maintenance of the facility had to undergo periodic polygraph tests to determine how much they knew and if they had discussed it with anyone else



INS TA L LA T/ON DOG — Thr sketch represents how the original facilitv must have looked when it was used as a "top secret" storage bunker. (The sketch was prepared by ORNL Graphic Arts personnel consulting with Luther Agee, designer of the original facility.)

Installation Dog was only *in use* from May, 1948, to May. 1949. but was kept under guard for several years in case the need for it arose again.

How "Katy" got name

In 1957,. the Analytical Chemistry Division at ORNL acquired the facility from AEC to be used as a low-level counting laboratory. The isolated location of the building and the shielded walls made it perfect for such use.

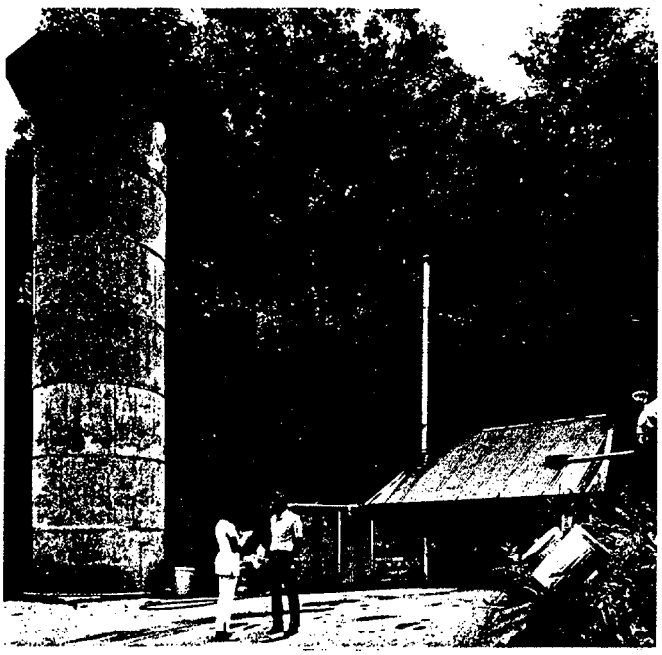
According to Larry T. Corbin, this is when the facility came to be known as Katv's Kitchen Katherine Odom, who was secretary to Myron Kelley, the director of Analytical Chemistry, visited the facility several times after the low-level counting group moved in. She often had lunch there and it was decided by all concerned that "Katy's Kitchen," would be *an appropriate* name. Mrs Odom'r husband, Clyde, still works at ORNL

Walker Branch Watershed

Katv's Kitchen is now used as a laboratory for the Walker Branch Watershed studies by the Environmental Sciences Division at ORNL Grav S. Henderson is director of the Walker Branch Watershed project, and Tom Grizzard is in charge of rhc facilitv. The objective of the study, as described by Henderson. is to investigate biogeochemical cycle, of forested landscapes with emphasis on the interactions between terrestrial and aquatic ecosystems

The present facility represents a big change from the original "Installation

(Continued on page 8)



KATY'S KITCHEN TODAY — The barn-like structure has been removed and the entrance to the original building con be seen to the right. The farm silo remains intact. except for the wooden stoves which have been removed. What was once the watch tower at the top of the silo is now a giant bee hive.

Katy's Kitchen facility

(Continued from page 2)

Dog." The barn structure has been removed; the long room into which trucks drove is an experimental laboratory, and the vault is used as an office. Even the building number has been changed. What used to be the "unknown" Building 9214, is now Building 0907.

Katy's older sister

While attempting to find out the facts about Katy's Kitchen, another facility which could be called Katy's older sister war discovered. This facility, Building 9213, was constructed in 1946 and was used for the storage of uranium until Katy's Kitchen was built. The two facilities are very much alike. in fact, Agee was taken to Building 9213. so that he could get ideas for designing Katy's Kitchen. Thir building was also built of remforced concrete and had a "room within a room," of bank vault construction. Building 9213 was never camouflaged, but was heavily guarded. The Corps of Engineers was in charge of protecting the building, and its alarm system was tied into the Oak Ridge Police Department.

After Katy's Kitchen took over its function, Building 9213 became the site of what is now the Critical Experiments Facility. The original building is still intact and exists as part of the Critical Facility. The vault is used for storage. Dixon Callihan, director of the Critical Experiments Facility, supervised construction of the present facility in 1949. It is used to conduct critical experiments which entail accumulation of fissile and other materials of interest. Information gathered at the Facility is used in developing conceptual design for nuclear reactors, in determining safety standards for handling and processing fissile materials and for basic criticality research.

VAULT STILL USED — Johnnie J. Lynn, a 9213 building staff member from the Development Division at Y-12, is shown inside the vault with his hand on one of the original Storage shelves. To the right, Lynn opens the heavy bank vault door

Charles Barton, Bob Moore, and George Killough-would join ESD as part of a new section. During the next few years this section would grow rapidly in both size and reputation under Kaye's effective leadership. Others who joined this group included Owen Hoffman, Curtis Travis, Charles Miller, and David Kocher. One of their goals was to develop a standard method for the. prediction of radiation exposure to humans. By 1973 they had such a method, called CUEX (cumulative, exposure index) and had begun to apply it to impact statements. CUEX consisted of a series of models simulating the movement and accumulation of radionuclides within various parts of the environment, including the atmosphere, terrestrial and aquatic food chains, hydrological transport mechanisms, and sediment.

After the reorganization of the HPD groups, Struxness and Auerbach set about to rebuild a geosciences unit in the new division. Both had long viewed the Laboratory's low-level waste disposal systems as totally inadequate. Radioactive materials in the so-called waste disposal pits and trenches continued to move underground, and there was no organized scientific effort under way to characterize the nature of the problem, much less to arrive at a scientific understanding of the underlying processes. They set about the process of recruiting geoscientists who would augment the soil scientists already on staff. The first of these individuals was James Duguid, a geohydrologist and modeler. Duguid began a program of studies around the waste pits and also began to recruit other staff. It was a difficult challenge, not only because funding was limited but also because most geologists were not interested in surficial problems that were typical of low-level burial grounds.

While all of this turmoil was going on in the early 70s, planning for a new building to house the new division was still in the engineering pipeline. In fact, the planning had been under way almost continuously since 1963 and 1964 when the building concept emerged as a five-story circular facility. During the following years the facility was restudied annually and reworked both in size and shape. In 1972 the request for funding a new Environmental Sciences Laboratory in the amount of $7,300,000 was submitted to Congress but was not approved. The request was resubmitted in 1973 with construction to begin in FY 1975 at a cost of $8,800,000. The funding was approved and appropriated, finally bringing to a successful conclusion an effort that had involved the support of many individuals, including Jim Liverman, Eugene Joyce, Alvin Weinberg, Welles Stanley (deceased), our congressional delegation, and many individuals in the Engineering organization who coped with the ideas and concepts the ecologists threw at them.

When word of the final approval for construction was officially received in the latter part of 1972, it set into motion another set of hectic activities. The new facility had to be sited. For a number of years the proposed site was the area east of Building 4500N and south of White Oak Ave. Two problems with that site emerged almost immediately. First, the new Aquatic Laboratory for tbe thermal effects research program was already located at the west end of the Laboratory complex and was in the final stages of completion. Separating it from the main facility by almost a mile did not seem like a workable proposition. Second, engineering analysis showed that the extension of the required utility lines to the east site would cost almost a million dollars; that large an amount had not been included in the building cost estimates. On the basis of these considerations, Auerbach decided to use the smaller but more accessible site, now known as Building 1505.

As 1972 shifted into, 1973 more staff members were added to the Division. Many came to work in the Impact and Assessment programs. Others were involved in the IBP Program and in AEC programs. Names included, Sig Christensen, Steve Hildebrand, John Huckabee, G. W. Parker, Henry Vanderploeg, Sidney Draggan, Ron McConathy, Fred Baes, Bob Cushman, Rich McLean, James McBrayer, Rod Strand, and Carter Johnson. The following year saw the names of Dick Olson, Don DeAngelis, Kent Schreiber, Bob Gardner, Dale Huff, Dennis Parzyck, Sandy McLaughlin, Darrell West, Anders Andren, Steve Lindberg, Bob Luxmoore, Dave Shriner, George Southworth, John Till, Sam Suffern, J. C. Randolph, Steve Herbes, Roger Kroodsma, Gerry Eddlemon, Bob Craig, Marshal Adams, Bart Dozier, Tom Kitchings, and others. The Division was growing fast!

Technician Marvin Shanks collecting radioactive liquid trunk runoff from a tagged tree in the International Biological Program forest ecosystem studies (1972).

Even though the new building had been approved, the Division was critically short of space. Building 3017 was fully occupied by Reichle's program. Coutant and the Thermal Ecology Group moved to the new Aquatic Ecology Laboratory. An office facility was created out of previous laboratory facilities in the connecting brick wing between Buildings 2000 and 2001 to house the Environmental Impact Group. A new greenhouse and plant research facility was built adjacent to what is now Building 1503, which at that time was a sheet metal storage and minor office facility formerly used by the on-site construction contractors. A new wing was approved and built at the east end of Building 2001 to house the Division's first satellite computer facility and to provide space for at least a dozen more staff members. A new plutonium laboratory was created in the Chem Tech facility in Building 3503.

The following year (1974) brought even more dramatic changes. First, after a year or more of growing public resistance to the continuation of AEC as the responsible agency for dealing with the nation's energy problems, Congress and the Administration agreed to split the agency into two components. The regulatory program was spun off as a new Nuclear Regulatory Commission, while the remaining AEC was reorganized into a new Energy Research and Development Administration (ERDA). One result of this reorganization was a major de-emphasis of research on radiation effects and transport. Instead, interest shifted to other forms of energy and their potentially hazardous by-products, especially coal. A new coal studies group was established under Carl Gehrs. The environmental impact statement group was placed under Blaine Dinger. The advent of the breeder reactor and the recycling of plutonium placed new emphasis on the **radioecology** of plutonium and other transuranic radionuclides. A new research group was established under the leadership of Roger Dahlman to work on this problem area.

The early seventies was a period of social and energy turmoil. Women everywhere were beginning to assert their long-denied rights. Within the Laboratory, women lobbied for greater recognition, responsibility, and growth opportunities. ESD was one of the first divisions to move toward meeting these needs. The new information centers provided an immediate opportunity to employ women with technical backgrounds and this was done. Recruiting for women scientists also got under way, but because of the paucity of female candidates in the Ph.D. training pipelines, hiring of female staff scientists was slow at first. Early members included Beverly Ausmus, Pat Cunningham, Lynn (Dye) Wright, Janet (Hyndman) Cushman, Kathy Oakes, and Carolyn Young. This was a period of intense national activity calling for a change in attitudes and

NUCLEAR DIVISION NEWS July 3, 1975

THE RED WEDGE — Shown with the *Nuclear* Division's first electric car are, ***from left, Lee Tucker, Dan*** Nelson and Stan Auerbach ***of*** *HNL's Environ-*mental Sciences Division.

Lab staff will **evaluate** electric car

The Nuclear Division's first electric car arrived at Holifield National Laboratory in late May. The CitiCar, made by Sebring Vanguard, Inc., of Florida, is assigned to the Environmental Sciences Division. (ESD).

The small, two-seat car is referred to by employees at the Laboratory as "the red wedge" because of its bright red wedge-shaped body. It is powered by eight 6-volt, lead-acid batteries, and has a direct energy cost of about 0.4¢ per mile. It has a rated range of 55 miles at a maximum speed of 35 miles per hour before its batteries have to be recharged.

According to Stanley Auerbach, Director of Environmental Sciences, the car was assigned to his division because of the diversity of landscape over which employees must travel to perform normal work activities. Initially the vehicle will be used on paved streets, but will be evaluated for potential field use in environmental research areas.

Lee Tucker, ESD, and Charley Abner of the Plant and Equipment Division, are responsible for the maintenance and care of the CitiCar. They will be involved in determining the cost of maintenance, operational efficiency, durability and the frequency of recharging batteries to keep the vehicle in optimum operating condition.

Environmental Sciences announces new appointments, reorganization

The appointment of David E. Reichle and Edward G. Struxness as associate directors of the Environmental Sciences Division at Oak Ridge National Laboratory has been announced by Stanley I. Auerbach, Division Director.

Struxness' responsibilities include impact assessment and earth science related activities of the Division. Reichle is responsible for aquatic and terrestrial research, ***including new*** programs related to coal conversion and effects of energy technology on the environment.

Struxness

Struxness joined the Nuclear Division at the Y-12 Plant in 1943. He transferred to ORNL in 1953 and served as assistant director of the Health Physics Division and director of the Laboratory's Environmental Impacts Projects. Struxness was appointed assistant director of Environmental Sciences in 1973, and has served as managerof the Environmental Assessments programs.

A native of Minnesota, Struxness holds a degree in biology and chemistry from Luther College, and has been certified by the American Board of Health Physics. He has done graduate study at both The University of Tennessee and Northwestern University.

Struxness was the recipient of the American Nuclear Society's Special Award for Waste Disposal and Management in 1975. He is a member of Committee 4 of the International Commission on Radiological Protection, and the Health Physics Society.

Reichle

Reichle received his B.S. degree from Muskingum College and M.S. and Ph.D. degrees in ecology from Northwestern University. He came to ORNL on a two-year AEC postdoctoral fellowship in 1964, and joined the Environmental Sciences Division staff two years later. He had served as program director for Ecosystem Analysis since 1970.

David E. Reichle

Edward C. Struxness

Reichle has served on a number of professional advisory commitees for the Atomic Energy Commission (now ERDA), the National Science Foundation, the National Academy of Sciences and The Instituteof Ecology. He is currently serving a three-year term on the Environmental Studies Board of the National Academy of Sciences.

A Fellow of the American Association for the Advancement of Science, Reichle holds membership in several professional societies.

Reorganization

Auerbach also announced the reorganization of the Division into five new sections.

Stephen V. Kaye will head the Analysis and Assessments section, with responsibility for development and application of methodologies related to the analysis and assessment of the impact of energy facilities on human populations.

James O. Duguid will serve as section head for Earth Sciences. This section will be responsible for soils, geochemistry, atmospheric and hydrologic sciences, and both basic and applied waste research related to energy technology.

The Aquatic Ecology section will have responsible for basic and applied aquatic research in freshwater and marine environments related to energy problems.

W. Frank Harris heads the Terrestrial Ecology section, which will be responsible for basic and applied terrestrial research related to energy problems.

The Resources and Operations section will be headed by Robert L. Burgess. Division-wide research in modeling and systems analysis, computer operations, and data management and information resources will be the responsibility of this section.

Seven projects

A major portion of the Division's program is grouped into seven projects. These projects and their leaders are:

- Eastern Deciduous Forest Biome - Robert L. Burgess
- Environmental Impact Statements - Robert W. Brocksen
- Power Plant Effects - Charles C. Coutant
- Regional Resources Analysis and Planning - Dennis C. Parzyek
- Trace Contaminants Behavior - Robert I. Van Hook
- Transuranics - Roger C. Dahlman
- Coal Conversion Effluents - Carl W. Gehrs

sending social messages; ESD and ORNL were not immune to this activity.

The year 1973 was a crisis year for energy and energy programs in the United States. The Mid-East oil countries declared an oil embargo against the Western countries. Gasoline and oil shortages showed up quickly, and a new awareness for the need to conserve energy swept the country. Energy-saving measures were encouraged everywhere, including at the Laboratory. The Division participated in many ways, not the least of which was acquiring the first electric car in the Laboratory automotive fleet. It wasn't much of a vehicle, but it symbolized our commitment to conservation. More important, Dan Nelson, who was always alert for new ideas, urged that we should try to incorporate energy-saving features in the new building. With typical enthusiasm, he located one of the country's very few consulting groups specializing in energy conservation construction and persuaded our engineering people and ORO to employ these consultants. The group examined our design and recommended a number of major changes that would result in significant savings in energy consumption. So the new Environmental Sciences Building, when constructed, would not only be the first major new building at the Laboratory in well over a decade, but would be the first in the ERDA organization to incorporate energy conservation features.

By the middle of the decade the Division had reached a staff level of 127 people, with an overall optimism about the challenges being posed by energy problems and what seemed like limitless research opportunities.

Researchers Charles Malone (foreground) and Nelson Edwards checking CO_2 measuring and recording apparatus at a litter decomposition experiment as part of the cesium forest ecosystem studies.

Three summer students working on a land-water microcosm experiment utilizing radioisotopic tags (1971).

6. MID-DECADE CHANGES

The decade of the 1970s was a period of great changes at the Laboratory, and these changes would have a profound effect on ESD as well. One of the most significant events occurred in 1973 when Alvin Weinberg, having served for 18 years, stepped down as Laboratory Director just as the country was entering its most serious energy crisis ever. Weinberg's duties were assumed by his deputy, Floyd Culler, who served in that position for only one year. Early in 1974 Herman Postma, who had been director of the Fusion Energy Division, was appointed as the new director. Postma brought a different style and concept of leadership to this position that focused more on management and the application of industrial-type management methods to Laboratory operations.

As noted earlier, in 1973 AEC became the Energy Research and Development Administration (ERDA), while regulatory responsibilities were assumed by the Nuclear Regulatory Commission. In 1972 one of the last environmental actions taken by ARC was the administrative designation of a number of the Agency's reservations into national environmental research parks. The basis for this action was the recognition that these facilities and their adjoining lands represented research areas of great potential for examining the impacts of energy technology on their immediate environs. It also reflected the growing national interest in environmental protection.

Unfortunately, among the results of the administrative changes in Washington was a change in the management of ORO. The long-time manager Sam Sapirie retired, as did many of his key management subordinates. The new management team was not sympathetic to the establishment of a research park. It was not until 8 years later, when the Department of Energy (DOE) replaced ERDA during the administration of President Carter, that Assistant Secretary for the Environment Ruth Clusen effectuated the designation; the National Environmental Research Park (NERP) was dedicated on October 2, 1980. Although Oak Ridge was the last to be named, it had long been recognized as the leading environmental research unit in the national laboratory complex. In fact, the Division had initiated the research and administrative steps necessary to operate such a park as early as 1972 The key people involved were Tom Kitchings, Linda Mann, and Jay Story-three individuals who were dedicated to the idea.

View of the sIgns identifying the Oak Ridge National Environmental Research Park (NERP). The signs were based on a design submitted by Pat Parr, future manager of NERP (1981).

Chapter 6

Nineteen seventy-five turned out to be a year of tragedy and loss for the Division. In mid-summer Dan Nelson died suddenly from a heart attack while working in his garden. This was not only a personal blow to many in the Division, but a professional loss as well because Nelson brought his own brand of scientific leadership and vision to the Division research programs, especially in aquatic ecology, land-water interactions, and impact assessment. At the time of his death he had been heavily involved with design changes and energy conservation in the new building. His role in making the new building a reality was a keynote of the groundbreaking ceremonies, which were held on September 12, 1975. To honor his memory and his contributions, the auditorium in the new building was named in his honor-the first such designation at the Laboratory.

In 1971 Nelson had been invited to join the new three-person Board of Environmental Consultants that had been established by the Army Corps of Engineers to oversee and advise on the construction of the newly authorized Tennessee-Tombigbee Waterway. Nelson helped in the preparation of the major environmental impact statement that was needed and was a key witness in the defense of the project against the intervening groups. He also saw the potential of the waterway for contributing to environmental education and development in that region and early on urged that a number of visitor centers that would use exhibits to emphasize the environmental and historical aspects of the waterway be included in the project. One of these, located at the Bay Springs, Mississippi, Lock and Dam site, is dedicated to his memory and vision.

By the middle of the 1970s the Division had become a complex matrix organization with greatly increased interactions with other units at ORNL. The combination of the new management philosophy of the Laboratory and the steadily growing interest in environmental issues both locally and nationally began to increase the pressures on both Division management and staff. To fill the void left by Nelson's untimely death, Auerbach named Dave Reichle and Ed Struxness as associate directors. W. Frank Harris was promoted to section leader for ecosystem analysis to replace Reichle.

However, not all was positive in the research area as the decade advanced. There had been a change in the research leadership at NSF with the advent of the Nixon presidency. The new leadership did not have a strong ecological orientation and soon signaled that it did not wish to continue the structured biome programs of IBP beyond 1977. On the positive side, NSF did agree to continue to accept ecosystem research proposals from ORNL, but these would have to undergo the same peer review and competition that university-based proposals did. Therefore, since ESD was staffed with full-time research ecologists, our proposals would have to reflect an even greater degree of innovation and scientific skills than those of the high-rating university-originated proposals.

New programs were emerging in ERDA/DOE that helped to absorb the loss of support in the NSF IBP program and in the AEC radioecology research program. One of these new programs, the Synthetic Fuels Program, was the result of a national effort to create synthetic liquid fuels from coal. Although it eventually foundered, during its active period the program involved major ancillary research on potential health and environmental effects. The effort was led by Carl Gehrs and involved a multidisciplinary study that included field and laboratory research on both fates and effects of potential products and effluent streams that would result from the 27 different processes that were put under development. New faces included Julie Watts, Ben Parkhurst, Ralph Turner, Marti Salk, Jack Mattice, Barbara Walton, and many others.

Another new national effort that got under way during the seventies was the solar energy research program, which included the start of a fuels-from-biomass research program, a component of which was a fuels-from-woody-biomass initiative. Drawing on our experience and background in forest management of the ORR and in forest ecology from IBP, we approached ERDA for a key role in this new program. Although action was not immediately forthcoming, we were asked to assist in program development and proposal reviews. After several years of high-level interagency negotiations between

October 2, 1980

Research park dedication set

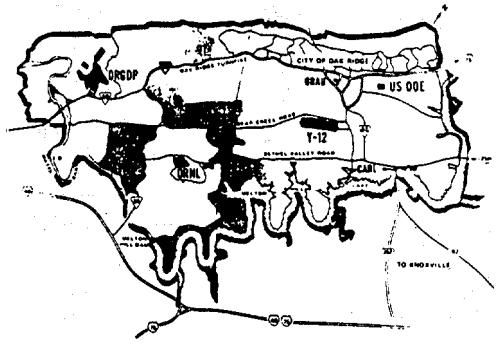
Ruth C Clusen, DOE Assistant Secretary for Environment, will participate in dedication ceremonies for the Oak Ridge National Environmental Research Park (NERP) today, October 2 The program will be held outside ORNL's Environmental Sciences Laboratory at noon

NERPs are established under DOE to provide protected land areas for research and education in the environmental sciences and to demonstrate that environmental quality can be compatible with energy technology development and use.

Portions of the Oek Ridge reservation were officially designated by DOE as a research perk on June 5. 1980 'The Oak Ridge NERP became the fifth in a network of parks located at government site across the U.S The other are a, Los Alamos, N.M.; Idaho Falls. Idaho; Hanford. Wash : and Aiken (Savannah River), S.C.

Ruth C. Clusen

Following the dedication, a multimedia program entitled "The Oak Ridge NERP," will be shown in the ESL auditorium Chester R Richmond, ORNL associate director for Biological and Environmental Sciences, will preside



RESEARCH PARK—Approximately 13.600 acres of woodland in the Osk Ridge area have been declared a National Environmental Research Park and will be dedicated today.

News About People

Barnthouse

Lawrence W Barnthouse, research associate in ORNL's Environmental Sciences Division, has been named to a national panel which will oversee a $12 million endowment for the study, of the effects of power plants on aquatic life

The panel was established as part of the recent agreement among five New York electric power companies, the Environmental Protection Agency (EPA) and other federal and state agencies, and several citizens' groups Concerned with the use of Hudson River waters for electric power generation As par, of that settlement, the companies agreed to establish and provide a $12 million endowment for the Hudson River Foundation for Science and Environmental Research

Barnthouse was nominated by the New York regional administrator of EPA to be a member of a panel which will select research projects to be financed through the foundation He was par, of a team which evaluated cooling water intake modifications and changes i" plan, operating procedures designed to reduce adverse impacts of power plants on fish populations These evaluations provided the technical foundation for the December 1980 settlement

Barnthouse came to the Laboratory in 1976 alter receiving his PhD from the University of Chicago A native of Ohio he lives in Kingston

Named technical advisor

July 8, 1976

Robert I. Van Hook has begun a special one-year appointment as technical assistant to Chester R. Richmond, associate director for biomedical and environmental sciences at Oak Ridge National Laboratory. He succeeds James E. Turner, who has returned to the Laboratory's Health Physics Division as associate director.

Van Hook plans to return to the Environmental Sciences Division as a program manager after completion of the new assignment.

Van Hook is a native of Florence, S.C., where he attended the University of South Carolina at Florence. He received his B.S. and Ph.D. degrees in entomology from Clemson University.

In 1970 he joined.ORNL's Environmental Sciences Division as a research staff member. His research interests have included the effects of ionizing radiations on animal populations and the transport of radionuclides and trace contaminants in the environment. For the past three years he has been involved in the Laboratory's program on ecology and analysis of trace contaminants supported by the National Science Foundation, and , was appointed manager of the Environmental Sciences Division's trace contaminants behavior project earlier this year.

Van Hook is a member of the American Association for, the

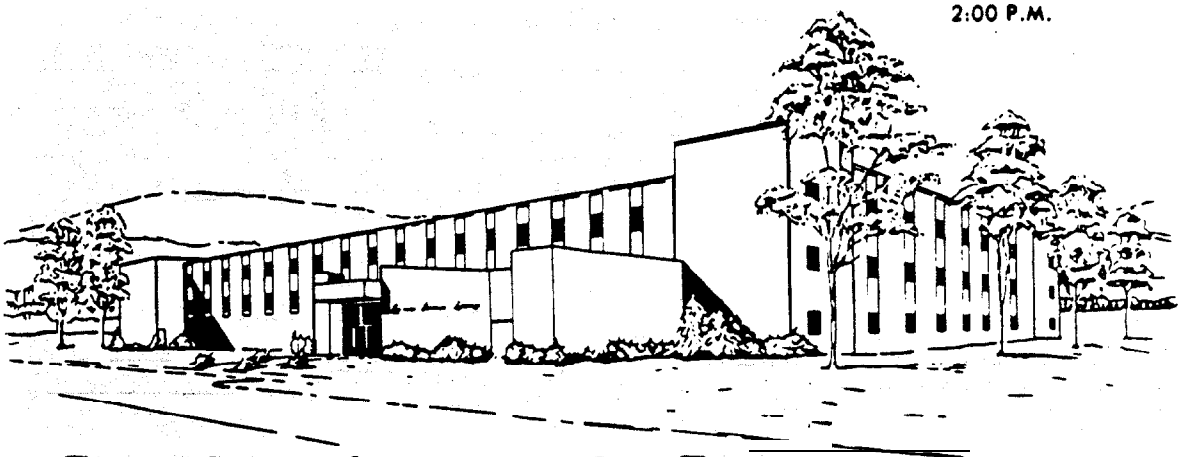
Robert I. Van Hook

Advancement of Science, the Ecological Society of America, and the Society for Geochemistry and Health. He has served as chairman of several ERDA and NSF-sponsored symposia on the Transport of Effects of Trace Contaminants in the Environment.

He and his wife, Nancy, reside at 43 'Montclair Road in Oak Ridge. They have a son, Mark, and a daughter. Sydney.

Environmental Sciences Laboratory - Groundbreaking

SEPTEMBER 12, 1975
2:00 P.M.



Holifield National Laboratory . Oak Ridge, Tennessee

operated by UNION CARBIDE CORPORATION for the U S ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION

PROGRAM

Introductions	Stanley I. Auerbach Director. Environmental Sciences Divieion Holitield National Laboratory
Welcome	Chester R. Richmond Associate Director for Biomedical and Environmental Sciences Holifield National Laboratory
Opening **Remarks**	Herman Poerma Director. Holifield Nanonal Laboratory
Remarks	Honorable Marilyn Lloyd U.S. Houae of Representatives
Remarks	Honorable William E. Brock U.S. Senate
Remarks	Honorable Howard H. Baker, Jr. US. Senate
Introduction of Robert C. Seamans, Jr.	Jamea L Liverman Assistant Administrator, U.S. Energy Research and Development Administration
Remarks	Robert C. Seamans, Jr. Administrator, U.S. Energy Research and Development Administration

ENVIRONMENTAL SCIENCES LABORATORY

Construction of the $8.8 million Environmental Sciences Laboratory was authorized by Congress in 1974. The two-unit structure, scheduled for completion in the fall of 1977, will be the first in the U.S. Energy Research and Development Administration (ERDA) complex, and previously the Atomic Energy Commission, designed specifically for environmental sciences research. It will house the Laboratory's Environmental Sciences Division, the largest single environmental unit within ERDA, with 20 years of research experience in the behavior and ecological consequences of radioactivity and trace elements released to the environment. The division has established a position of national and international leadership in ecology and in the application of concepts and techniques from physics, chemistry, and mathematics to environmental problems. Its major focus has been on ecosystem analysis, terrestrial and aquatic ecology, and assessment of the environmental impacts of both nuclear and nonnuclear power generation.

The principal facility is to be a three-story laboratory and office building containing approximately 88,000 square feet of space. Connected by a walkway to the main building will be a 14,600 square foot controlled environment and animal building. The design emphasizes features expected to reduce annual energy consumption for heating, cooling, and lighting by some 60 percent compared to a similar building of conventional design and construction. These include use of more insulation in walls and roof areas, reductions in the amount of window glass area, reduced lighting intensity, night shutdown of some energy-consuming equipment, and recycling of discharged heat from exhaust stacks. Titan Southern Services Construction Co., Atlanta, Georgia, has been selected as the construction contractor. The architect-engineer is Sanders and Thomas, Inc., Pottstown, Pennsylvania.

ESD assistant director Nelson dies August 16

Daniel J. Nelson died suddenly August 16 at his 116 East Morningside Drive, Oak Ridge, home. He was an assistant director of the Environmental Sciences Division at Oak Ridge National laboratory.

Mr. Nelson

Mr. Nelson, a native of Roland, Iowa, received his doctorate degree in ecology from the University of Georgia. He joined ORNL's Health Physics Division in 1959, and had served as assistant director of the Environmental Sciences Division since its inception in 1970.

Survivors include his wife, Barbara Wright Nelson; sons, Daniel Jr. and Eric: mother, Mrs. Katherine Nelson of Iowa; three brothers and a sister.

Craveside services were held August 18 at Oak Ridge Memorial Gardens.

May 27, 1976

Carl Gehrs to coordinate Synthetic Fuels-Life Sciences

Carl W. Cehrs has *been* appointed Coordinator of the Synthetic Fuels-Life Sciences Program at Oak Ridge National Laboratory. Cehrs' appointment was announced by Chester R. Richmond, ORNL Associate Director for Biomedical and Environmental Sciences.

The conversion of coal into clean synthetic fuel products is an urgent national objective, but potential hazardous substances are also produced when coal is converted. Cehrs will coordinate ail laboratory activities that are directed toward insuring that the technological development of synthetic fuels derived from coal is amenable to man and his environment.

Eight divisions involved

The program will provide timely information and data to insure that potential hazards are identified and characterized, and that methods for monitoring them are developed. Information will be developed on the carcinogenic, mutagenic, teratogenic and toxic properties of materials generated by coal conversion technologies. The persistence, transformation, food-chain kinetics and fate of effluent components will also be determined to allow a total assessment of their potential impact on the environment.

Eight ORNL divisions in the life-sciences area are currently involved in this interdisciplinary effort related to coal conversion. Included are Analytical Chemistry, Biology, Chemical Technology, Energy, Environmental Sciences, Health, Health Physics and Information.

Wilt continue effluents post

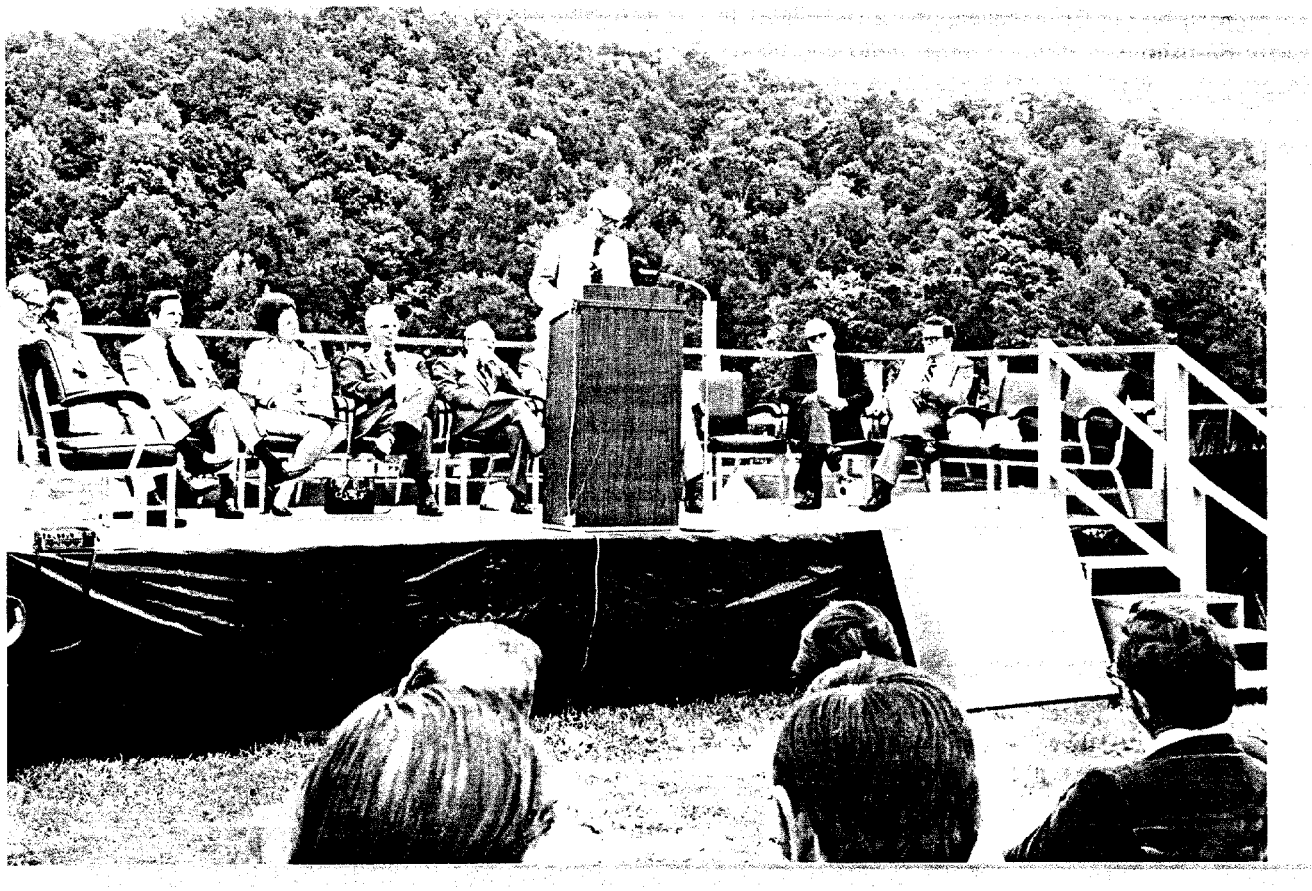
During the past year, Cehrs has served as interim coordinator of the developing program, and has worked very closely with Richmond and representatives from the participating divisions in program planning activities for the Energy Research and Developmental Administration's Division of Biomedical and Environmental Research and other organizations.

Carl W. Cehrs

Cehrs, a native of Elmhurst, Ill., received his bachelor's degree from Concordia Teachers' College, his master's degree in biology from Kansas State Teachers College, and his Ph.D. in zoology from the University of Oklahoma. He joined the staff of ORNL's Environmental Sciences Division in 1972.

In addition to his new position as coordinator of the Synthetic Fuels-Life Sciences Program in which he reports to Richmond, Cehrs will continue as leader of the Coal Conversion Effluents Project, reporting to Environmental Sciences Division Director Stanley I. Auerbach.

Cehrs holds membership inseveral professional organizations including Sigma Xi, the Societas internationalis Limnologiae, Ecological Society of America, and the American Association for the Advancement of Science. He resides with his wife, Judi, and three children in Oak Ridge.



Speakers platform at ground-breaking ceremonies for the new environmental sciences complex. Shown from left to right are ORNL Director Herman Postma, U.S. Senator, Howard H. Baker, Jr., U.S. Senator William E. Brock, Congresswoman Marilyn Lloyd, ORNL Deputy Director Floyd Culler, ESD Director Stanley I. Auerbach, Energy Research and Development Agency (ERDA) Administrator Robert C. Seamans, Jr., ERDA Assistant Administrator James L. Liverman, and Oak Ridge Operations Office (ORO-ERDA) Manager Robert Hart (September 12, 1975).

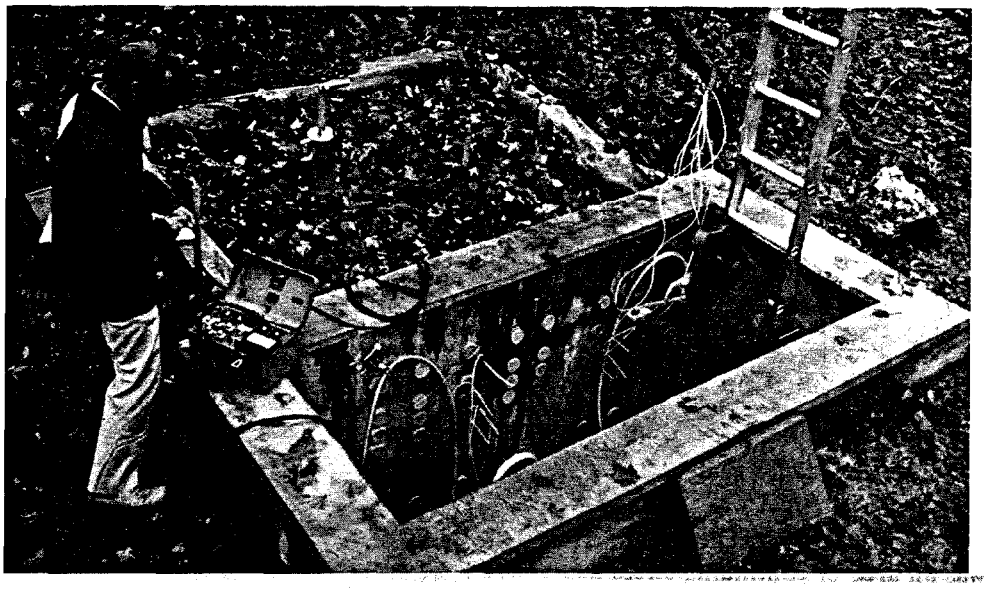
ERDA/DOE and the Department of Agriculture, the program was left with DOE, and ESD was asked to take over management of the program. Leadership for the program was provided initially by Bob Van Hook, then subsequently by Jack Ranney, Janet Cushman, and Lynn Dye.

The environmental impact assessment project was an area of continuing stress and action. An example of this was the controversy that arose over the licensing of the Indian Point nuclear power plant on the Hudson River in the early 1970s. This controversy resulted in a lo-year legal battle between plant operators and conservation organizations, EPA, and federal and state agencies and centered on the need for closed-cycle cooling towers to protect a major spawning area for striped bass. ESD provided technical support and population modeling expertise for the opponent organizations. The licensing hearings and pressures associated with them were very difficult. In part because of these pressures, Phil Goodyear, an outstanding young fisheries population ecologist who had carried this burden for the initial years, left the Laboratory for the Fish and Wildlife Service.

Leadership was taken over by Webb Van Winkle, augmented by Sig Christensen, and a little later by Larry Bamthouse. Blaine Dinger, who had been leading the overall impact assessment project, left to work for the state of Wyoming. His replacement was Bob Brocksen, an experienced aquatic ecologist who came from California. The unit was further augmented by Marti Salk, Patricia Cunningham, Ben Parkhurst, Jim Loar, Glenn Suter, Joan Baker, and Andy Robinson.

ORO considered the local radioactive waste disposal. situation to'be a sensitive area. Jim Duguid's hydrological studies had identified a number of the problems associated with ^{90}Sr leakage from the low-level waste burial grounds, particularly the need to divert surface water from infiltrating them. Under Duguid's leadership, the first diversion system was designed and implemented. As part of a general divisional reorganization that took place in the latter part of 1975, a new Earth Sciences Section was created to replace the small waste management studies group. Duguid was appointed head of the Section. The Section continued its studies at the burial grounds while also initiating laboratory studies of a more fundamental nature. By 1978 activities of the Earth Sciences Section had increased considerably, with much of its efforts directed both at the radioactive waste burial grounds and at a number of new problems associated with coal and the disposal of its by-products. It was a frustrating period for earth sciences, with conflicting management attitudes on what was needed in research related to remedial action activities in the burial grounds, as well as a shortage of qualified geoscientists on the staff and difficulties in recruiting and keeping them. Duguid left the Laboratory in 1977 and Tamura took over the leadership of the Section. Tom Lomenick joined the Division to lead the burial ground technology effort for a short period of time.

Another major reorganizational effort occurred in the 1977-78 period. John Auxier, who had succeeded Karl Morgan as director of HPD, left the Laboratory to work in the private sector. This gave Laboratory management the opportunity to reorganize that division-a process that impacted ESD also. The Radiological Analysis and Assessments Section headed by Steve Kaye had become a major leader in the field and had grown to a staff of 15 highly productive scientists, When HPD was divided into two new divisions, Health and Safety Research and Applied Health Physics, Kaye was appointed director of the new research division and his section was transferred to the new unit. This left a void in ESD, but within a year and a half the loss in staff and funding was more than made up.



Soil scientist Robert Luxmoore (left) end technician Tom Grizzard taking samples and data from the specialized subsurface soils study device on Walker Branch Waterghed. The concrete face contains a series of sampling ports at different levels enabling investigators to study changes in soil solution chemistry vertically and laterally (19751.

The most important event in 1978 was the completion of the hew building. The construction period of 3 years, one year longer than originally planned, was a frustrating one for Division management. As a result of the 1974 national recession, which had severely impacted real estate development nationwide, the bid for construction was much lower than estimated, but the contractor firm seemed to have difficulties meeting construction timetables. It was also a period of frenetic activity. The additional funds resulting from the low bid were more than welcome, but much equipment, previously eliminated due to a projected lack of funds, had to be respecified and justified. In addition, the changes in staffing and research programs had to be taken into account in planning laboratories and staff housing.

Finally, the building was declared available for occupancy and the process of moving could begin, a process that would require both planning and organizational skills, Two individuals played key roles in this complicated but ultimately successful effort. One was our long-time Plant and Equipment Division engineer, Charlie Abner; the other was an ESD research engineer, the late Bill Boegly, who, in his usual quiet and unassuming way, organized the moving schedules room by room, unit by unit. Boegly and Abner had been going over the building blueprints almost continuously since construction began and turned up numerous errors in planning or construction. Their vigilance proved to be invaluable not only for the resident Architect Engineer, who represented the design firm and who wanted to turn out a first-class building, but also, of course, for ESD Division Director Stan Auerbach, for whom the building would be the culmination of a 20-year career devoted to the creation of ecological and environmental research facilities at the Laboratory.

The building, which was the first to be constructed in over a decade at ORNL, incorporated many new features that reflected its role as an environmental research facility. The placement of all power and telephone lines underground, for example, may not appear to be significant, but it represented a radical change from previous local construction techniques. Other innovations included earthquake-resistant construction, earth-tone bricks, zonal heating and cooling, and energy conservation measures.

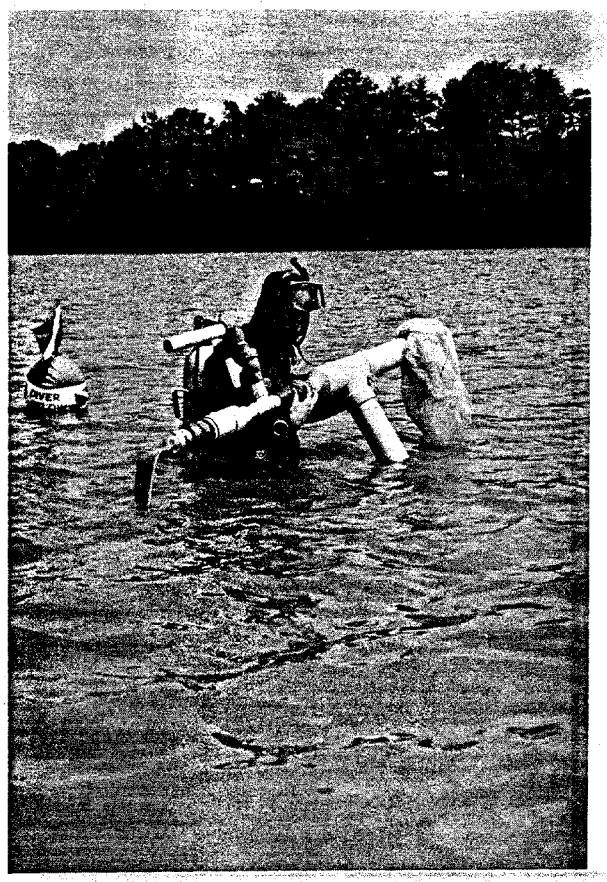
Well before ground had been broken for construction, Ed Struxness and Dan Nelson were urging that the building have an outside decoration that would also reflect its role and purpose. Although this idea was almost unprecedented in AEC/ERDA/DOE construction philosophy, it was being applied to other government buildings. Armed with this information and the support of DOE headquarters, Auerbach was able to convince ORO to fund an external mural or logo. Struxness was acquainted with the well-known artist and potter Charles Counts and approached him about undertaking this assignment. Counts was interested and submitted a design, which was eventually accepted, that called for modifying the brick work on the southeast wall as a suitable background for a mural. As an abstract expression of the environment, the completed mural had both proponents and opponents on the staff, but it received considerable praise from members of the community and from visitors, who appreciated its design and appearance.

The decade of the seventies was a tumultuous one for ecology, the environmental movement, and the Laboratory. In 1978 President Carter visited ORNL, the first sitting President ever to do so, and received special briefings on various aspects of Laboratory programs. One of the individuals chosen to address the President was Sandy McLaughlin, who talked on the subject of ecological and environmental impacts of air pollution. Unfortunately, because of security restrictions and time limitations, President Carter did not visit the new environmental sciences laboratory, but the building was given special prominence on the commemorative coin that was presented to him.

For the Division, the end of the decade and the occupation of the new building provided an opportunity to look back at what had been accomplished at ORNL in ecology. The occasion for this was the formal dedication that was held on February 26-27, 1979. The dedication was given by Ruth C. Clusen, Assistant Secretary for the Environment for DOE. Also present were key officials from NSF and EPA The program was

President Jimmy Carter receiving a briefing on the new Environmental Sciences Building mural from Laboratory Director Herman Postma during the President's visit to ORNL in 1978.

entitled Perspectives in Ecology, and the speakers were outstanding scientists, all of whom had a previous association with ORNL. These were John E. Cantlon, Frank F. Hooper, Eugene P. Odum, George M. Woodwell, Frank L. Parker, George M. Van Dyne, Bernard C. Patten, and Frederick E. Smith. As noted in the Preface to the Dedication Volume: "The dedication of the new Environmental Sciences Laboratory coincided with the 25th year of the establishment of the science of ecology at Oak Ridge National Laboratory. That quarter century witnessed the evolution of ecology from an obscure, backwater discipline of biology to a broadly used, everyday household word."



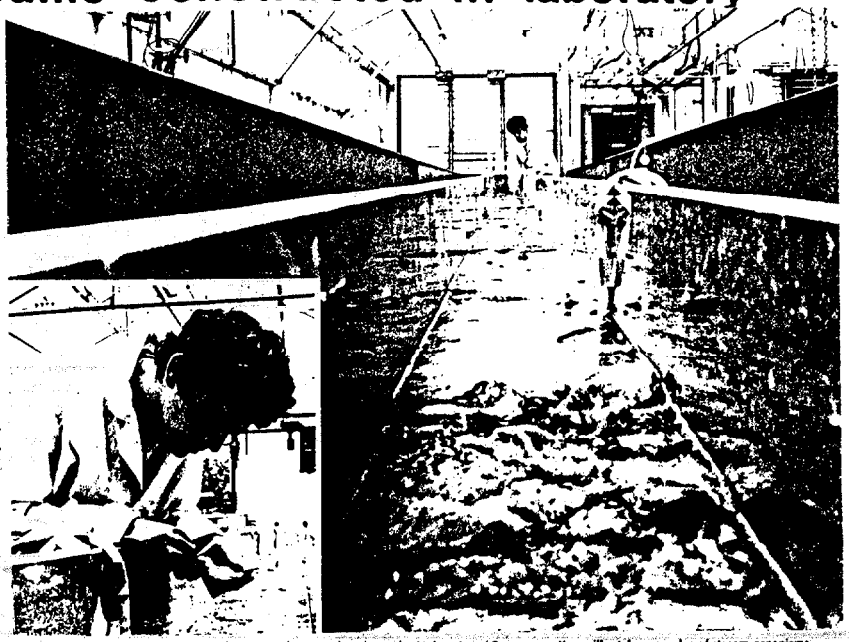
Aquatic ecologist Jack Mattice using underwater sampling device for aquatic insects in lower Clinch River (1976).

Researchers Lynn Dye Wright and Jack Mattice emptying bottom sediment sampling device 11976).

Ron McConathy and assistant making photosynthetic measurements in tree foliage on Walker Branch Watershed (1976).

Technician Jay D. Story weighing a young bobcat live-trapped on the Oak Ridge Reservation. This was part of an ongoing study of the predator populations in the area (1979).

'Living streams' constructed in laboratory



LIVING STREAM—Martin Silver, a graduate student from the University of Tennessee, Knoxville, takes samples of stream organisms from one of eight 65-foot-long channels to which radioisotopes of phosphorus were added.

Research which will aid in the management of stream and river systems is being conducted by ORNL for the National Science Foundation (NSF). The work is being carried out under a $1.3 million interagency agreement between NSF and the DOE.

The three-year program, titled "Material Spiraling in Stream Ecosystems," was begun in 1978 by the Environmental Sciences Division which has more than 20 years of research experience on the behavior and ecological consequences of radioactive and trace elements released to the environment.

Data useful

"Spiraling" is a term used to describe the reutilization of nutrients by aquatic organisms as the nutrients are transported downstream. Streams are unable to recycle nutrients in place because of the continuous, unidirectional flow of water. However, nutrients released upstream can be reused by aquatic organisms downstream.

The objective of the research is to test the hypothesis that biological mechanisms have evolved in stream ecosystems to enhance the reutilization of nutrients released upstream, and to retard the rate at which the nutrients ate transported downstream. Information obtained from the program will enable scientists to determine the ability of streams to recover from theimpactof pollutants and aid in understanding factors which regulate the productivity of streams.

'Living' streams

The research is being conducted in a series of field and laboratory ● xpcrimenfr using radioactive and stable isotopes as tracers to ten the effects Of organisms, such as algae, bacteria, fungi, aquatic insects and fish. on nutrient spiraling in streams. Preliminary studies at Walker Branch Watershed, a 250-acre forested landscape located near ORNL, provided information on major mechanisms and pathways of nutrient spiraling, and pinpointed areas of biotic adaptation which required further investigation.

Using data from the field studies, scientists have developed methods for testing the hypothesis about streams in artificial systems that simulate natural conditions. Eight of there "living streams" have been constructed in greenhouses at the Laboratory.

The channels are approximately 65 feet long, 10 inches wide and five inches deep. They can be linked together with module attachments to allow for adjustments in stream length. The streams, which are supplied by water from a nearby well, are slightly sloped to allow for the kind of continuous flow that would exist under natural conditions.

Use of these artificial streams allows the researchers to maintain careful control of the hydrologic inputs and outputs and the aquatic organisms in the system. They are also able to isolate various "pieces" of the nutrient cycle and examine them in detail without disturbing a natural system.

(Please see page 8)

NUCLEAR DIVISION NEWS
a newspaper for employees of the nuclear division • union carbide corporation
UNION CARBIDE
Vol. 10/No. 16 August 23, 1979

'Living stream'

(Continued from page 1)

The primary elements to be studied are phosphorus and nitrogen. These are essential nutrients of all aquatic systems, although cycling and availability of their various forms are not well understood. Isotopically labelled nutrients will be released simultaneously into the channels, and the intake and release by the various stream components will be monitored.

By simulating conditions in a natural stream while maintaining control over its components, the scientists will be able to determine the relative availability of different forms of phosphorus and nitrogen in flowing waters and, thereby. increase their understanding of this key aspect of stream nutrient cycling.

Field studier of stream spiraling will continue at Walker Branch Watershed and at Coweeta Hydrologic Laboratory in the Southern Appalachian Mountains. near Franklin, N.C.

Deliberate pollution

Stream spiraling studies at Coweeta will involve intentionally polluting a natural stream with a pesticide to determine how it will affect the stream's ability to recycle and retain essential nutrients.

ferry W. Elwood, J. Dennis Nmbold and Robert V. O'Neill, ORNL Environmental Sciences Division, are principal investigators for the program. The experiments at Coweeta are being conducted in cooperation with I. Bruce Wallace of the University of Georgia.

Chapter 6

New landscaping complete at ORNL Aquatic Ecology Laboratory

When landscape architect Larry Rackstraw looked at the jumble of dirt, rocks and weeds in front of the ORNL Environmental Sciences Division's Aquatic Ecology Laboratory nine months ago. he saw a stream bed. complete with boulders, bamboo. rhododendron and azaleas.

Rackstraw's vision is now a reality with completion of landscaping around the recently enlarged building and its exterior research facilities.

The aquatic research theme is reflectedin Rackstraw's design, although those stylized 'ponds' never will be filled with water.

Inside the building are tanks for studying energy-related stresses on aquatic life Outside, to the rear, are 17 plastic-lined ponds for larger-scale experiments on long-term ecological effects of synthetic fuel spills.

But it is the landscaping in the front of the building that first draws the attention of the passer-by The aquatic research theme is reflected i" Rackstraw's design, although the stylized "stream" never will be filled with water. "We didn't want to create a wet pond or stream because of the maintenance it would entail." said Rackstraw. "However, I think the overall appearance will have a pleasing visual impact not only on those who work in the area. but also on visitors during the World's Fair."

The aquatic lab, along with the new Visitor Overlook and the Graphite Reactor, will form a triad of tour opportunities for visitors later this year.

The Aquatic lab, along with the new Visitor Overlook and the Graphite Reactor, will form a triad of tour opportunities for visitors later this year. Each area will house displays depicting research and development at the Laboratory. Life sciences programs will be featured in the aquatic lab.

Rackstraw's design earlier was endorsed by the ORNL Landscape and Architectural Review Committee. "I was surprised and pleased that so much could be done for a relatively small outlay of funds." said review committee member Dave Reichle, associate director of the Environmental Sciences Division.

"We wanted to come up with a landscape design that would be both attractive and efficient," said Rackstraw, who now is working on the master plan for site development at Y-12

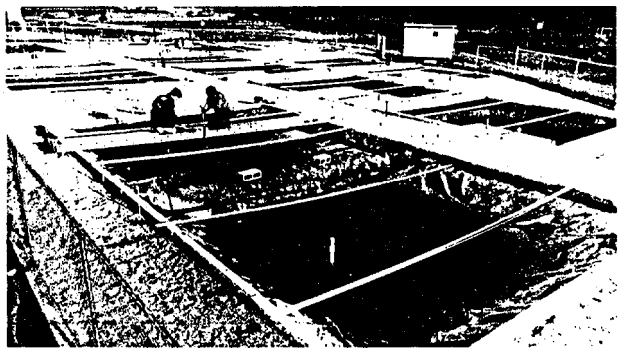
"Since we are using a groundcover, hypericum. instead of grass around the building, no mowing will be necessary. and the bamboo around the stream bed will eventually get thick and can be transplanted to other areas," Rackstraw added. The rest of the plantings include rhododendron, azalea, flowering dogwood, redbud and flowering quince. Pines on the east separate the area from other research facilities.

"We've had lots of favorable comments from visitors," said Webb Van Winkle. head of the aquatic ecology section in the Environmental Sciences Division "It's a very innovative, impressive design, and it makes for a more attractive place to work."

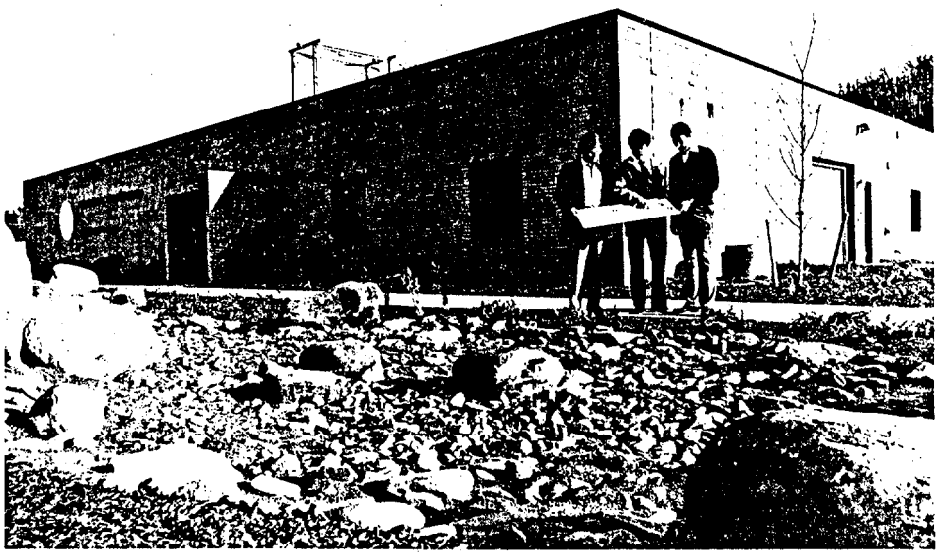
The rest of the plantings include rhododendron, azalea, flowering dogwood, redbud, flowering quince and pines to separate the area from other research facilities.

Project engineer for the Aquatic Ecology Laboratory addition was Pete Sothman Jr. of Nuclear Division Engineering.

LANDSCAPE ARCHITECT Larry Rackstraw, right, points out a feature of his design for the new Aquatic Ecology Laboratory grounds to Coutent. left, and Van Winkle.



DRNL ENVIRONMENTAL SCIENTISTS take a sample from one of the environmental research ponds at the rear of the Aquatic Ecology Laboratory.



LOOKING OVER THE STREAM BED" that is a prominent feature of the laboratory's landscaping are, from left. Chuck Coutant, senior ecologist in the Environmental Sciences Division; landscape architect Larry Rackstraw: and Webb Van Winkle. head of the division's aquatic ecology section.

7. THE CONTROVERSIAL EIGHTIES

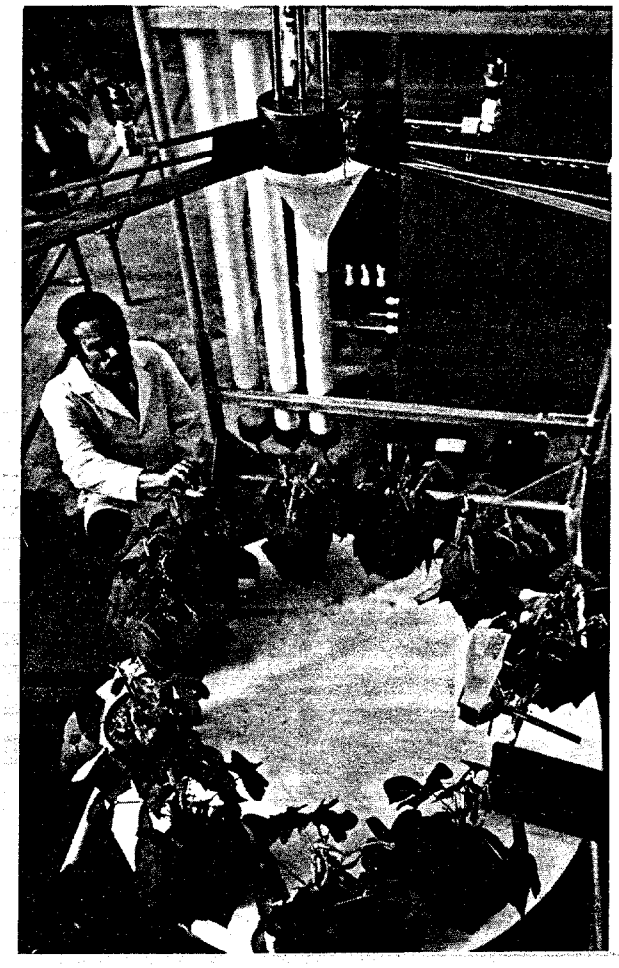
As the decade of the eighties began, a new, conservatively oriented administration was signaling a departure from the environmentally proactive Carter administration. However, the public and the Congress showed no signs of diminishing concern about environmental issues. In fact, the opposite was the case. In spite of the Reagan administration's attempts to downplay or curtail government support or activity in environmental protection, major issues emerged.

ESD continued to operate under the matrix organization that had been established a few years earlier. The 1980 organization charts (there were two) showed five sections (Aquatic Ecology, Earth Sciences, Environmental Resources, Terrestrial Ecology, and Administrative Services) and seven programs (Advanced Fossil Energy, Fuels from Biomass, Environmental Impacts, Low-Level Waste Research and Development, Toxic Substances, National Low-Level Waste Management, and Waste Isolation). It was a cumbersome arrangement, yet typical of a number of the larger divisions in the Laboratory, and ESD was well on its way to becoming a very large division.

The new decade also witnessed the retirement of Ed Struxness. While Karl Morgan had provided the broad insight that led to the establishment of ecology, it was Struxness who made it an operational reality. His direct guidance and' counseling provided many of the insights and directions that enabled the program to achieve its early goals. Struxness was a superb organizer and builder of programs. He was able to guide these programs to the advantage of the Laboratory even when they were not popular. He brought a driving enthusiasm to his tasks, which led to a degree of success even when the projects were inadequately supported. Struxness was responsible for organizing at least three major programs-the high-level waste disposal effort, which included the salt repository and the hydrofracture effort; the Clinch River Study, one of the country's first interdisciplinary, integrated risk (then called hazard) assessment projects; and the Environmental Impact Statement Project.

Although many of the major research projects under way by the beginning of the 1980s had their genesis in the previous decade or even earlier, a newly sensitized public was beginning to call for more and more action on what they perceived as major threats to the environment.

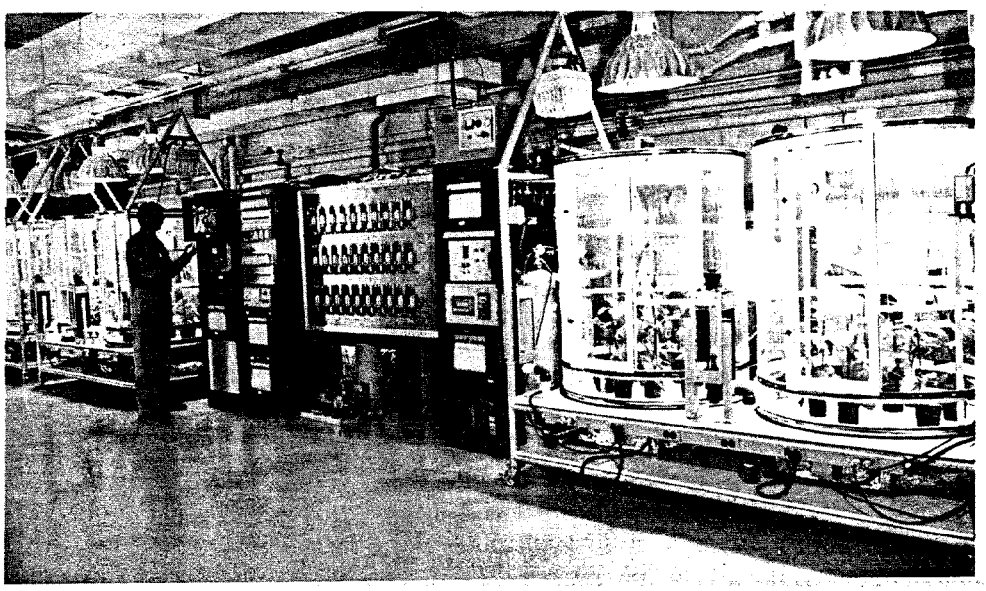
The problem of acid rain or deposition had already been identified by researchers. Reichle and his colleagues had been writing proposals to DOE for several years, only to be told repeatedly that there was no acid rain problem in the United States. They persisted, however, and soon the Electric



Technician Bill Selvidge operating acid rain apparatus. The device delivers artificial rain acidified to predetermined levels to plants mounted on turntable below (1978).

Power Research Institute (EPRI) recognized ORNL's unique talents in plant physiology and agreed to fund ESD. This recognition enabled ORNL to develop a national visibility, and soon EPA approached ESD to work on problems related to acid rain. ESD scientists Dave Shriner and Sandy McLaughlin began active field and laboratory research efforts. Early in the decade Congress had authorized a multiagency 10-year National Acid Precipitation Assessment Program as part of major energy legislation. The Act called for management of the program to be carried out by four of the DOE national laboratories. Although the four laboratories (ANL, ORNL, PNL, and Brookhaven National Laboratory) would play various research roles in the program, they were not given the responsibility called for in the Act. An interagency effort emerged that was coordinated through the Council on Environmental Quality, with much of the research effort funded through EPA, USGS, and other agencies. ESD staff were involved in several aspects. Steve Lindberg, using facilities constructed on Walker Branch Watershed and the 0800 field experimental area, began his pioneering researches on dry deposition. Sandy McLaughlin designed and built a state-of-the art plant exposure facility in Building 1506. He also initiated under EPA auspices a major tree-ring analysis survey of what eventually would be 16,000 trees in the southeastern United States, a study whose preliminary findings generated political controversy. The Plant Physiology Group was augmented at this time by Richard Norby and Paul Hanson. A new staff soil scientist, Dale Johnson, came from the University of Washington and began a major series of soil studies on Walker Branch Watershed. The experimental field study site at the 0800 area was enlarged with a new experimental facility consisting of 36 open-top field chambers, which could be subjected to controlled doses of acid precipitation while being excluded from normal rainfall. This site became a research base for the new group of plant scientists who were led by George Taylor.

By the middle of the decade, EPRI, whose environmental research programs were influenced by former ORNL staff (Bob Brocksen, Bob Goldstein, John Huckabee, and Jack Mattice) who had taken key positions in the new organization, had funded a major integrated forest research program on acid deposition led by Ernie Bondietti, Dale Johnson, and Steve Lindberg. In another EPRI-funded study, Jerry Elwood and Pat Mulholland examined the water chemistry and ecology of acidic and nonacidic streamsin the Great Smoky Mountains National Park in Tennessee and North Carolina and in the Adirondack Mountains. of New York.



Staff member Sandy McLaughlin standing beside gas exposure chambers for higher plants. McLaughlin was responsible for the conceptual design of this state-of-the-art apparatus (1 9801.

April 29, 1982

Trabalka appointed manager of ORNL program

John R. Trabalka has been appointed manager of the Global Carbon Cycle Program in ORNL's Environmental Sciences Division

Trabalka

The long-term national research program is concerned with determining the amount of carbon. in the form of carbon dioxide, ejected to the atmosphere and absorbed from it by global vegetation, soils and oceans. Many scientists believe increasing atmospheric levels of carbon dioxide, caused by fossil fuel burning and deforestation, could lead to a global warming — the so-called "greenhouse effect" — since excess carbon dioxide could trap heat now radiated back into space

Trabalka. assistant manager of the program since 1982, succeeds David E. Reichle, who has managed the program in addition to his duties as associate director of the Environmental Sciences Division.

Trabalka will oversee projects sponsored by DOE's Carbon Dioxide Research Division at ORNL and in nine universities and research centers and is responsible for supervising the development by 1985 of an overall assessment of the state of knowledge on the global carbon cycle

Trabalka holds BS. MS. master of public health, and PhD degrees, the latter in environmental health sciences, from the University of Michigan He joined the Environmental Sciences Division in 1971, where his research specialities have been the transport of radionuclides and other potentially toxic materials in food chains and their effects on aquatic life.

He is a member of the American Geophysical Union, Health Physics Society, Ecological Society of America and the North American Benthological Society. He served as an editor for the proceedings of the Fourth National Radioecology Symposium and was cochairman of the ORNL 1983 Life Sciences Symposium on the global carbon cycle.

Trabalka. his wife, Betty. and three children live in Oak Ridge

Norman H. Cutshall heads ORNL section

Norman H. Cutshall has been named head of the earth sciences section in the ORNL Environmental Sciences Division.

Cutshall

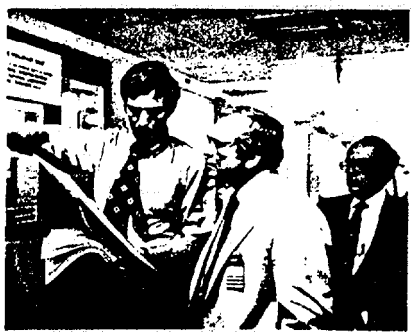
Cutshall, formerly low-temperature geochemistry. group leader and low-level waste program manager in Environmental Sciences. succeeds L. Dean Evman. Eyman has been appointed manager of the lead office — located at ORNL — for DOE's new national Hazardous Chemical Defense Waste Program.

The earth sciences section, an interdisciplinary group of chemists, geologists, oceanographers and other environmental engineering specialists. studies natural processes by which hazardous wastes move rn the environment and designs more effective approaches to waste disposal and storage.

Cutshall. who holds BS, MS and PhD degrees from Oregon State. first joined the ORNL staff in 1967.

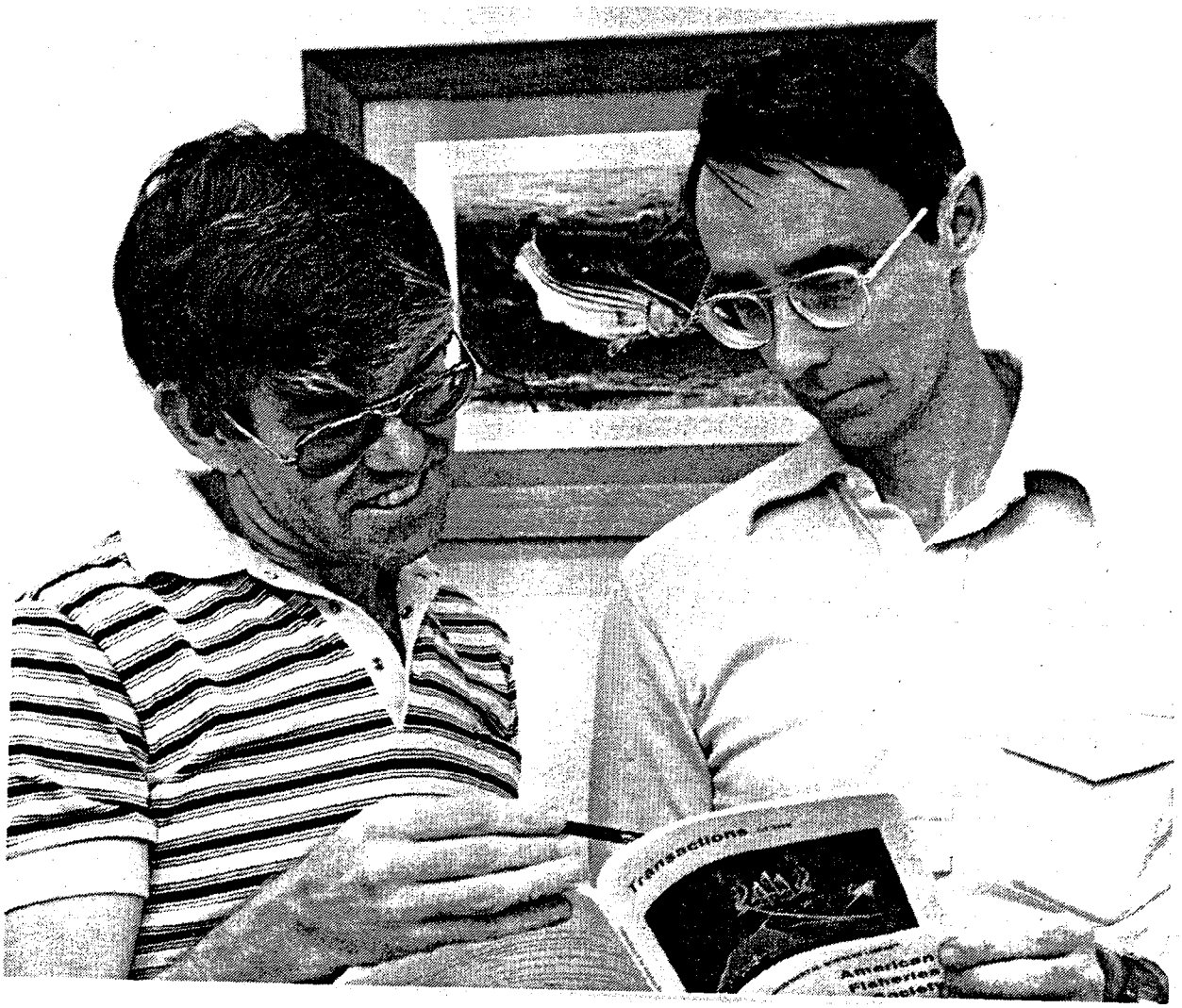
He is a member of the Amertcan Geophysical Union. American Chemical Society, Amertcan Socretv of Limnologv and Ocean. ography. Canadian Nuclear Socretv and the Nuclear Regulatory Commission's Hydrology and Geochemistry Review Group.

Cutshall, his wife, Cheryl. and their daughter live in Oak Ridge.



BAKER'S ANNUAL VISIT-In his annual visit to ORNL, U.S. Senator Howard Baker (center, left photo) was briefed et the Environmental Sciences Division by Division Director Stanley Auerbech (right) end Sandy McLaughlin, who discussed ORNL studies of the effects of atmospheric pollutants on regional forest growth. At the Fuel Recycle Division (photo on right), Baker tried his hend with the M-2 Telemanipulator. Observing his efforts are Division Director William Burch (right) end Dan Kington.

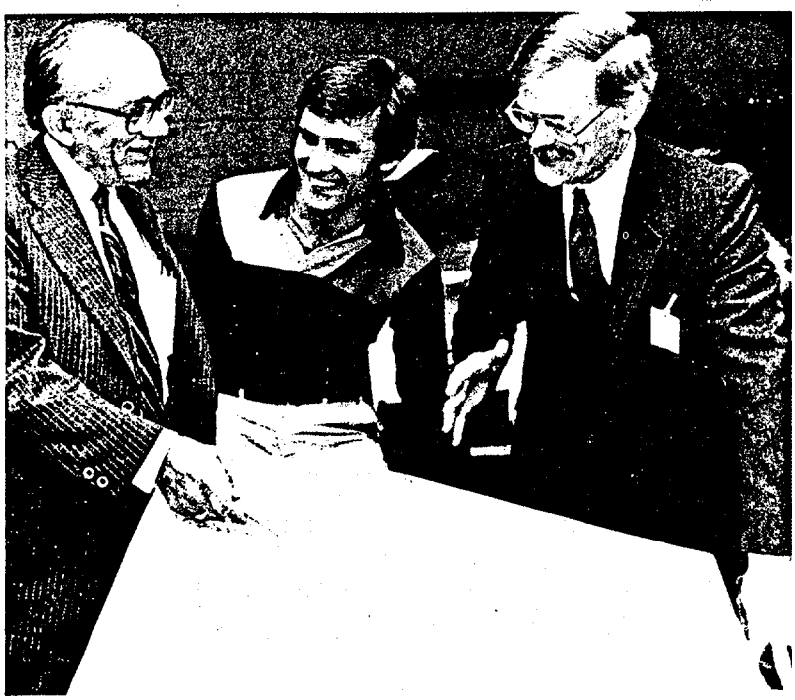
27 JAN 1983



JOURNAL EDITORS — ORNL environmental scientists Marshall Adams, left, and Webster Van Winkle have been named to the editorial board of the American Fisheries Society and will serve as associate editors of the society's journal, Transactions of the American Fisheries Society. Adams is associate editor for publications in warmwater ecology and Van Winkle will edit publications in modeling and statistics.

ENERGY SYSTEMS NEWS

2375-85 Volume 2/Number 7 May 2, 1985 A Newspaper for the Employees of Martin Marietta Energy Systems, Inc



NEW RESEARCH PROJECT- Under a new contract with the Electric Power Research Institute (EPRI), ORNL researchers are managing a national project to assess the effects of atmospheric deposition on forest systems. From left are Stanley I. Auerbach, ORNL Environmental Sciences Division director; Steven E. Lindberg. Division research staff member and technical leader for the study's atmospheric/canopy task; end John Huckabee, manager of EPRI's Ecological Studies Program.

ORNL researchers to manage national environmental study

Under a four-year, $8.2 million contract with the Electric Power Research Institute (EPRI), Palo Alto, Calif., ORNL environmental researchers are managing a national project to assess the effects of atmospheric deposition, including acid rain, on forest systems.

The project, which began last month, is the biggest yet undertaken under EPRI's Ecological Studies Program. It involves field research at nine forest sites in New York, North Carolina. Tennessee and Washington to investigate the role acid deposition plays in producing changes in the cycling of forest nutrients. Special attention will be given to areas of forest dieback.

Objectives of the *project* are to investigate both short- and long-term effects of atmospheric deposition on nutrient Cycles on a regional scale. Two important questions to be answered will be, first, whether acid deposition can be linked to nutritional changes that affect forest productivity, and second. which key natural processes regulate both the acidity of dry end wet deposits end the effects of such deposits on forest element cycling.

The goal is to provide better scientific information to guide future regulatory and legislative judgments on appropriate controls or needed remedial actions.

"The health of forests end the impact of acidic depositions, including acid rain. is one of the, most active aspects of the environmental pollution debate," explained John Huckabae. EPRI Ecological Studies Program manager, at a recent ceremony announcing the project. "In this study we are seeking the necessary scientific understanding of the factors and the interactions behind forest decline." he said.

Co-sponsors with EPRI are the Empire State Electric Energy Corporation end the New York State Energy Research and Development Authority. Subcontractors and participants with ORNL are Duke University; the Universities of Georgia. Michigan, Pennsylvania and Washington: the State Universities of New

(Please *turn to* page 3)

New ORNL project

(Continued from page 1)

York at Albany end at Syracuse; and the U.S. Forest Service.

Ernest A. Bondietti, group leader in ORNL's Environmental Sciences division, is manager of the project. Dale W. Johnson and Steven E. Lindberg, Division research staff members in biogeochamical cycling and environmental chemistry. are technical leaders for the soil chemistry and atmospheric/canopy tasks, respectively.

"While disagreeing on the causes of forest decline, most scientists agree that several interacting factors likely are involved," Lindberg said. "This study. for the first time. will attempt to quantify how atmospheric deposition end canopy and soil processes are linked to a forest's nutrient status and overall health." he explained.

The nine research sites include both dying and healthy forests representing a range of climate. air quality, soil type and vegetation conditions, as wall as different concentrations of acids in the atmosphere end different concentrations of sulfur. nitrogen and hydrogen in the soil.

Three forests. one of Douglas fir, one of red alder and one of subalpine fir. were chosen as sites in the Cascade Mountains of Washington, along with a loblolly pine forest on the Oak Ridge Reservation. Also selected were two spruce forests and one stand of beach in the Great Smokv Mountains National Park, a mixed hardwood end a white pine forest at Coweeta, N.C., a Huntington Forest beech stand near Syracuse, N.Y.. and four stands of spruce and fir on New York's Whiteface Mountain.

Five other U.S. forests and sites in Canada. Germany and Norway may be added later.

July , 1984

NERP Ecological Study Center offers 'hands-on' program for local schools

A new National Environmental Research Park (NERP) program. the Ecological Study Center. began on an experimental basis this spring a, ORNL

In the past, the NERP, which wasestablished by DOE for providing protected land areas for research and education in the environmental sciences and demonstration of the environmental compatibility of energy technology developments. limited its research opportunities mainly to university scientists and students. With the new NERP Study Center. however. the full potential of the research park (comprised of 5,500 hectaresol federally owned land) as a public demonstration area can now be realized by other age groups.

Under the direction of Pat Parr. an e&c&t in the Environmental Sciences Division and coordinator for the Oak Ridge NERP, the center will contribute to the environmental education of young people in the surrounding school systems by providing outdoor experiences with a half-day field activity that complements classroom presentations.

The NEAP provides teachers with introductory ecology information to lay the groundwork for the field-learning activity. The "hands-on" program. which is geared to accommodate elementary. junior and senior high school students. has provided Study units in resource allocation in a small-mammal community and faunal and floral succession in fallen logs.

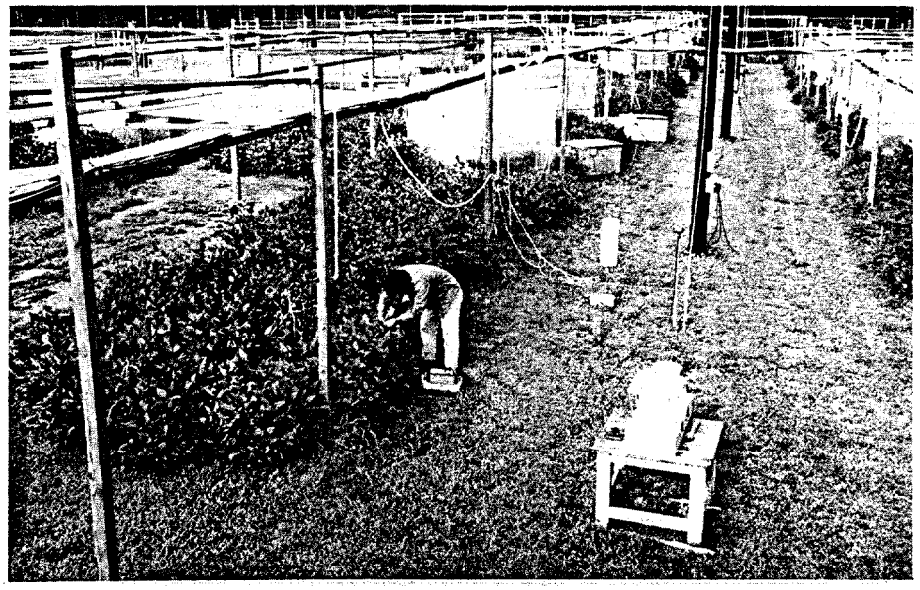
Because of the pilot program's success this spring, study units will be offered in the fell on a limited basis. For more information on the center, Parr can be reached et 576.6123

RECORDING DATA — Students record vegetational data on a small-mammal habitat during their half-day field activity et the NEAP.

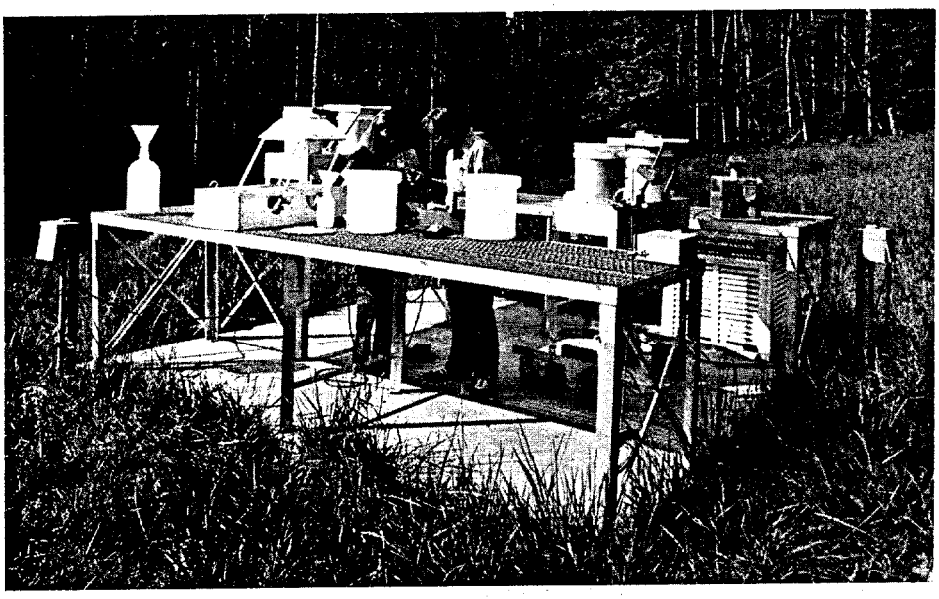
TYPICAL SMALL MAMMALS — Parr (third from right) shows Robertsville Junior High School students, the firs, participants in a pilot program offered by the Ecological Study Center. small mammals typical of those found in East Tennessee forests.

WRAP-UP SESSION — Parr (standing et left) discusses the student's field experience in a wrap up session on resource allocation in a small mammal community.

View of the 0800 Experimental Area's facility for air pollution research on higher plants. The acid rain research facility is at the upper left and the general purpose air pollution open-top chamber facility is at left center (1988).



Close-up view of the acid rain research facility. The framing over the open-top, plastic wall chambers contain movable covers which were programmed to cover the chambers during a rainfall. At the same time, each chamber received artificial acid rain or control rain through a series of jets mounted above the chambers. Artificial acid rain was prepared in various concentrations of acidity and stored in tanks until required. The entire operation was controlled and monitored by a computer system (1984).



Meteorological and acid deposition monitoring station located on top of Walker Branch Watershed. This station was part of the National Acid Deposition Monitoring Network. Researcher Steve Lindberg explains apparatus to technician Jan Coe (1981).

Howard Baker (U.S. Senator from Tennessee) discussing acid rain and related air pollution problems during one of his periodic visits to the Laboratory. Left to right are Senator Baker, David Shriner, Stanley Auerbach, and Sandy McLaughlin.

August 14, 1966

NERP used as site for wildlife research study

Jane Griess (left), University of Tennessee researcher, and Pat Parr, manager of the Oak Ridge National Environmental Research Park (NERP), study tracks left at one of the 30 scent stations set up on the NERP.

Bobcats, foxes and minks are just a few of the known furbearing animals that consider DOE's Oak Ridge Reservation home

So says Jane Griess, a University of Tennessee graduate student in the Department of Forestry, Wildlife and Fisheries Griess recently completed a preliminary assessment of the visitation habits Of furbearing animals using "scent stations" set up on the National Environmental Research Park (NERP)—a 13,000-acre area on a Reservation thot is available for environmental research by scientists from universities, colleges, foundations and research facilities

Griess said scent stations—small circular areas containing an animal attractant and surrounded by clean, dry dirt-hove bee" used for many years by the U S Fish and Wildlife Service and state wildlife agencies a s a practical means of determining trends in carnivore populations "The University of Tennessee has been studying carnivore population densities since 1970 and specifically studying raccoons—to delineate raccoon abundance i" several locations throughout Tennessee—for the post three years," Griess added

A total of 30 NERP scent stations, operated from April 1985 to January 1986, were located at 0.2-mile intervals along three lines located in different areas of the Reservation

Using bobcat urine as an attractant, Griess was able to identify the tracks of animals that freauented the stations The time, date, weather conditions and type of habitat at each station were recorded

In all, Griess found evidence of tracks from eight different furbearers: bobcat, red fox, gray fox, raccoon, oppossum, striped skunk mink and Eastern cottontail Tracks from deer and smaller mammals such as field mice, squirrels and chipmunks, also were noted

Because bobcat urine was used as the attractant, the most freauent visitor by far was the bobcat However, a large number of white-tailed deer also visited the stations "This," explained Griess, "is due primarily to the fact that deer are curious animals."

Although Griess said she hod hoped to find coyote ond Eastern cougar tracks, since sightings of cougars hod been reported and road-killed coyote carcasses had been Collected by biologists, no evidence was found during this study to substantiate then presence on the Reservation

In addition to identifying the variety of furbearing animals in the pork, the study pointed cut the importance of species ond nabitat diversity "Without habitat diversity there would be no species diversity," Griess said

It also was noted that the greater the diversity of plant species the more frequently visits were made to the scent stations and the greater the diversity was among the furbearers By the same token, the lower the variety of plant species the fewer the visits and the less diverse the animal species

The NERP offers several advantages for wildlife research which is coordinated with the Tennessee Wildlife Resources Agency protected land areas a large data base of information on the Oak Ridge Reservation, and close proximity to laboratory facilities and area colleges and universities Individuals interested in doing research on the Oak Ridge NERP should contact Pat Parr, manager of the Oak Ridge National Environmental Research Pork. 01576.8123

Area plant species to be protected by state

Eight sites of rare or endangered plant species on DOE's Oak Ridge Reservation have bee" added to the Tennessee Natural Areas Registry

According to Pat Parr, manager of the Oak Ridge National Environmental Research Park (NERP), the Tennessee Natural Areas Registry protects land not owned by the state that is known to have outstanding ecological or geological significance. Under criteria established by the Department of Conservation's Ecological Services Division, such areas include representatives of plant community types, rare species of plants, and areas with scenic and recreational values

Parr described one of the eight newly registered areas as the best-known remaining example of a cedar barren community, identified by the state as a plant community in critical need of protection.

Cedar barrens, Parr explained, are Open areas of extremely thin, cherty, silt loam soil thot ore dominoted by grasses, legumes and composites with scattered red cedars. Once more widespread in East Tennessee, most of me barrens have been heavily disturbed or completely destroyed

Also registered as State Natural Areas on the reservation ore stands Of Canada hemlock with rhododendron understory, relic stands of northern white cedar and swamp forest. Tall larkspur, southern-rein orchid, bush-honeysuckle, false foxglove, auricled gerardia, blazing star and prairie goldenrod are among the rare or threatened plants found in the areas

"Research has been initiated to obtain more information about the individual species and their specific environmental requirements, so that the habitats can be protected and maintained in the way most beneficial to each plant population or community," Parr said

Besides providing a protected area for research, the Oak Ridge NERP staff is responsible for identifying and protecting endangered, rare or threatened species of vegetation on the reservation, as well as preserving areas representative of the southern Appalachian region or those with unique biotic features Information can be obtained by contacting Parr at National Environmental Research Park, ORNL

Pat Parr, manager of the National Environmental Research Park, examines plants growing in one of the newly registered State Natural Areas on the Oak Ridge Reservation. Parr works in conjunction with the Tennessee Department of Conservation in determining optimum site-management strategies.

April 4, 1985

energy systems people . . .

Barbara T. Walton, research associate in the Environmental Sciences Division at ORNL, has been elected president of the Society of Environmental Toxicology and Chemistry (SETAC).

SETAC is a 1,000-member professional society established to promote research, education and training in the environmental sciences. Walton, who is currently serving as the organization's vice president and editor of special publications, will become president this fall.

. . .

Walton

energy systems people . . .

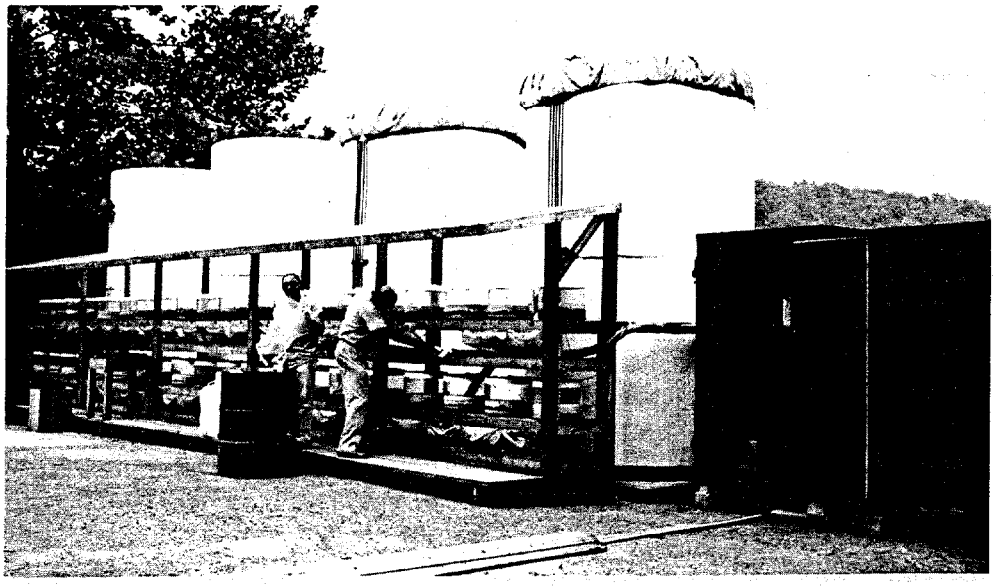
Lindberg

Steven E. Lindberg, research staff member in the Environmental Sciences Division at ORNL, was recently awarded the Alexander von Humboldt Foundation Research Fellowship.

The award is designed to promote scientific cooperation between universities and research institutions in the Federal Republic of Germany and the United States. Lindberg plans to work for one year at the University of Gottingen, West Germany, where he will study nitrogen and trace metal deposition to forests.

ESD had been interested in problems related to the carbon cycle since the 1960s because of its interest in forest ecosystem processes. The IBP biome program served to extend ESD's carbon interests to a worldwide scale. During the previous decade, an ORNL team provided an assessment of the global CO, problem. The NSF-sponsored IBP had provided the means to quantify the pools and fluxes of carbon in ecosystems. The goal to establish a global carbon project with the objective of determining whether world forests are a source or sink for carbon became a reality. In the early 1980s DOE established a national climate change research program and ESD was given a lead role in the carbon cycle research phase. ESD already had a 2-year lead in carbon cycle research based on an earlier proposal by Reichle and Shugart to model fossil CO, releases uptake by forests. ORNL's CO, program was led initially by Dave Reichle and John Trabalka, assisted by Larry Voorhees. Scientists involved included Bill Emanuel, Mac Post, and Tsung-Hung Peng, with others to come. ESD research has focused on the global carbon cycle, especially in relation to vegetation. It developed the most detailed global models of the biosphere and coupled these to atmospheric and oceanic carbon models. In 1982 the Carbon Dioxide Information Analysis Center (CDIAC) was established at ORNL to serve the DOE CO, research program. CDIAC was modeled after the information analysis center concept developed by Alvin Weinberg. Although the program was not initially established in ESD, a new Division staff member, Mike Farrell, was placed in charge. Soon joining him from ESD were Bob Cushman, Paul Kanciruk, and Ray Millemann. Under Farrell's leadership CDIAC has become a world center for carbon dioxide–related information and is in the process of becoming the tenth U.S. World Data Center.

Although lacking a cohesive geosciences research effort, the Division (and the Laboratory) continued to make progress in that direction. The Earth Sciences Section led successively by Tammy Tamura, Norm Cutshall and most recently by Steve Stow, was striving to contribute in a number of areas, including the low-level waste program, synthetic fuels program, nuclear programs, and EPA-supported efforts in leaching studies. There was a heavy influx (and turnover) of staff, visitors, and students. Key individuals by that time included Norm Cutshall, Ed Davis, Bob Fitts, Steve Haase, Dale Huff, Gary Jacobs, Lauren Larsen, Mary Moran, Curt Olsen, Brian Spalding, Steve Stow, Leroy Stratton, Ralph Turner, and George Yeh. Many of these individuals would have key roles and



Large-scale lysimeter test facility used to characterize the leaching properties of mixed industrial and municipal wastes co-disposed in landfills. This apparatus was used to develop a laboratory extraction test for the U.S. Environmental Protection Agency. ESD technicians operating the system were Joe Gooch (left) and Milt Sealand (right) (1982).

make contributions to many aspects of the on-site and off-site nuclear waste disposal issues as well as to related problems in the earth sciences.

In the late 1970s, at Auerbach's invitation, the Russian biologist and chemist Zhores Medvedev was invited to ORNL to give a seminar on his recently published account of a major nuclear accident that had occurred in September of 1957 on a secret Soviet atomic weapons complex in the Ural Mountains. In his account he alleged that this accident had serious health and ecological consequences. He believed that, in spite of censorship, definite clues to the location and extent of the accident were contained in Soviet radioecological literature. He came to ORNL because he had been advised that it was a world center for radioecology and he wanted to enlist our aid in corroborating his findings. It was an exciting challenge. Fortunately, in the person of John Trabalka, ESD had a scientist who could read and understand Russian and was gifted with exceptional analytical ability. Trabalka, assisted by Dean Eyman and Auerbach, undertook the task of collecting, organizing, and interpreting the Soviet information. Using plant, animal, soils, and lake data given piecemeal in over 50 Soviet open literature papers, he was able to pinpoint the location of the accident (Cheliabinsk-40 and Kyshtm in the Southern Urals) as well as ascertain the circumstance, magnitude, and possible causes of the accident that supported Medevedev's general hypothesis. In addition, the team uncovered evidence of major radiation contaminations of nearby lakes and rivers that could not be attributed to a single event such as an accident but rather was indicative of continuing and deliberate release of high levels of radioactive fission products over a long period of time. The magnitude of these releases were later determined to be greater than the Chernobyl nuclear accident of 1986. A major paper was prepared for submittal to Science. There was, however, a certain amount of controversy about Medvedev's story, especially his allegation that the explosion was related to high-level waste disposal, a finding that we at ORNL concurred with, although our analysis indicated a different set of mechanisms. Another DOE laboratory rushed into publication a totally different explanation for the explosion, which bordered on being incredible but nevertheless appeared to have some degree of Agency support. Because of this controversy and other factors, Laboratory management approval of our manuscript was delayed for a year, but when it was released, it was quickly accepted and published by *Science.*

Because the accident was alleged to be related to radioactive waste, a certain public notoriety developed about this story, especially since the Soviet government vehemently denied its occurrence. The CBS television program "60 Minutes" became interested, and the division director's office was the site of a taped interview involving Dan Rather (now the "CBS Evening News" anchorman), Trabalka, and Auerbach.

A number of skeptics within and without the Agency questioned our analysis and findings. But even before the breakup of the Soviet Union, a top Soviet nuclear scientist and official finally confirmed (in December 1988) that there had indeed been such an accident in the Urals in September of 1957. Since then much more information has been released, all of which confirms the ORNL analysis. There are still some missing gaps, especially related to human health impacts, but it is hoped that these data too will be forthcoming in the near future.

In 1981 ESD became involved in risk analysis. EPA asked ESD to undertake the development of methods for applying the concept of risk to regulatory problems related to the ecological effects of synthetic fuels and other potentially toxic chemicals. A research team consisting of Glenn Suter, Larry Bamthouse, Bob O'Neill, Bob Gardner, and Steve Bartell began attacking the various conceptual and analytic problems associated with applying risk assessment to ecological phenomena. Using the available large data bases on the effects of toxic substances on fish populations, they developed quantitative methods for estimating the risks of toxic chemicals to the fish populations inhabiting typical rivers and lakes in North America. They showed that the responses of fish species to exposures from a particular contaminant are highly correlated and predictable using the ORNL ESD models. They derived ways of integrating toxicity test data with existing population and ecosystem models and demonstrated that risk assessments

Energy Systems News

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ORNL research shows

Acid rain, acidification of environment linked

Two ORNL environmental researchers have documented a critical link between acid rain and acidification of forests. lakes. and streams.

Reporting in the November 10 issue of the British journal *Nature*. they report that atmospheric sources including both acid ram and so called "dry deposition" on foliage dominate the input of sulfur to soils underlying hoth pine and deciduous trees in the Southeast.

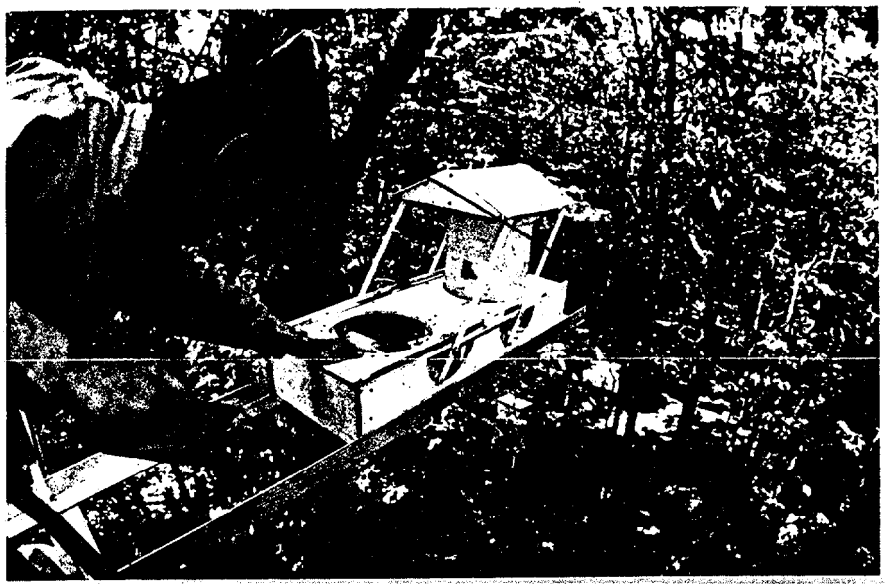
The research, a part of the ORNL-managed Integrated Forest Study and also of work here under the National Acid Precipitation Assessment Program. is a step toward resolving a longstanding scientific puzzle: whether deposition of acidifying sulfates to forest soils is influenced primarily by airborne pollutant sulfur or by sulfur naturally recycled by trees from the soil.

The report by Steven Lindberg and Charles Garten of the ORNL Environmental Sciences Division shows that forest canopy "throughfall." the wash off by rain of previously dry deposited sulfur compounds on leaves and needles, has significantly higher concentrations of sulfur than rainfall that is not intercepted by the trees.

The researchers used sulfur isotope tracers to determine that more than 95 percent of the sulfur deposited to forest soils at study sites in a forested area of East Tennessee comes from atmospheric sources.

This finding has important implications. Lindberg and Garten report, for understanding and predicting the effects of acid rain and atmospheric deposition on trees. soils. and lakes and for testing atmospheric transport models and emission control strategies.

Previous studies here and elsewhere have observed the higher sulfate concentrations in throughfall compared to rainfall. But the sulfur enrichment often has been ascribed to natural plant element cycling or to plant foliage leaching processes.



ORNL researcher **Steve Lindberg of Environmental Sciences Division conducts field research.**

NERP designated as part of biosphere reserve

The Oak Ridge National Environmental Research Park (NERP), a 12,400-acre protected area on the DOE Oak Ridge Reservation, has been designated as a unit of the Southern Appalachian Biosphere Reserve.

Designation as a biosphere reserve is made by the United Nations Educational. Scientific and Cultural Organization (UNESCO) on the basis of nominations submitted by the more than 110 countries participating in its Man and Biosphere program.

The Southern Appalachian reserve, itself a new designation, comprises two sites designated in 1976 as separate biosphere reserves-the Great Smoky Mountains National Park and Coweeta (N.C.) Hydrologic Laboratory-and the Oak Ridge NERP.

These three areas, and others expected to be added in the future, are representative of what is described as the "temperate broadleaf forest biogeographical region" of the Southern Appalachians.

Robert I. Van Hook. associate director of the Environmental Sciences Division at ORNL, which manages the Oak Ridge park for DOE, noted that "the diversity of the physical and biological resources of the Oak Ridge NERP fit well into the biosphere reserve concept."

The designation, Van Hook said, "will strengthen a long history of productive interaction with our partners in the Southern Appalachian reserve and will provide an international network for communication. problem solving. data access and cooperation."

The biosphere reserves are keystones of the Man and Biosphere Program, established in 1971 to provide the knowledge, skills and human values to support harmonious relationships between people and their environments throughout the world.

The reserves provide a global network of sites for cooperative research. The ideal reserve is a multiple-use area with a protected core area surrounded by environmental rehabilitation, traditional use and experimental research areas.

The Oak Ridge NERP was established in 1980 as an "outdoor laboratory," open to outside researchers. The site encompasses about one-third of the land area of the 37,000-acre Oak Ridge Reservation. It is representative of the ridge and valley province of the Southern Appalachians. with gently sloping valleys, rolling to steep slopes, ridges, and small streams and reservoirs. Five native types of forest exist in the park.

Under an agreement between DOE and the State of Tennessee, the Oak Ridge Reservation also was designated in 1984 as a Wildlife Management Area by the Tennessee Wildlife Resources Agency.

Biosphere reserve

The effects of gaseous pollutants on food crops are investigated in field studies at ORNL. Here, researchers William Kyker, left, and William Selvidge at the Oak Ridge National Environmental Research Park harvest soybeans grown under an exposure chamber (like the ones shown in the background), which enabled a desired pollutant to be administered at a steady rate. The NERP was recently named a biosphere reserve. **(See story, page 5.)**

ESD research hydrologist Dale Huff (foreground), assisted by Norman Farrow, making measures of flow along White Oak Creek using a wading rod and current meter as part of an overall evaluation of flow conditions and groundwater inputs to surface drainage (1981 I.

can be based on the best available data from fisheries management and aquatic ecology. Although highly successful in initial endeavors, which included publication of a number of widely accepted seminal papers on ecological risk assessment, eco-risk research a decade later is still only weakly supported by EPA and not at all by most other agencies, including DOE.

In their involvement with ORR activities, ESD scientists were increasingly frustrated with governmental resistance to their proposed investigations of contaminant conditions in local streams and other bodies of water. The proposed construction of the Liquid Metal Fast Breeder Reactor adjacent to the Clinch River alerted ESD staff to the fact that knowledge of the quantities and distribution of war-time released plutonium isotopes in river bottom sediments was almost. nil. The Clinch River Study of 1958–64 had not looked at plutonium. Now a facility for a major new nuclear technology was under construction that had the potential to release plutonium under certain circumstances, and no information was available on background levels of plutonium in the river sediments downstream from the reactor site. Funding was finally obtained to initiate a plutonium survey, which was carried out under the leadership of Dean Eyman. The small quantities of plutonium that were found in areas of sediment deposition were of no significant health or environmental hazard, but key background levels were now available even though the reactor project was canceled.

NEPA requirements called for formal environmental assessments of each of the three major facilities on the ORR. ESD staff were involved in the preparation of these documents, except at the Y-12 facility. Stream analyses of creeks on the reservation (except the East Fork of Poplar Creek, which drains the main part of the Y-12 Plant) revealed the extent of chemical and radionuclide contamination. Of particular interest were the high mercury levels detected at the mouth of Poplar Creek, whose branches drained both the Oak Ridge K-25 Site and the Y-12 Plant. This information was reported at the time.

ESD interest in mercury was not merely academic. In 1975 NSF had asked ESD to undertake ecological and environmental studies of mercury around the famous mercury mines in central Spain. John Huckabee and Steve Hildebrand conducted a several-year effort that was carried out in conjunction with the Spanish government. ESD had also been doing studies of mercury and its behavior in a number of mercury-contaminated rivers and lakes in the southeastern

United States. At this time ORNL had what was probably the leading research group (Jerry Elwood, Steve Hildebrand, John Huckabee, Steve Lindberg, Gordon Blaylock, and Ralph Turner) in the environmental behavior of mercury in fresh water systems. It was therefore ironic that they were not given the opportunity to further pursue the investigation of mercury in local streams until the private investigations of a then ESD staff member resulted in a series of events that brought forth the revelation that scores of tons of mercury had been accidentally released from the Y-12 Plant at about the same time that the White Oak Lake was drained (late 1955 to 1956). The public outcry resulted in a special Congressional investigation concomitant with a change in the management of the local DOE field office. Since 1983, however, ESD has been responsible for a long-term biomonitoring effort under the leadership of Jim Loar and Ralph Turner to evaluate the mercury contamination hazards and the results of remedial actions on the ecology of the streams of the ORR.

Although the new buildings provided much-needed space for the expanding divisional activities, changes in program directions soon made manifest a shortage of experimental research facilities. This was particularly true in the aquatic area. Jerry Elwood, Bob O'Neill, Dennis Newbold, and Pat Mulholland had received NSF support for a new project in stream ecosystem spiraling. A major field experiment using radioactive phosphorus was carried out on the lower stretches of Walker Branch. But laboratory facilities were needed-especially artificial streams. The greenhouses that had been added to Building 1503 were taken over, and sets of streams were built in them for this research. The thermal effects research under Coutant was beginning to phase down, but research space for *new* aquatic microcosm studies, as well as for other aquatic efforts, was needed. Funding was requested from DOE to add another 5000 ft^2 to the aquatic ecology building and give it a new brick facade to match the main building, Funding was approved and the new facility was completed in time to be a visitor site for the 1982 Knoxville World's Fair.

At the same time Building 1503, which had been nothing more than a large metal shed that had housed the on-site construction facilities, was remodeled in a style that matched Building 1505; this office and laboratory facility would house other divisional units. The need was urgent because the Division was taking on a number of program management activities that were utilizing much of the remaining available space in Building 1505. The space in Building 1503 was assigned to the Biomass (Short Rotation Woody Crops) Program and the Forest Management Program Since then, the other

Treetop apparatus used for mounting experimental dry pollutant deposition apparatus within and above the canopy of the forest. Technician Jan Coe is working at lower level and researcher Steve Lindberg is at upper station (1981).

Energy Systems News

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At ORNL

Environmental studies,. initiative under way

At a lab-wide seminar July 13. ORNL Director Al Trivelpiece announced the creation of an initiative that will draw on talents both within and outside of the laboratory—a Center for Global Environmental Studies.

Trivelpiece spoke before an audience that included guests from the Tennessee. Valley Authority. the University of Tennessee. the National Park Service. Oak Ridge Associated Unwersities. and the Atmospheric Turbulence and Diffusion Laboratory in Oak Ridge. all of which will be collaborating in the center's activities. Special guests also included representatives of DOE Headquarters and Oak Ridge Operations. as well as some 60 high school students who are participating in the 1989 DOE High School Science Honors Program in ORNL's Environmental Sciences Division.

Following the morning's activities. Trivelpiece toured Environmental Sciences labs where the honor students are working during their two week stay at the laboratory.

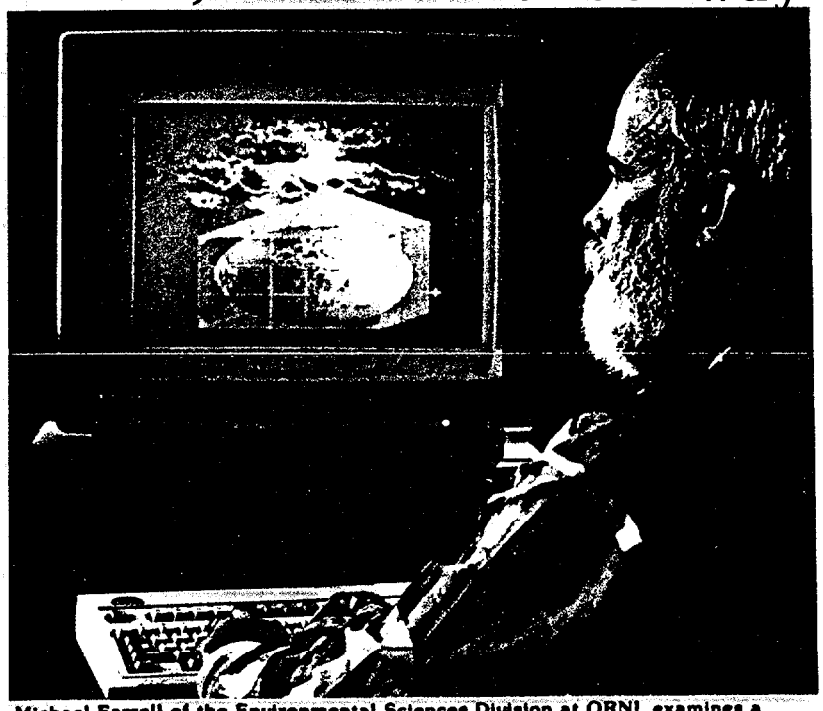
'The scientific goal will be lo better understand the large-scale workings of the global air. land and water environments.' Trivelpiece said. "and to be able to predict the long-term consequences of human actions that have the potential to alter. perhaps irreversibly. the vital-often fragile-balances that exist in nature.'

Currently at ORNL. global environmental activities center on the DOE-sponsored Carbon Dioxide Information Analysis and Research Program managed by the Environmental Sciences Division. The new center will expand the scope of this research to include other trace gases important in the greenhouse effect. ozone depletion causes and effects, and the role of deforestation and reforestation in the climate issue.

The new center will draw heavily on contributions by visiting investigators and collaborators from universities, other DOE laboratories. and other research institutions. Partnership agreements are already In place with a number of these.

Director of the new center, which will be housed in the Environmental Sciences Division. is Bob Van Hook. associate division director. He will report to Chet Richmond.

see GLOBAL. page 4



Michael Farrell of the Environmental Sciences Division at ORNL examines a computer image of global warming as part of his research on the "greenhouse effect" and the possible worldwide effects of increasing atmospheric levels of carbon dioxide.

Global continued from page 1

ORNL associate director for Biomedical and Environmental Sciences. Mike Farrell, carbon dioxide program manager, will serve as the center's deputy director.

Four major areas of research and assessment activities are planned within the center. Each area will directly support the center's main theme, global systems analysis. which will be coordinated by Bill Emanuel of the Environmental Sciences Division. The individual areas and their staff coordinators are data and model systems, Paul Kanciruk, Environmental Sciences; measurement science and instrumentation, Bill Eads, Instrumentation and Controls Division; policy, energy. and human systems analysis. Steve Rayner. Energy Division; and largescale environmental studies. Monica Turner. Environmental Sciences,

December 15, 1988

ESD team sets guidelines for data transfer

Exchanging information in computer systems can he lime consuming and frustrating when errors in transfer occur. but a Performance Improvement Process team in the Environmental Sciences Division (ESD) has completed a project that should make the process easier and more accurate for both receiving and sending computerized information.

In recent years, much research has come to involve the production of computerized information, including data sets. models and text files. Thus, ensuring the quality of data transmission has become an ongoing concern Errors. omissions and lack of documentation in the data are costly for both ESD and the users of the information. The Performance Improvement Process team was chartered by Division Director David Reichle to analyze transfer problems in computerized information and to recommend ways to eliminate them.

Team members are chairman Richard J. Olson, Tom A. Boden, Sigurd W. Christensen, Virginia H. Dale and Jean A. Solomon.

"If other researchers or agencies are going to use our data sets to support their research or for making decisions. we must maintain the integrity of the data sets in transfer." Olson said.

Analysis of quality assurance concerns revealed that transfer problems occurred in almost one-third of the computer files received in ESD and in about one-tenth of the computer files sent out. Average time required to process computer files with transfer problems was 34 percent greater than for files with no problems.

"Ii the files can't be read. then the information is useless," Boden said. "We can't really control the quality of incoming information, but we can make sure that what is sent out from ESD can be read."

Analysis concentrated on two data-intensive activities in the division: the Acid Deposition Data Network (ADDNET), which receives computerized data from various agencies throughout the United States. and the Carbon Dioxide information Analysts Center (CDIAC), which receives and disseminates data pertinent to DOE's carbon dioxide research program. Both had recorded difficulties in receiving data.

Project team members (from loft to right) Virginia Dale. Sigurd Christenson. Dick Olson and Tom **Boden (seated)** worked to simplify the process of exchanging **computerized information.**

The study showed that most transfer problems resulted from insufficient information about the kinds of computer files being sent and how they were catalogued.

"Computer systems have evolved at alarming rates: unfortunately. the documentation process has not kept pace," Boden said.

Other problems identified included hardware or software incompatibility, tape or disk errors, data inconsistencies and transmission of the wrong data set.

Ways of resolving the problems ranged from making a telephone call to generating new tapes. Pareto analysis showed that about 30 percent of the problems could have been prevented through more complete and accurate computer file documentation.

"We must protect our credibility, and to do that we must avoid problems with data documentation or accuracy." Olson said

Although these problems do not occur frequently, it was the team's finding that guidelines for file transfer would be useful Quality Assurance regulations for large data base management activities already have been established

"It's not that procedures haven't been in place." Dale said. "We thought that by putting this information together. we could provide an easy guide to help those who send files infrequently."

To avoid lengthening an already extensive review process. the team recommended flexible guidelines that would serve as a checklist for researchers. would simplify personal recordkeeping. and could be adapted to suit individual needs.

The guidelines involve listing pertinent information such as file title. contact person. definitions of variables, original uses of the file, lik size. reference citations, and restrictions on the use of data or programs Also included might be file characterizations such as "unverified data; use at your own risk," "draft data. use with caution," or "clean data to the best of our knowledge "

"It doesn't really take any more time." said Dale. who transfers computer code occasionally "We need to provide the information anyway. and in the end it makes less work. i just make copies of the guidelines and fill in the blanks "

Use of the guidelines in ESD has been so successful that they have become selling points for rhe division. According to Olson, as a result of the reduction in processing time, the guidelines have proved effective both for ESD and for off-site researchers and agencies

"I have had the opportunity to use the guidelines myself." Christensen said "I'm now encouraging those who send us tapes or diskettes to do the same. and I think they're working on it."

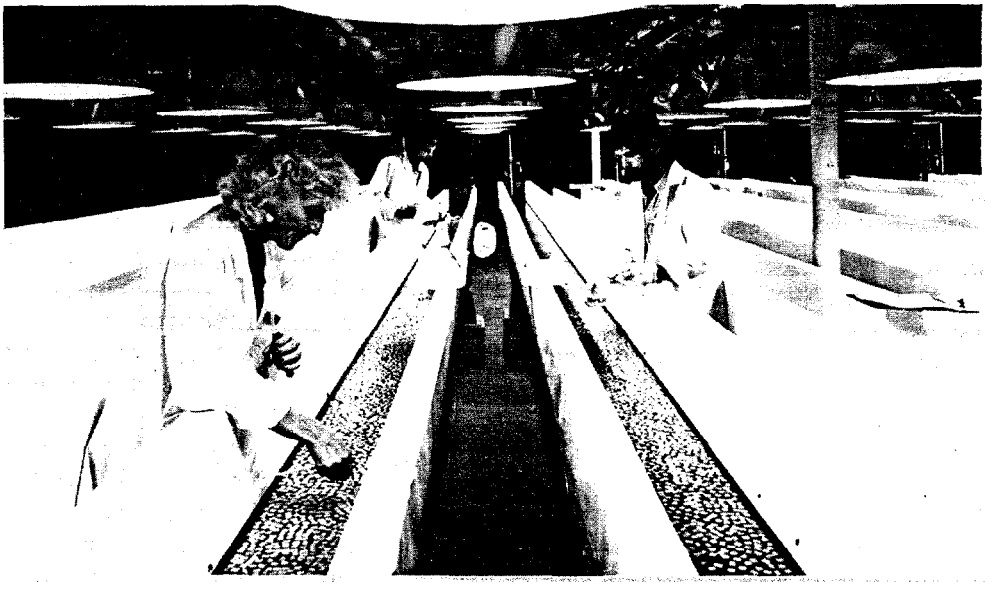
Gone fishin'

Members of the ORNL Environmental Sciences Division recently **moved several thousand sunfish and small minnows from a 300-foot section of East Fork Poplar Creek to another location downstream of the new Lake Reality at the Y-12 Plant. The fish were removed because that section of the stream, at the outflow of the now-closed New Hope Pond, will be allowed to dry up and eventually will be filled in. A temporary barrier was installed in the creek to prevent the fish from returning to that area as the flow decreased. From left, are: Mike Ryon, Mark Harris, Dave Cox, Elizabeth Schilling and Mark Peterson.**

end of the building has also been remodeled into offices, which are occupied by a number of division geoscientists.

By the middle of the new decade more new faces were to be found amongst the research staff. These included Harry Boston, Mike Huston, Bruce Kimmel, John McCarthy, Lee Shugart, Art Stewart, Tom Ashwood, Roger Clapp, RaNaye Dreier, Gary Jacobs, S. Y. Lee, V. Tripathi, Rob Turner, Karen Von Damm, Jim Breck, Glenn Cada, Carolyn Hunsaker, Bob Reed, Mike Sale, Lorene Sigal, Ellen Smith, Virginia Tolbert, T. J. Blasing, Virginia Dale, Mel Dyer, Pat Layton, Gregg Marland, and Allen Solomon, plus many others on a temporary basis. At the same time, individuals were leaving for other organizations in the Laboratory or other jobs. Overall funding was tightening up within DOE and elsewhere. Although ESD had always carried out research projects that involved the use of students, especially graduate students pursuing theses, the need to reduce costs of research made it evident to Division management that much more emphasis needed to be placed on using graduate and postgraduate students in the research programs. By. the middle of the decade an increased number of such students were in residence. But perhaps more important, individual staff members had become more comfortable working with students and were now planning their research programs with emphasis on student participation in the research.

One of the major events of this decade was the decision of the Union Carbide Corporation to not renew its contract for management of the Oak Ridge facilities. After a national solicitation for proposals, DOE chose Martin Marietta Corporation to replace Union Carbide as the managing contractor. In April 1984 Martin Marietta Energy Systems, Inc., took over full responsibility for Laboratory operations. The new contractor made no changes in the management directorate of the Laboratory and so, from a management point of view, there was little impact on division operations. But there was growing national concern about the residual contamination present at the former AEC facilities, and pressure was growing to do something about cleaning these up. The mercury problems in Oak Ridge had already resulted in a broadened biomonitoring effort in which ESD had a major role. One of the results of the synthetic fuels project was a new research interest in toxicology related to ecological concerns. The new field of ecotoxicology began to emerge from this interest as did the new field of ecological risk analysis.



View of the experimental stream ecosystem research facility located in the Aquatic Ecology Laboratory. Streams are located under a high-intensity lighting system needed for growth of experimental aquatic plants. Shown are technicians sampling for test organisms (19881.

One of the major changes in ESD in the 1980s was the change in Division leadership when Auerbach, having reached the age of 65, retired as division director. Assuming the demanding role of manager was his highly qualified associate David Reichle. Accordingly, in May 1986, the change was effectuated, with Auerbach becoming the senior staff advisor. The change was timely because more and more demands were being placed on the Division to assist and participate in the growing and manifold activities dealing with environmental issues at the DOE sites managed by ORO.

Dean Eyman had already left the Division to organize a new Hazardous Waste Remedial Action Program (HAZWRAP) for Energy Systems. Joining him were a number of ESD staff or former staff, notably Bob Craig, Paul Franco, Sam Suffem, James McBrayer, and others.

Environmental issues of cleanup, assessment, auditing, education, and compliance were now becoming the order of the day both in Oak Ridge and nationwide, and these presented opportunities that required ESD involvement. As a reflection of these new concerns, the impact assessment program was reorganized into a new Environmental Analyses Section under the leadership of Steve Hildebrand. The section was organized around four themes: environmental assessment, environmental compliance, risk analysis, and regional studies. This change thus established assessment activities as an important line function of ESD.

At the same time, much of the traditional research support was being reduced within the DOE Office of Health and Environmental Research (OHER), a situation that placed greater competitive stresses on both staff and management. Competitive proposals were required for all research projects, both new ones and renewals, irrespective of the funding agency. The ecosystem research programs, which had received most of their support from NSF, underwent severe attrition as that agency reduced its funding support and imposed more restrictions on submission of proposals from ORNL. In order to maintain our ecosystem research endeavor, an Ecosystems Studies Section was established with Webb Van Winkle in charge. Under this section, much of the DOE support was consolidated in a new, integrated Walker Branch Watershed project led by Mike Huston.

The global change concerns were growing, and Reichle reorganized the Division's efforts to take advantage of increased national interest. CDIAC was transferred back to ESD. Mike Farrell, who had been in charge, was given the leadership of the total global change program, while Paul Kanciruk took over management of CDIAC At the same time Laboratory approval was obtained to establish an ORNL Center for Global Environmental Studies. Bob Van Hook managed this programinitially, in addition to his other responsibilities.

The Division took on a major role in assisting Energy Systems in compliance monitoring in the creeks draining the reservation and in the Clinch River. A new toxicology laboratory was established in the aquatic ecology facility (Building 1506) under the leadership of Art Stewart. Hydrological problems on the reservation began to be addressed in a major fashion. Dale Huff, who in many ways had been the Division's pioneering research hydrologist, assumed program management leadership of a portion of the Laboratory's environmental activities in relation to rad waste disposal problems. Roger Clapp, in turn, assumed leadership for carrying out or coordinating the many hydrological studies being initiated in the White Oak Creek drainage basin area and in other parts of the reservation.

Compliance activities required knowledge and understanding of the burgeoning array of environmental statutes and the regulations that were being formulated under these statutes. For the most part, Energy Systems staff as well as Laboratory staff were woefully ignorant of these new requirements and their implications for operations. Training was needed, including the development of lectures, courses, etc. Fran Sharples was given responsibility for this endeavor, and under her leadership a very effective group was built. Members included Fred Baes, Gerry Eddlemon, Marti Salk, Catherine Sigmon, Ellen Smith, and others.

Activities in NERP were also moving along in spite of a meager budget. For a number of years Pat Parr had been carrying out an ecology studies

program in cooperation with local schools beginning at the kindergarten level. This was proving to be a highly popular endeavor. Pat had arranged to carry out parts of the course at the historic Freels Bend cabin on the reservation, and this added to the appeal of the program. With special DOE educational funds, the program was expanded to a new Ecological and Physical Sciences Center for training of students at the kindergarten through 12th-grade levels.

By this time the Division's policy on post-graduate education was also bearing positive results. An increasing number of Wigner postdoctoral fellowships were being awarded to Division-recommended candidates. DOE also established a new and prestigious postdoctoral fellowship program in the life sciences that was named after Alexander Hollaender, the founding director of the ORNL Biology Division. Here, too, the Division was successful in attracting top-notch graduates. The first of these was Monica Turner, from the University of Georgia, who subsequently played a key role in establishing the Division as a national leader in and center for basic research in Landscape Ecology. That program, which was sparked by Bob Gardner and Bob O'Neill, also involved Robin Graham, Carolyn Hunsaker, Virginia Dale, Antoinette Brenkert, and Kenny Rose. In addition, this group developed paradigms for regional-level ecological risk analysis and initiated new research projects on the impact of global change on forest resources.

The Forest Management Program, initiated in 1964 to harvest pulp wood and supply hardwood to local timber processors, had reached a dead end. The pine forests had been thinned sufficiently, and cutting of more hardwoods was posing a threat to the research projects and to needed wildlife habitats. Early in the decade the program was transferred to the Laboratory's Operations Division, and, after continuing efforts by Reichle and Van Hook, the program was effectively terminated.

Another important action accomplished by the new ESD management concerned NERP. In the fall of 1974 ESD contracted with UT to carry out a study of the deer population for the purpose of determining the density and distribution of deer on the reservation. Because of the ongoing forest management practices, we foresaw the likelihood of a great increase in the population with a concomitant increase in deer/auto accidents. This forecast was accurate. The deer population exploded to estimated numbers that ranged from 2000 to 3500 deer, and deer/auto collisions soon reached a frequency of almost one per day. Poaching also became a problem, but despite the

View of some of the components of the Geographic Information System located in the ESD computer facility. Standing at left is Linda W. Littleton, computer systems specialist, and at right is Raymond A. McCord, computer systems supervisor. Seated at console is a GIS technician (1987).

poaching and attempts at legal trapping and removal of deer, the problem continued to escalate. Finally DOE entered into an agreement with the state of Tennessee establishing NERP as a wildlife resources and management area. To back this up, the state assigned a wildlife resources manager to ESD whose costs were partially underwritten by DOE. Organized deer hunts were started and carried out annually in the autumn, which served to reduce the population. Poaching was soon brought under control, and new programs in wildlife studies were initiated with graduate students carrying out particular studies. Lastly, programs to restore components of the original wildlife were begun with the introduction of wild turkey flocks.

Throughout the seventies and eighties ESD scientists achieved another kind of recognition as they were asked to contribute their talents to new program leadership in other organizations. In the seventies Jim Curlin, who had obtained a law degree, went to Washington, where he served as an Assistant Secretary of the Department of the Interior, thence with the Library of Congress and the Office of Technology Assessment. W. Frank Harris took a 2-year assignment at NSF. His work was so impressive he was asked to join the staff and has since achieved a senior management position there. Roger Dahlman took a temporary assignment at OHER, which subsequently became permanent. Roger has played a key role in the development and management of DOE's carbon dioxide and global change program. Much more recently, Curtis Olsen and long-time ESD scientist Jerry Elwood joined OHER program staff.

As the decade of the eighties waned, ESD continued to expand its activities, The new environmental action and remediation programs at various DOE facilities as well as on the reservation were providing new applied research opportunities; at the same time, experienced Division managers were being assigned new managerial responsibilities in the burgeoning waste and cleanup programs. Norm Cutshall went on assignment to DOE headquarters in the new waste technology programs. Leroy Stratton, John Trabalka, and Sid Garland took on new program assignments elsewhere in the Laboratory.

By this time ESD had become one of the larger research divisions at the Laboratory, both in personnel and in budget. It had also achieved a distinction, once held by the Biology Division, of being the research division with the largest number of Ph.D.-level scientists on its staff. In recognition of the heavy managerial burdens imposed by this development, Laboratory Management approved Reichle's request that Bob Van Hook be promoted to associate director in 1989. Four research sections (Ecosystem Studies, Environmental Analyses, Environmental Toxicology, and Geosciences), headed by Webb Van Winkle, Steve Hildebrand, Carl Gehrs, and Steve Stow, respectively, constituted the main administrative structure. Drawing on these were the carbon dioxide, global environment, biomass production, and environmental waste programs.

Educational programs, coordinated by Steve Herbes, had also become a major and widely recognized set of activities. Because of its reputation in environmental research and as a result of strong marketing to DOE by Reichle, ESD was chosen from among all the national laboratories to host a high school honors workshop in environmental sciences. For 2 weeks each summer, 58 exceptional high school students-l from each state and the remainder from the District of Columbia, Puerto Rico, and 5 foreign countries—worked on research projects in different areas of the Division. This program was so successful that it has been continued annually since. The Ecological and Physical Sciences Study Center grew from 125 students in 1984 to over 9945 students and teachers representing nine East Tennessee counties in 1989. A new secondary school science education program was established, and new initiatives were undertaken to assist and work with minority educational institutions. As a result, increasing numbers of Black and Hispanic undergraduate and graduate students are coming to ESD to participate in or carry out research projects. By the end of the decade ESD had truly become a mini-national laboratory in itself.

8. THE SUPPORT PEOPLE AND ORGANIZATIONAL DYNAMICS

Every organization, and research units are no exception, requires a combination of skills and people to accomplish its goals and objectives. The larger and more complex the overall organization is, the more essential it becomes to have a support staff that is knowledgeable, dedicated, skilled in their specialties, and compatible with the habits of the unit. ESD has been fortunate to have had many such individuals during the course of its history from research group to major division. These people have contributed ideas, special knowledge, and their own particular brand of loyalty to the organization and its goals. This chapter attempts to summarize some of the many contributions made by these individuals.

Secretaries. No individuals are more responsible for making the machinery of an organization function effectively than are the secretaries. Their skills, both interpersonal and operational, can make the difference between a smoothly running operation and a chaotic one.

When the ecology unit achieved section status in 1959, Dot Blankenship was the secretary and it was she who was responsible for providing the beginnings of an office support structure. Blankenship was followed by a woman who had recently entered the stenographic pool from the K-25 Site and whom Personnel recommended because of her exemplary skills with the typewriter. Her name was Charlotte Galloway and she had the fastest typing score ever achieved by an applicant. Galloway brought more than typing skills to the position; she viewed the unit, which soon became a section, as an extension of her family. When the unit moved back to ORNL and occupied the newly remodeled Building 2001, she organized the office structure for the Section and assisted in laying the groundwork for what was becoming a rapidly growing unit. Tragically, Galloway died of liver disease in 1969, eight years after joining the unit.

Galloway's replacement was Mary Rhea, who had several years' experience as a legal secretary and who had joined the Section the year before. This was a period of dynamic expansion: many activities such as the IBP were getting under way and a number of strong personalities had joined the scientific staff. The need for secretarial support far exceeded the number on the staff. Rhea coped with these pressures superbly. She left the organization in 1975 when her husband took a position in a different locale. She has since returned to Oak Ridge and serves as the executive secretary to the HAZWRAP program.

Taking over as the new executive secretary was Virginia Lee, who had. been in the Central Management offices. Lee was a thorough and dedicated professional and a superb organizer. After five years she was offered a position as a senior executive secretary in the Central Management offices, which was a tribute to her outstanding abilities and performance.

Her successor was Linda Croff, another dedicated and hard-working professional. Croff came aboard in the early eighties when the entire organization was being stressed with nonscientific pressures from a variety of sources. Like her predecessor Croff was totally dedicated to her job and would not hesitate to undertake any assignment no matter how demanding in time and personal resources. Her performance, too, was noted elsewhere, and after 5 years at ESD she was offered the position of executive secretary to the Laboratory director. She has since become secretary to the Senior Vice President of Energy Systems.

To succeed Croff, the Division was fortunate in finding a highly experienced senior level secretary who had worked in the private sector for a number of years and had recently joined the Laboratory. Her name was Donna Wiffen and she joined ESD in 1985. Wiffen was a master at handling details, and her skills were invaluable and timely because of the vast amount of administrative minutiae that research divisions had to cope with. She managed the office during the Division's leadership transition from Auerbach to Reichle and remained with ESD for about 5 years before joining her husband in Washington where both took positions with DOE headquarters.

The current secretary is Bakita Lakin, who joined ESD as a section head's secretary, having

been in the Travel Office for a number of years. Lakin works with Division Director Bob Van Hook in coping with an almost innumerable amount of details and does so with great efficiency.

There were many other secretaries who have worked and served the Division over the years. Among the more outstanding was Joanne Stanford who came from Central Management offices in 1969 and remained until her retirement. Many others have been with ESD for a decade or more, contributing significantly to the effective functioning of the organization.

Administrative Assistants. After ESD was established, the first Administrative Assistant authorized for the Division was Bob Canning. Canning came from the Biology Division, where he had gained experience working for the Centrifuge Program under Norman Anderson. Canning brought an understanding of the administrative requirements and operational needs to the new division; he continued with ESD until his retirement in 1986.

Canning was succeeded by Judy Trimble who, like Canning, had a technical degree (MS) in Biology. Trimble had been working in the Biomass program, where she had handled subcontracts and related organizational matters, and brought a competency in computer science to her new position. She completely reorganized many aspects of the administrative support organization while effectively supporting the director's office with timely information on all aspects of division operation. In addition, she greatly improved, at the divisional level, the subcontracting operations, which accounted for a significant component of the budget. At the same time she worked to improve the Work-for-Others proposal process operations.

In 1990, with a change in Division management, Trimble transferred to the Personnel Resources Division to take advantage of a major professional opportunity. The Division Director solicited expressions of interest for the vacant position from qualified staff members, and David Fowler was selected to lead what had become the Division Operations Section. By 1991 this section had responsibility for over 40 individuals representing both ESD and personnel from the service divisions assigned to ESD. While that may appear to be a large number, the Section serves a division that has a total staff (including guests, students, consultants, subcontractors, and other visitors) that exceeds 500 individuals.

Finance Officers. Under the ORNL organizational scheme, each operating division has a finance officer with general responsibility for keeping abreast of all the fiscal activities, including income and expenditures. Essentially every aspect of budget-inflow and outgo-is tracked by the finance officer. In addition, timekeeping, payroll matters, subcontracts, and all other financial matters are followed in this office. Moreover, it is the finance officer's special responsibility to serve as a form of comptroller, not only tracking income and expenditures, but keeping Division management apprised continually of the status of finances-an essential requirement in a dynamic fiscal situation that is characteristic of DOE and Laboratory operations.

ESD has been fortunate to have had the services of knowledgeable and dedicated finance officers who have helped develop and keep the Division to a philosophy of living within its annual budget. This was sometimes painful, but over the long term it brought ESD the long-deserved recognition of a well-managed organization.

Four individuals have served in this capacity since ESD was established in 1970. The first was John Gann. Gann had been a finance officer in HPD. With the formation of the new division, Gann was transferred to ESD because he was familiar with the types of operations that the new division would be involved with. Gann had been involved in finance for many years and, had a broad knowledge and insight about Laboratory operations, so his advice was always timely and invaluable. He served until his retirement in 1974.

Up to this time finance officers had been Division employees. But beginning with the new management of the Laboratory in 1973, finance officers were members of the central Finance and Materials Division, and assignments to the divisions would be made from the central unit. Gann's retirement provided the opportunity to carry out the policy with ESD.

The new finance officer, Tracy Vann, had previously worked in the Biology Division as an

assistant officer. Vann brought to the job quiet competency, superb record keeping, and a sense of fiscal conservatism.

Replacing Vann was Carlos Brooks, who had worked previously in the Analytical Chemistry and Chemical Technology divisions. During his tenure there was an overall budget cut and reduction in staff in most of the research divisions at the Laboratory, including ESD. Brooks not only met that challenge but helped staff members clarify the new complex budget system, especially as it related to Work-for-Others.

In 1983 Brooks was assigned to another division because it offered a promotional opportunity. Replacing him was Mike Emery, who came from the Central Office without previous experience as a finance officer. Emery was good for ESD because he brought a fresh perspective and could evaluate ESD's needs and complexities in a different context. Recognizing that the complex, matrix, multiproject support that was becoming typical of ESD operations was posing a heavy burden on the finance office, he obtained approval for the assignment of an Accounting Clerk to ESD. The new assignee was Aileen McDaniel, who came to the Division in 1984 with a long background and extensive experience in bookkeeping and accounting.

Personnel timekeeping was becoming increasingly complex at the Laboratory because of new DOE requirements that called for accounting for every individual hour of a staff person's time. In a multiproject, interdisciplinary division, this requirement imposed an onerous burden on all levels of Division management. Emery was asked to undertake the development of a computer-based electronic system for timekeeping and arranged for Steve Blum of the Computing and Telecommunications Division to develop such a program. After a year of effort Blum perfected the program INTIME for internal time charges. Thus ESD became the first research division at the Laboratory to develop and implement an electronic program for submission of all labor costs. Beginning with fiscal year 1985, the monthly charges to the Division's various research programs were submitted electronically instead of through the manual system, which required time cards. This electronic time system eliminated bad charges and overruns for labor because it was possible to sort and review all charges prior to submission. Six years later, beginning with fiscal year 1991, all the Laboratory research divisions began using a similar electronic internal time program.

After 2 years, Emery's skills and abilities were needed back at the central system, which was undergoing rapid change and expansion. Replacing him in 1985 was Tracy Vann, returning from the Biology Division to a division whose budget was rapidly approaching $30 million and was on a continuing growth trajectory. Vann's knowledge and experience were invaluable to the new ESD management.

In 1991 Aileen took a well-deserved retirement and was replaced by Opal Grooms, another experienced accounting person. Pam Gambuzza was detailed from the Finance and Materials Division to help with the greatly increased work load in the office.

Technicians and Research Assistants. No scientific research organization, especially one that must rely on extensive, empirically derived observations and measurements, can function effectively without the support of trained and motivated assistants and technicians. In the almost four decades of its activities, ESD and its precursor organizations have had the services of a number of individuals whose work or careers were dedicated to the job of assisting and serving the scientists in the Division. The following individuals represent a cross section of these persons who over the years played a role in the growth and accomplishments of ESD.

Regina Anderson, who was our first permanent technician, came to the ecology unit from the Applied Health Physics Section in 1957. Anderson was a hard-working individual who worked in all areas of division activity until her retirement in 1984. Cynthia Corley came to ORNL in 1960 from the University of Georgia where she was a cum laude graduate in biology. Corley won recognition throughout the Laboratory, whether driving the new cab-over-engine Jeep truck or appearing in photos of research activity. In 1961 the technician staff was augmented by Gladys Dodson and Love11 Lawrence and a year later by

Marilyn Frank. Frank was assigned as a research assistant to Martin Witkamp, a challenge that she effectively managed during the years of his tenure. Love11 Lawrence brought special skills in laboratory procedures to the then newly developing small mammal program under Paul Dunaway. Lawrence was a dedicated and innovative assistant. It was great loss to all when she was killed in an automobile accident in 1965.

In the early 1960s the expansion into more field work, especially in forest and aquatic ecology, brought an influx of technicians and assistants into these programs. Neil Griffith was employed to help in the new Clinch River Study. Working in the boats and learning to handle hoop nets and gill nets was a totally new experience for Griffith and involved a near miss or two with cables strung across the Clinch River during sediment measuring activity. Griffith adjusted very well to a new assignment in the computer facility, where he comes into daily contact with many staff.

Hubert Waller, trained in soil science, and Bill Cate, who had a background in forestry, were employed to assist Jerry Olson in the forest ecology effort. Waller contributed much in that developing effort. Cate had the ability to get maximum output from the craft and labor support staff. When the forest management program was established, his knowledge of the reservation and practical forestry experience were of great help. It was a loss when he left to work in the private sector.

Marvin Shanks was another individual who joined about this time. Shanks had been an assistant at ORAU and came with a baccalaureate in agricultural science. He brought a zealous dedication to his particular assignments and an outstanding sense of responsibility to his role. Over the years he devoted himself to the organization and its development and thereby was given greater and greater responsibilities, culminating in his promotion to Division safety officer.

Tom Grizzard joined the organization in 1963 and remains with the division some 30 years later. Grizzard earned a B.S. in biology, since augmented by an M.S. (1975), and has worked in Walker Branch. More recently he has worked in the Ecotoxicity Group of the Environmental Biotechnology Section.

In 1964 Jay Story, another highly dedicated person, joined the staff. Story became interested in the mammal problems on the reservation, especially the deer, and for years was almost totally dedicated to following the problems associated with them. A year later Fred Taylor was hired. With a degree in botany, Taylor contributed over the years to our knowledge of the reservation flora and its distribution. Carol Allen, who also joined the staff in 1965, served for many years as a dedicated and skilled laboratory technician in various aquatic research projects.

After Ecological Sciences became the Environmental Sciences Division in 1972, more technicians came aboard either through direct hiring or by transfer from HPD. From the latter came Frank Brinkley, Eddie Eastwood, and Milt Sealand-three dedicated, hard working individuals who combined extensive experience and responsibility in every assignment they were given.

In the following decade the support staff was joined by Donald Todd, Linda Mann, Arnold Hunley, David Cox, Monty Ross, Dave Farmer, Mack Stubbs, and Bill Kyker, as well as others who have left or transferred out of the organization. Many, if not most of the early staff have retired so that now there are new generations of technicians present in the Division who are busy augmenting and contributing to the overall effort.

Organizational Contributions and Leadership. As Environmental Sciences grew as a research organization with its manifold contributions to science, it developed a reputation for leadership and innovation in organizational management. Certainly it was successful in attracting funding support; the accompanying chart shows an initial start of $50,000 in FY 1954 to approximately $45,000,000 in FY 1992. These numbers reflect not only success in terms of growth, but responsible dedication to the underlying precept that a national laboratory is the proper place to carry out programs that require the combination of skills and resources that cannot be put together in any other type of research organization in this country-claims to the contrary, notwithstanding.

...ynthia Corley Crowned 'Miss ORNL' for 1963

Frances Carr Wins Runner-Up Honor; Capacity Crowd Attends Annual Dance

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Pretty young Cynthia Corley was crowned "Miss Oak Ridge National Laboratory" for 1963 before a capacity crowd of about 400 people last Saturday night at the annual Girls' Club Queen of Hearts Dance. Runner-up for the title this year was Frances Carr.

L. H. Barker, superintendent of Personnel Division, crowned the queen and served as master of ceremonies. Girls' Club president Bobbie Scandlyn, Biology Division, assisted with the intermission ceremony.

The dance, featuring music by the Nick Raven Quintet, was held at the Oak Terrace. A Valentine theme was carried out in the decorations. Proceeds from the dance will support the Girls' Club scholarship fund.

Queen in Health Physics

Cynthia is a graduate of the University of Georgia with B. S. and M. S. degrees in science education. A member of Health Physics Division, she received several honors in college. She was listed in Who's Who in American Colleges and Universities and is a member of Phi Beta Kappa. Also, Cynthia is a member of Alpha Delta Pi National Sorority, Phi Kappa Phi, Alpha Lambda Delta, Phi Sigma, Kappa Delta Epsilon, which she served as vice president, and the Z Club, a local honorary society of which she was president. An enthusiastic football fan, Cynthia was co-captain of the cheerleaders at the University. She was voted most outstanding pledge of ADPi. Cynthia's hobby is art.

Runner-Up in Personnel

Frances is a member of Personnel Division and is assigned presently to the Central Research Library. She lists as her main interests typing and oratory, fields in which she won awards. Frances also enjoys singing and reading. She received her secondary education at John Hey High School in Cleveland, Ohm. end Tanner High School in Newport. She attended Cooper Institute for two years.

Cynthia received a $25 U. S. Savings Band from the Girls' Club, a silver bowl, and a bouquet of red roses. Frances also received a silver bow,. All the candidates were given silver bracelets from the Girls' Club as mementos of the occasion.

Other Candidates

The other candid=,== in the annual event were Sandra Suzanne Beidel, Technical Information Division; Patricia R. Creech, Engineering and Mechanical Division; Jeanette D. Denny, Technical Information Division; Shirley Kirkwood, Director's Division; Kathrine McGrath, Biology Division; Pat Murphy, Engineering and Mechanical Division; Mary Jo Pryor, Health Division; and Helen M. Scandlyn, Biology Division.

Candidates for the title were nominated by fellow ORNL employees by popular ballot, which appeared in the News. Final votes for "Miss ORNL" were cast at the Queen of Hearts Dance, Febuary 16. Each person purchasing a ticket was entitled to one vote. Provisions were made for final balloting as dance attendants entered the door at the Oak Terrace.

"MISS ORNL—1963", Cynthia Corley, was crowned by Emcee L. H. Barker at the Queen of Hearts Dance last Saturday night at the Oak Terrace. A capacity crowd of approximately 400 people attended the annual Girls' Club-sponsored event.

RADIOISOTOPE SHIPMENTS

ORNL made 1,110 shipments of radioisotopes totaling 9,566 curies during January.

Construction of the Graphite Reactor, then known as the X-10 Pile, began on February 1, 1943, and the first production type of uranium chain reactor in the world went critical at 5 AM, November 4, 1943.

MASTER OF CEREMONIES L. H. Barker, center, superintendent of Personnel Division, presented "Miss ORNL—1963," Cynthia Corley, left, and the runner-up for the title, Frances Carr, right, to the audience. Cynthia is a member of Health Physics Division, and Frances is a Personnel Division staff member.

least, spare you from some of the most anxious moments a parent can endure

TEN YOUNG LADIES decorated the stage at the Girls' Club Queen of Hearts Dance last Saturday night. The candidates for the title of "Miss ORNL—1963" were, left to right, Pat Murphy, Engineering and Mechanical Division; Shirley Kirkwood, Director's Division; Sandra Suzanne Beidel, Technical Information Division; Kathrine McGrath, Biology Division; Cynthia Corley, Health Physics Division, the new "Miss ORNL"; Frances Carr, Personnel Division, runner-up for the title; Helen M. Scandlyn, Biology Division; Mary Jo Pryor, Health Division; Jeanette D. Denny, Technical Information Division; and Patricia R. Creech, Engineering and Mechanical Division.

Lovell Lawrence Crowned 'Miss ORNL'–1964

SMILING PRETTILY, Lovell Lawrence bows her head for master of ceremonies S. I. Auerbach, Health Physics Division, to crown her "Miss ORNL" for 1964. Lovell, also Health Physics Division, accepted the honor before a capacity crowd of about 400 people.

Rose McBath Wins Runner-Up Honor; Capacity Crowd Affends Annual Dance

Pretty. vivacious Lovell Lawrence is the 1964 "Miss Oak Ridge National Laboratory." The new Queen of Hearts and the runner-up for the title. Rose Joyce McBath, were presented to a capacity crowd of about 400 people last Saturday night at the annual Girls' Club Queen of Hearts Dance.

S. I. Auerbach. Health Physics Division. crowned the queen and served as master of ceremonies. Last year's "Miss ORNL," Cynthia Corley Diamond. formerly of Health Physics Division. assisted with the intermission ceremony.

The dance. featuring music by the Martiniques, was held at the Oak Terrace Ballroom. decorated to carry out a Valentine theme. Proceeds from the fourteenth annual dance. as in the past, go toward financing the Girls' Club Scholarship Fund. Each year the Girls' Club presents two $350 scholarships to two high school graduates.

The 1964 "Miss ORNL" is a member of Health Physics Division. Lovell. the daughter of Mrs. Ophelia Lawrence of Memphis. is a graduate of Whitehaven High School and received her B.S. in chemistry from Memphis State University. While at MSU, she was a memebr of the Chemistry Club. Biology Club, and Dramatics Group. Auburn-haired Lovell enjoys tennis. water sports, painting, cooking, and reading. She is vice president of the Girls' Club. Lovell, who is five feet, four inches tall. weighs 110 pounds, and has brown eyes, lives at 129 Villanova Road. Oak Ridge.

Runner-Up

The winner of the runner-up title also is a member of Health Physics Division, and winning contests is not a new experience for Rose. She was crowned "Miss Austin High" in 1958. her senior year at the high school from which she received her diploma. Rose received a B.S. degree in chemistry from Fisk University in 1962 and was awarded a graduate school assistantship for study at Wayne State University. During her undergraduate career, she was the recipient of two freshman scholarships and was an exchange student to Pomona College in Claremont. California. Rose also was the recipient of an Experiment in International Living scholarship which permitted her to travel to Europe in the summer of 1962. She was a member of Alpha Kappa Alpha sorority and Mortar Board at Fisk. Rose. who is five feet. five inches tell. weighs 115 pounds. and has brown eyes, lives with her mother. Mrs. James Porter. at 1932 Granville Terrace. Knoxville. Her interests lie in modern dancmg. ballet. swimming, traveling, and working with young people.

Mementos of Contest

As the new "Miss ORNL," Lovel11 received from the Girls Club a $25 U. S. Savings Bond. a silver bowl. and a bouquet of red roses. Rose received a silver bowl. and all the can&dates were given silver bracelets as mementos of the occasion.

The other candidates for the title of "Miss ORNL" of 1964 were Harriet Cabage, Technical Information Division; Carole Bratten Cox, Operations Division; Kay Hawkins Dutton, Plant and Equipment Division; Charlotte Carmen Greene, Mathematics Division; Pat Cook Keeble. Plant and Equipment Division: Mary Elizabeth McCoy, Analytical Chemistry Division; Phyllis Lee Roberts, Plant and Equipment Division; and Bobbie Joyce Scandlyn, Biology Division.

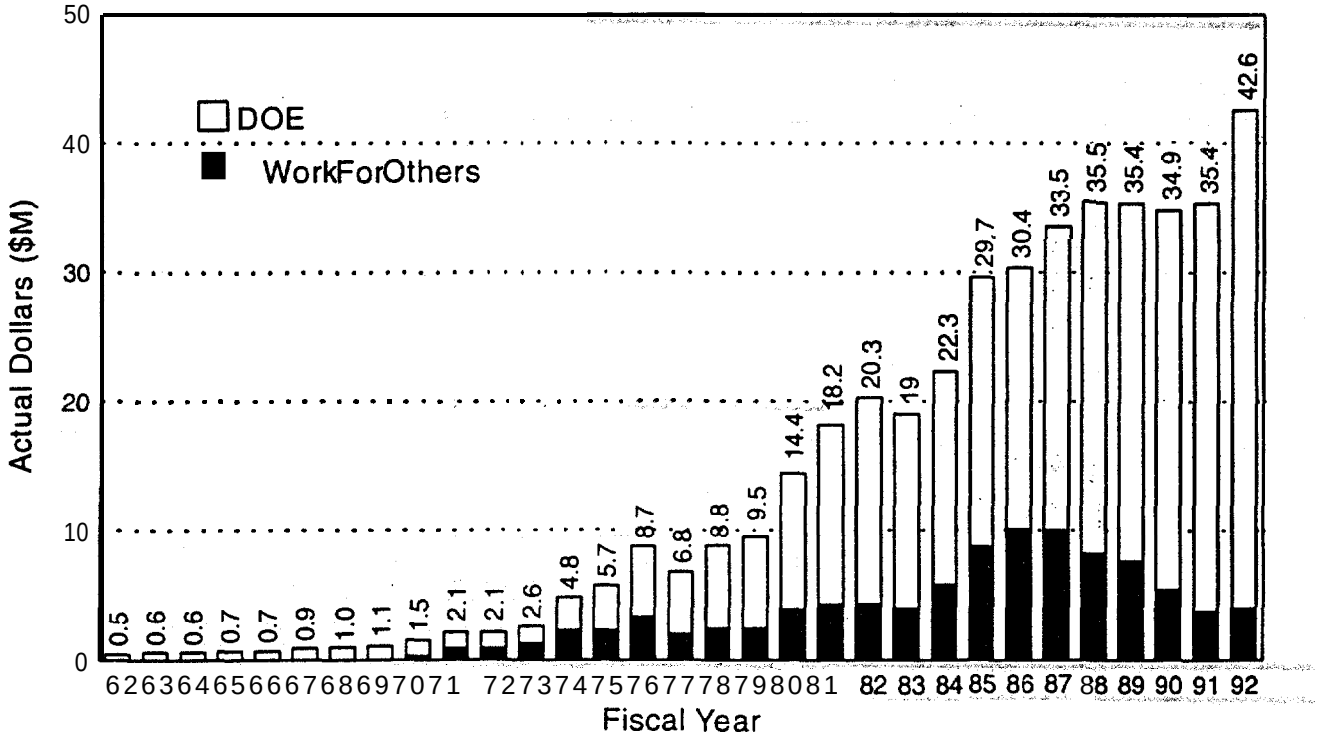
The candidates for the title were nominated by fellow Laboratory staff members by popular ballot, which appeared in the News. Final votes for "Miss ORNL" were cast at the Queen of Hearts Dance.

DECORATING THE STAGE during the intermission ceremonies of the annual Girls' Club Queen of Hearts Dance were, left to right, Cynthia Corley Diamond, "Miss ORNL" of 1963, formerly of Health Physics; and 1964 candidates Pat Keeble, Plant and Equipment; Mary Elizabeth McCoy, Analytical Chemistry; Charlotte Greene, Mathematics; Harriet Cabage, Technical Information; Rose McBath, Health Physics, who was named runner-up for the title; Bobbie Scandlyn, Biology; Lovell Lawrence, Health Physics, who was crowned "Miss ORNL" of 1964; Phyllis Roberts, Plant and Equipment; Kay Dutton, Plant and Equipment; and Carole Cox, Operations. Girls Club president Sylvia Ewing, back to camera, Isotopes, assisted with the intermission ceremonies and gave each candidate a silver bracelet as a memento of the occasion.

A SILVER CUP is presented by the master of ceremonies to Rose McBath, Health Physics Division, as the runner-up for the title of "Miss ORNL." The queen-crowning ceremonies were held at intermission during the annual Queen of Hearts Dance, held last Saturday night at the Oak Terrace Ballroom.

ORNL-DWG 92H-11312

ESD's Budget Continues To Increase With Growth In DOE And WFO Sponsored Activities



. From 1962 the budget has grown from -500K to -42M - 30 years.
** Projected financial plan

One major challenge that had to be addressed early on was field transportation. The first vehicle assigned to ecology was a battered surplus army jeep. Subsequently, this was augmented by a surplus army power wagon. It soon became evident that vehicles were going to be a critical problem because the Laboratory fleet was composed of a fixed assignment of vehicles and increasing that number involved a complex chain of interactions that were almost impossible to resolve. After numerous discussions and examination of the purchasing regulations, it was discovered that certain types of vehicles could be purchased directly by programs if they fit into the category of "special purpose" and if the capital funds were available. Four-wheel drive vehicles met this requirement, and, since ecology field work required off-the-road transport, it was soon possible to start purchasing these vehicles and creating sufficient transportation to meet the needs of the organization. Eventually, the fleet grew to be the largest of any of the research divisions. In the summer, with its influx of temporary visitors, additional vehicles were obtained by persuading Central Management to retain for those months a number of vehicles scheduled-. for replacement. Many of these were "dunkers" and often provided challenges in operation in the field areas and in getting individuals back to their laboratories at day's end.

A related matter was the problem posed by technicians working alone in remote areas of the reservation. While not a serious problem, in the fifties and early sixties many of the staff were carrying out studies and doing field operations miles

away from any means of communication. Should there be a vehicle breakdown, or an accident, or some kind of injury, such as being bitten by a poisonous snake, individuals could be placed in serious hazard. Consequently, with the first approvals for purchase of a new field vehicle fleet, Auerbach obtained approval to equip the vehicles with two-way radio sets that were tied into the security guard net. Included in this approval was the acquisition of base station sets that were shortly established in Building 2001. By the mid-1970s, ESD had the equivalent of its own motor pool with a variety of special-purpose trucks, including an aerial ladder and a snorkel, trucks equipped with fire-fighting gear and pumps, and an array of boats amounting to a small navy. Also for a period of time, the Division leased an airplane for aerial patrol of the reservation; it was flown by Jay Story, who was a licensed pilot.

In the mid-1960s, with the establishment of the IBP project in the radiation ecology section, two actions that were totally innovative to the Laboratory were begun. The first was large-scale subcontracting of research funding. While there was a history of large subcontracting for fabrication or special purchases, ORNL had not been funded to be a major research subcontractor. IBP, which was funded by NSF, called for subcontracting and managing research at a number of universities and colleges. Subcontracts ranging from $300,000 to $500,000 per year were initiated in the 1969-74 period. This was a totally new approach and required new arrangements with the purchasing departments, who had to arrange for and oversee these contracts.

The second innovation, another by-product of the IBP program, was the development of a centralized editorial and manuscript-processing facility. Magnetic tape typewriters had made their appearance in the early 1970s and seemed ideally suited for a centralized approach to report preparation and processing. A room was set aside in Building 2001, and a unit was organized under the leadership of Bob Burgess. The first person in charge was Natalie Tarr, who had been a secretary in Health Physics. Among the first staff was Linda Littleton, who subsequently took over management of the unit when Tarr became an editor. When the unit was moved into the new building, it acquired, under the direction of Tarr and Burgess, the first linked computer word processing system in all of the Oak Ridge facilities; for a time this system was a prototype for Union Carbide's private sector operations. Based on Wang computers, this unit was a key component of Division operations for a number of years. With the advent of wide-scale use of personal computers, the center took on a more diverse role in handling manuscripts. The responsibility for leadership of this shifted to Donna Rhew, while Littleton joined the ESD computing facility as a coordinator for personal computer assignments and usage.

Although ESD was primarily a biological science organization until the last decade or so, its long-time interest in mathematical modeling of ecosystems and related phenomena resulted early on in an orientation toward the use of computers. Jerry Olson's early work led to pioneering ecological model testing on the Laboratory's first large Analog Computer Facility. George Van Dyne, Olson, Shugart, O'Neill, Luxmoore, Huff, and many others utilized the ORACLE and its IBM successors for modeling, studies and development. With this orientation, it was not surprising that the Division would be among the first to acquire a remote computer linkage to the main center for batch station operations. This unit was acquired in 1975 and installed in a new facility built at the east end of Building 2001.

An advanced computer facility had been envisaged for the new building since the first conceptual designs in 1962. Therefore, it was a foregone conclusion that the new building would have its own computer and batch station facility-one that has been continuously upgraded to provide the staff with all the advancements that can be utilized effectively. The Division's geoscience interests and its early investment in hydrology research have now positioned it as a key player in the new Laboratory Center for Computational Science, where groundwater system modeling is one of the major areas of research in high-speed computational approaches.

Last, but certainly not least, mention must be made of the organizations and key individuals who contributed to the maintenance of the facilities, who

helped translate the ideas and plans of the investigators and leaders into operational facilities, devices, or equipment. Within HPD, such support was provided by an innovative and aggressive person assigned as an "expediter." Barney Hensley was an unusual, self-taught man, who knew all the ins and outs of the Laboratory. His analogue was the classical supply sergeant in the Army, who could acquire almost anything regardless of location or circumstances. Hensley was highly useful during the early days. His only serious mistake was not checking the design and construction of the first ship in the ecology navy, the ship that suffered the ill-fated launching ceremony. Another person who joined the Division in the 1960s as a technician was the late Lee Tucker, who transferred from the Security Division. Lee, an important contributor to the work in the small mammal research effort, was also an accomplished requisitioner.

The basic support organization for the research divisions is the Plant & Equipment Division. This unit provides craft support, fabrication of items, and building maintenance. Before ESD became a division, this support was provided to the radiation ecology section by Charles Abner, a field engineer assigned to HPD, and his recently augmented staff, consisting of Steve Bridges and Gary Alley. Abner was subsequently assigned to the new ESD and played a key role in checking out and planning for the new building. He has been the division engineer since and is totally dedicated to maintaining the building as an outstanding research facility, a challenge that he and his recently augmented staff have met well.

9. EPILOGUE

The end of the eighties brought significant changes to the Laboratory, beginning in early 1988 with the appointment of Laboratory Director Herman Postma as Senior Vice President of Martin Marietta Energy Systems, Inc. Postma had served as director for over 14 years, a period of major transition in the Agency (ERDA/DOE) that had a profound impact on the national laboratory system and a period of local management changes that had a similar impact on ORNL. For the next 11 months Alexander Zucker served as acting director, while a special search committee sought and evaluated prospective candidates for the position. The result of their search was the recommendation of Alvin Trivelpiece, who was serving as the executive secretary of the American Association for the Advancement of Science and had served as director of energy research for DOE for a number of years before that. Trivelpiece accepted the offer and became the next director of Oak Ridge National Laboratory in January 1989.

One of the director's first actions was to appoint Dave Reichle as associate director for Biomedical and Environmental Sciences, which was renamed Environmental, Life, and Social Sciences and which eventually included the Energy Division. At the end of February 1990 Bob Van Hook became the director of ESD and in 1992 Steve Hildebrand was appointed associate director-the fifth in the Division's history. These changes were timely because the start of the new decade coincided with the long-anticipated eruption of public concern over all matters that dealt with environmental pollution and damage. A significant part of this concern was directed at the DOE sites with their long history of environmental contamination. At the same time there was a pronounced demand for greater control over all operations that might impact both worker health and safety, including operations that could result in off-site releases of hazardous materials.

There was also a sad note as the nineties began. Ernie Bondietti, one of the Division's most brilliant scientists, died of injuries received in an auto accident while returning from a National Acid Precipitation Assessment Program meeting at Hilton Head, South Carolina. Bondietti was universally recognized for his original research on the environmental chemistry of transuranics and other radionuclides. At the time of his death he was completing widely heralded research on the impacts of acid rain on forests as mediated through changes in the ratios of aluminum to calcium in the annual rings of trees. As a memorial, ESD established a special reference collection in the Division library dealing with biogeochemical cycling of radioactivity and trace contaminants-the fields where Ernie made signal contributions. The collection is accompanied by a permanently 'mounted plaque and a bound volume of all his publications.

Environmental health and safety became high-priority national goals in the beginning of this decade. Major efforts to clean up or otherwise remediate the environmental contamination resulting from decades of facility operations on the ORR began with an unprecedented increase in funds and personnel. At the same time the private sector was also encouraged to participate, so that scores of environmental personnel were soon drilling wells, sampling streams, measuring releases, and collecting biota as part of a vast effort to comply with an ever-increasing number of regulations and to lay the groundwork for a gigantic remediation activity.

ESD is supplying both knowledge and personnel to this effort. A whole suite of new programs is under way in geosciences as well as in aquatic sciences, and a major new effort in biotechnology is meeting the challenge of pollution by researching new techniques and applications. Under Trivelpiece's leadership, the Laboratory is once again on the way to becoming a major center in computational science. A new supercomputer using parallel processing will be the keystone of this center. One of the problems to be addressed through this center will be multidimensional groundwater modeling, an area for which the hydrologists in ESD have the lead responsibility.

Environmental risk and ecological risk analysis—two areas that ESD pioneered during the Synthetic Fuel Programs of the late seventies and early eighties-have been elevated to a new threshold of opportunity with the organization of a

Laboratory Center for Risk Management. And the ORNL Center for Global Environmental Studies has been converted into a Laboratory Program with Mike Farrell as director.

All of the intense environmental action and activity within DOE, with emphasis on environmental compliance, worker safety, and remediation of historic waste sites, has not been without costs, both direct and indirect. Overhead has been increased, research funds have been impacted, and the staff of ESD has been challenged in many ways. But the world has finally become aware of environmental degradation and the threat that it poses to the planet. There will be no turning back from environmental studies and future actions. What this augurs for ESD in the rest of the decade is unprecedented opportunity to innovate, contribute, and participate in the greatest peacetime challenge to ever face mankind.

APPENDIX

Appendix

OAK RIDGE NATIONAL LABORATORY DIRECTORS

1943-45	Martin D. Whitaker, Dir (Clinton Laboratories)
194346	Richard L Doan, Associate Director for Research (Clinton Laboratories)
194647	James H. Lum. Executive Director (Clinton Laboratories)
1946-47	Eugene P. Wigner. Research and Development Director (Clinton Laboratories)
1948-50	C. Nelson Rucker. Acting Director and Executive Director, Oak Ridge National Laboratory
1950-55	Clarence E Larson. Director, ORNL
1948-55	Alvin M. Weinberg, Research Director, ORNL
1955-73	Alvin M. Weinberg, Director. ORNL
1973-74	Floyd L Culler. Acting Director, ORNL
1974-1/31/88	Herman Postma, Director, ORNL
2/1/88-1/1/89	Alexander Zucker. Acting Diitor, ORNL
1/1/89-pr.	Alvin W. Trivelpiece, Director, ORNL

History of Oak Ridge National Laboratory (by name and contractor):

Name	Date	Operated by
Clinton Laboratories	Jan. 1974 June 34 1945	E.I. DuPont de Nemours for The univ. of Chicago
Clinton Laboratory	July 1945-Dec. 1946	Monsanto Chemical Co.
Clinton Laboratory	Jan. 1, 1947-Feb. 28, 1948	Atomic Energy Comm.
Oak Ridge National Laboratory	March 4, 1948	Carbide & Carbon Chemical Div, Union Carbide Corp.
" " " "	1950	Carbide & Carbon Chemical Division of UCC
" " " "	1956	Union Carbide Nuclear Co.. Diiion of UCC
" " " "	1964-1974	Union Carbide Corporation, Nuclear Division
Holifield National Laboratory	1975	Union Carbide Corporation, Nuclear Division
Oak Ridge National Laboratory	1976-March 30, 1984	
Oak Ridge National Laboratory	April 1, 1984-present	Martin Marietta Energy Energy Systems, Inc.

Revised 7-19-89
db

AR - 525

Oak Ridge National Laboratory
Oak Ridge, Tennessee

OFFICIAL BULLETIN

March 13, 1970

ORGANIZATIONAL CHANGE

I am pleased to announce the establishment of the Ecological Sciences Division and the appointment of Stanley I. Auerbach as its Director, effective immediately. Members of the ORNL staff who are currently assigned to the Radiation Ecology Section of the Health Physics Division will be transferred to this new Division which will report to James L. Liverman.

Alvin M. Weinberg
Director

Distribution:
Res & Supv Staff

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

March 1, 1972

TO: F. L. Culler

Attached is a recent report of the National Science Board entitled "Environmental Science — Challenge for the Seventies". The thinking in this report has been very parallel to mine and has been the basis for my arguments for the need for establishing an Environmental Sciences Division whose components encompass more than the ecologists that are currently within the Division. The report brings out rather clearly that the area of environmental science is a totally new one and one in which the country lacks experience in organization and wherein the problems that it is to address are themselves somewhat poorly defined but highly challenging.

I think that we at ORNL have a tremendous opportunity to develop a lead in this area simply because, as the report points out, the universities are not suitable because of their fundamental educational responsibilities and disciplinary orientation. Likewise there are very few other major laboratories and institutions that have made a major organizational move in this direction. Most that have do not have as yet the core strength that we have already established by way of the Ecological Sciences Division.

My arguments therefore concerning the need for our getting into developing a stronger earth sciences and physical sciences components coupled to some applied environmental problems, such as waste management research, are predicated on this broader need to have an Environmental Sciences Division that isn't locked into research which has no direct application.

S. I. Auerbach

SIA/mr

Attachment

cc: J. L. Liverman

Appendix

Oak Ridge National Laboratory

Oak Ridge, Tennessee AR - 553

OFFICIAL BULLETIN

May 15, 1972

ORGANIZATIONAL CHANGES

I am pleased to announce the following organizational changes, effective immediately:

The name of the Ecological Sciences Division is changed to the Environmental Sciences Division.

E. G. Struxness is appointed Assistant Director of the Environmental Sciences Division.

The Waste Disposal Research and Engineering Section of the Health Physics Division will be reassigned as follows:

W. C. McClain, T. F. Lomenick, W. DeLaguna, F. M. Empson, T. W. Hodge, and H. J. Wyrick will join the Chemical Technology Division.

Tsuneo Tamura, P. S. Rohwer, W. J. Boegly, Jr., F. S. Brinkley, E. R. Eastwood, O. M. Sealand, Joe Marie Davis, and Mary Stooksbury will join the Environmental Sciences Division.

Building 3504, Waste Disposal Research and Engineering, is assigned to the Environmental Sciences Division.

Alvin M. Weinberg
Director

Distribution:
Res & Supv Staff

Oak Ridge National Laboratory
Oak Ridge, Tennessee

OFFICIAL BULLETIN

April 3, 1986

ORGANIZATIONAL ANNOUNCEMENT

Effective May 12, David E. Reichle will assume the position of Director of the Environmental Sciences Division. Stanley I. Auerbach, who has so effectively led the Division to its position of international stature since its inception 15 years ago, will assume other important responsibilities for the Environmental Sciences Division and the Laboratory.

Reichle has served as Associate Director of the Environmental Sciences Division for the past nine years. He comes to this position after a distinguished career in' ecology during which he established ecosystem research using systems analysis techniques for studying forest productivity and the metabolism of energy residuals, including early research on food chain uptake and accumulation of radionuclides released from nuclear fuel cycle facilities.

As the pioneer ecologist in the Laboratory and the founder of the Environmental Sciences Division, Auerbach built a radioecology program into what is now a national and international resource for interdisciplinary research on environmental and ecological research. As Director, he employed much of his management skills to the development of new leadership, an area in which he has been outstandingly successful. Additionally, he pursued successfully the creation of a totally new research facility for the Laboratory that will serve as the focal point for the future consolidation of life sciences facilities in the X-10 area. We wish him well in his new role.

Chester R. Richmond

Distribution:
Res & Supv Staff

Appendix

Oak Ridge National Laboratory
Oak Ridge, Tennessee

OFFICIAL BULLETIN

AR-795

February 28, 1990

ORGANIZATIONAL ANNOUNCEMENT

I am pleased to announce the appointment of Robert I. Van Hook, Jr., as Director of the Environmental Sciences Division, effective March 1, 1990. Bob has been serving as Acting Director of the division since my appointment as Associate Director. He received his Ph.D. from Clemson University in 1970 when he joined the Environmental Sciences Division as a research ecologist. Bob has successively served as Manager of the Biomass Program in the ORNL Conservation and Renewables Program, as Manager of the Terrestrial Ecology Section, and, most recently, as Associate Director of the Environmental Sciences Division and Director of the ORNL Center for Global Environmental Studies. I look forward to the continued success of Bob and the Environmental Sciences Division.

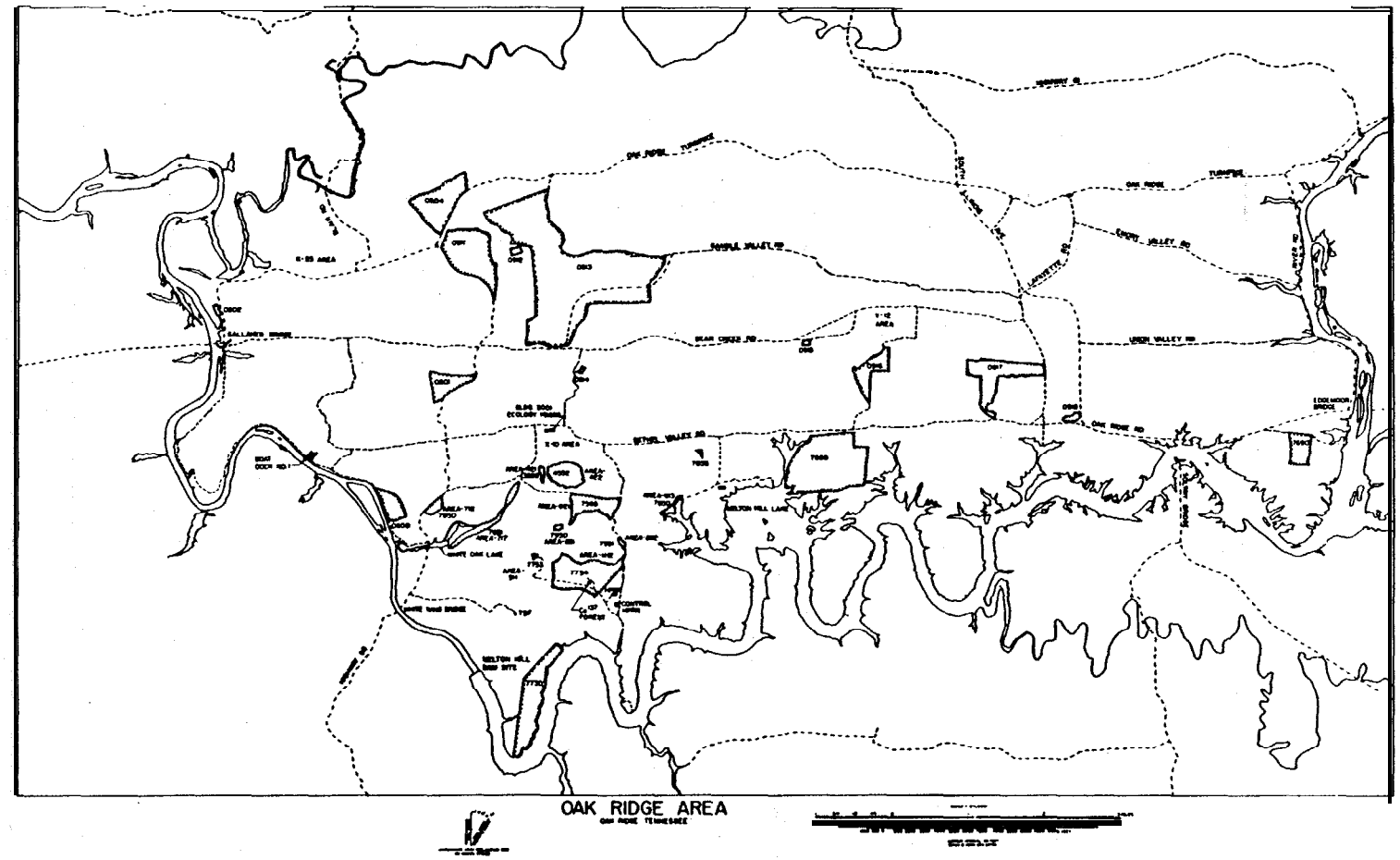
I am also pleased to announce, effective March 1, 1990, the appointments of Michael P. Farrell as Acting Director and Steve Rayner as Deputy Director of the ORNL Center for Global Environmental Studies. Mike received his Ph.D. in zoology and ecology from Mississippi State University in 1977. He joined the staff of the Environmental Sciences Division in 1979 and formerly served as Director of the Carbon Dioxide Information Analysis Center and currently serves as Director of the Carbon Dioxide Information Analysis and Research Program in the Environmental Sciences Division. Steve received his Ph.D. in anthropology from University College London in 1979 and joined the Energy Division in 1983 where he has conducted research on the interactions of science, technology, and public policy. He currently serves as Coordinator for Policy, Energy, and Human Systems Analysis in the ORNL Center for Global Environmental Studies. Both Mike and Steve will continue their leadership roles within their respective divisions while contributing to the growth and development of the ORNL Center for Global Environmental Studies. Mike's first responsibility will be to initiate a search for a new director for the Center, someone with an international scientific reputation who can expand upon the Laboratory's expertise in global environmental research.

David E. Reichle

Distribution:
Res & Supv Staff

(approx. 1966)

ECOLOGY STUDY AREAS



Appendix

ORNL-4446
Excerpt

RADIATION ECOLOGY SECTION

PROGRESS

IN

TERRESTRIAL AND FRESHWATER ECOLOGY

S. I. Auerbach

B. C. Blaylock
J. W. Curlin
R. C. Dahlman
P. B. Dunaway
J. W. Elwood
S. V. Kaye
D. J. Nelson
J. S. Olson
R. V. O'Neill
D. E. Reichle
A. F. Shinn
W. A. Thomas
J. P. Witherspoon
Martin Witkamp

Reprinted from

HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT

For Period Ending July 31, 1969, ORNL-4446

JANUARY 1970

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
opera ted by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION

ECOLOGICAL SCIENCES DIVISION

S. I. Auerbach, Director
D. J. Nelson, Asst. Dir.
Mary Rhea
Joanne Sanford
Norma Fraker

Engineering & Maintenance
C. H. Abner[1]
J. L. Malone[1]

Purchasing Records
Joanne Sanford

Publications
Norma Fraker

Reports
Wanda England

Administrative Assistant
J. H. Gann, Jr.
Sharon Fuller

International Biological Program Biome Director's Office
S. I. Auerbach*
R. L. Burgess
F. G. Goff*
R. V. O'Neill*
J. B. Mankin[2]
Virginia Glass

Forest Management
J. W. Curlin*
W. G. Strock
E. H. Rosenbalm
H. F. Raby[1]

Education and University Relations
S. I. Auerbach*
D. J. Nelson*
J. S. Olson*
D. E. Reichle*
J. P. Witherspoon*
M. Witkamp*

Long Range Planning
J. S. Olson, Sen. Res. Adv.*

Environmental Studies and Analyses

Radiological Hazards Analysis
D. J. Nelson*
S. V. Kaye*
R. C. Dahlman*
Y. Tanaka[3]
J. W. Elwood*

Radiation Effects on Animals and Plants
P. B. Dunaway*
B. G. Blaylock*
Gladys Dodson*
D. DiGregorio*
J. D. Story*
L. E. Tucker*
Carol Allen*
R. I. Van Hook*
G. U. Ulrikson*
J. P. Witherspoon*
R. C. Dahlman*
F. G. Taylor, Jr.*
Linda Mann*
M. Stubbs[1]

Civil Defense Postattack Ecology
S. I. Auerbach*
P. B. Dunaway*
R. C. Dahlman*
Linda Mann*
R. I. Van Hook*
J. P. Witherspoon*
F. G. Taylor, Jr.*
Y. Tanaka[3]
L. E. Tucker*
M. Stubbs[1]
L. N. Peters*
J. D. Story*
D. DiGregorio*
Gladys Dodson*

Radionuclides in Aquatic Systems
D. J. Nelson*
B. G. Blaylock*
J. W. Elwood*
N. A. Griffith
J. W. Gooch*
Sue Rucker*
Carol Allen*

Thermal Enrichment Studies
C. C. Coutant
G. U. Ulrikson*
P. D. Neumann
J. W. Gooch*
D. J. Nelson*

Ecosystems Analysis

Radionuclide Cycling in Terrestrial Ecosystems
D. E. Reichle*
R. C. Dahlman*
Marilyn Frank
C. W. Francis[4]
J. F. McBrayer[5]
J. P. Witherspoon*
M. Witkamp*
J. B. Mathies[5]
M. H. Shanks
R. I. Van Hook*
J. S. Olson*
A. R. Till[3]

Land-Water Interaction
J. W. Curlin*
W. P. Bonner[4]
J. W. Elwood*
T. Grizzard
T. Tamura[4]
J. L. Thompson
L. N. Peters*
Regina Anderson*
Sue Rucker*
J. M. Kelly[5]
W. J. Selvidge
A. Hundley[1]
Marion Ferguson[6]

International Biological Program Oak Ridge Site
D. E. Reichle*
Carolyn Henley
R. A. Goldstein*
W. F. Harris
N. T. Edwards
Joan Hett
F. G. Taylor, Jr.*
P. Sollins[5]
Regina Anderson*
A. Stephens[5]
Gladys Dodson*
B. A. Hutchison[7]
T. Cox[5]
G. S. Henderson
R. I. Van Hook*
B. L. Madsen[3]
B. E. Dinger
Mary Hoglund[8]
M. G. Nielsen[3]

Information, Communication and Systems Analysis

Ecology Information Centers
G. U. Ulrikson*
Nancy Sollins[8]
Carol Oen

Systems Ecology
S. V. Kaye*
R. Goldstein*
J. S. Olson*
R. V. O'Neill*
P. Sollins[5]
J. B. Mankin[2]
F. G. Goff*
J. Beauchamp[9]

Consultants
J. T. Tanner[10]
G. M. Van Dyne[11]
C. E. Styron[12]
E. C. Clebsch[10]

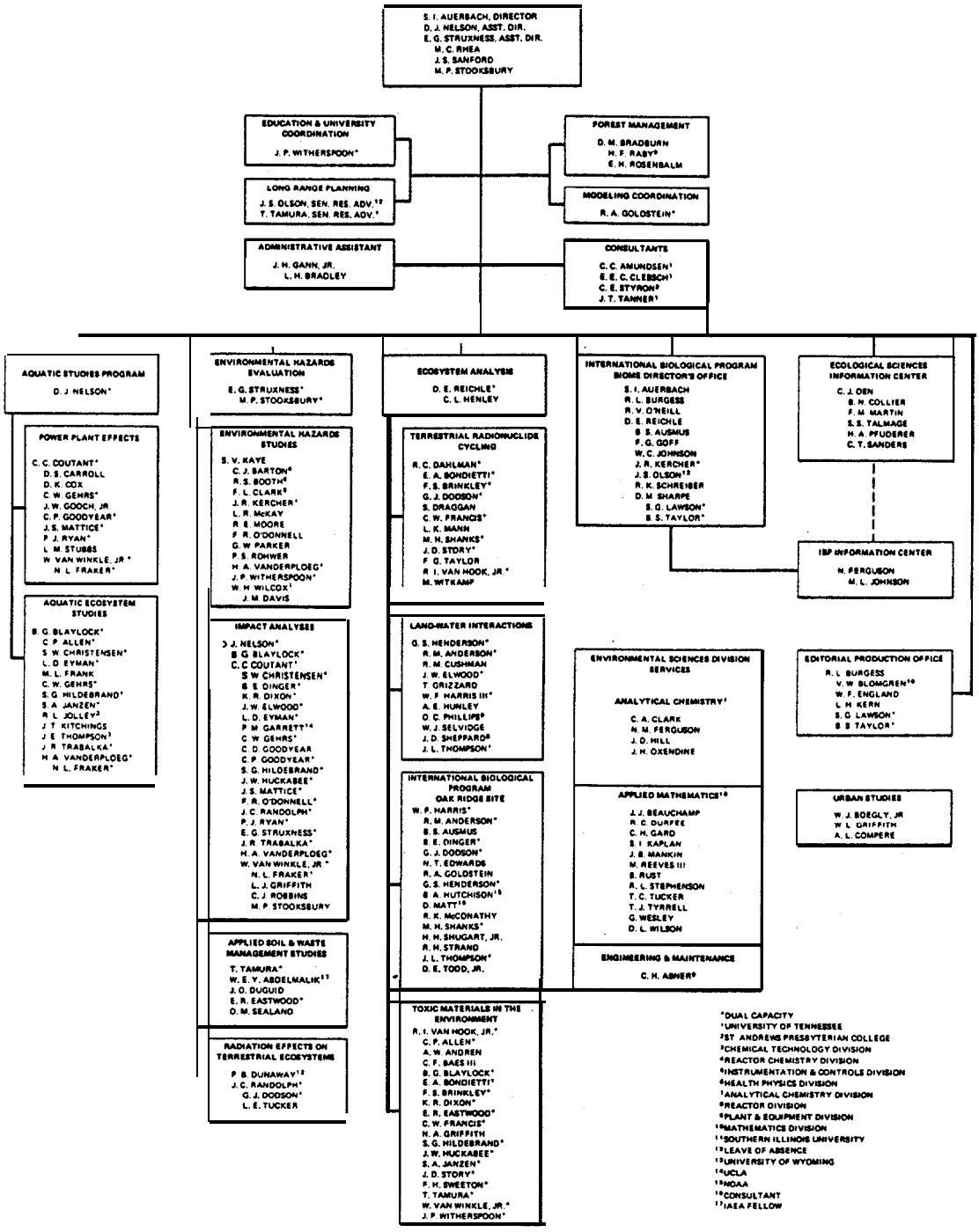
*Dual capacity
[1]Plant and Equipment Division
[2]Computing Technology Center
[3]Alien Guest
[4]Health Physics Division
[5]Graduate Student
[6]Analytical Chemistry Division
[7]Atmospheric Turbulence and Diffusion Laboratory, NOAA
[8]Consultant
[9]Mathematics Division
[10]University of Tennessee
[11]Colorado State University
[12]St. Andrews Presbyterian College

(Year: 1971)

Appendix

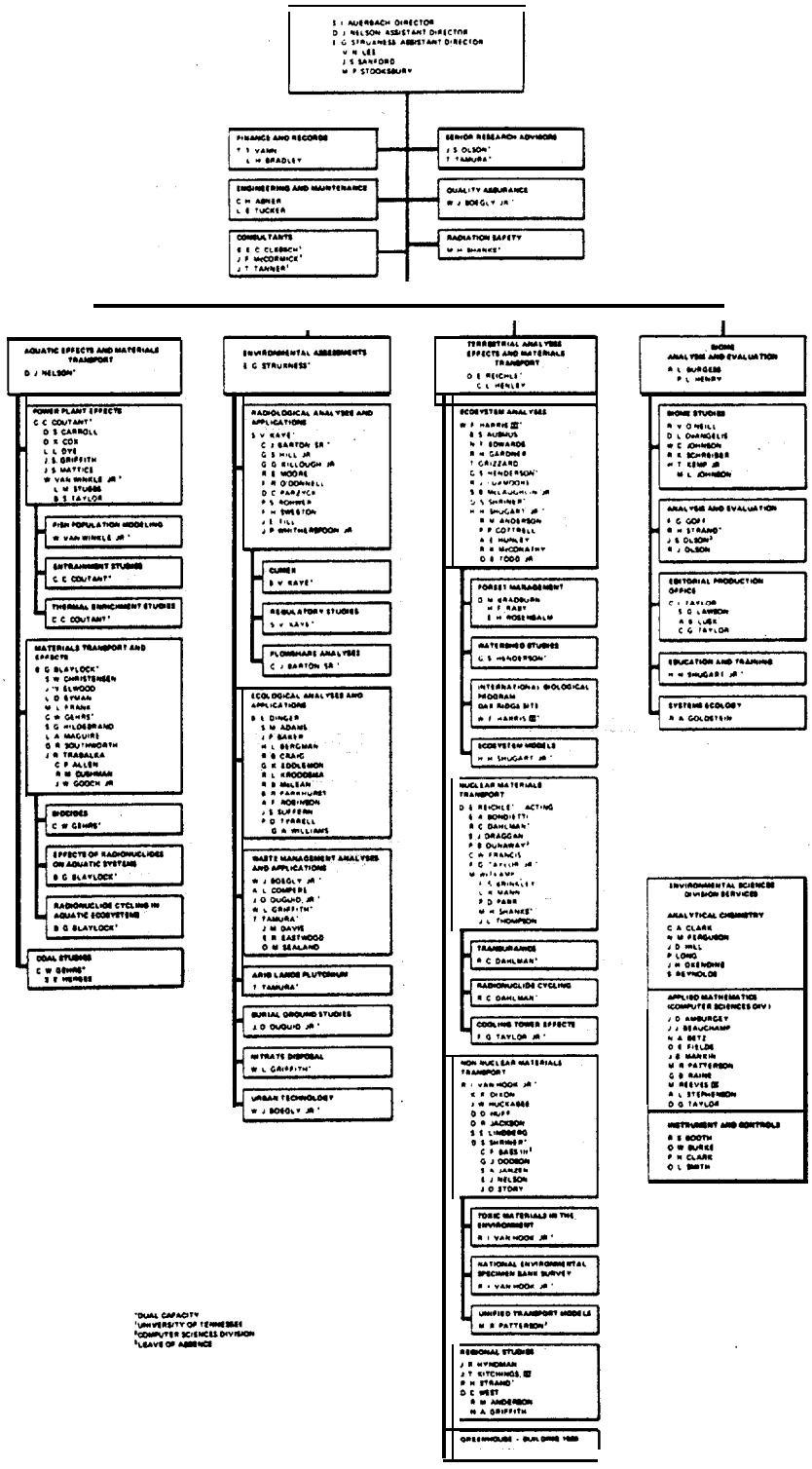
ENVIRONMENTAL SCIENCES DIVISION

October 1973



ENVIRONMENTAL SCIENCES DIVISION

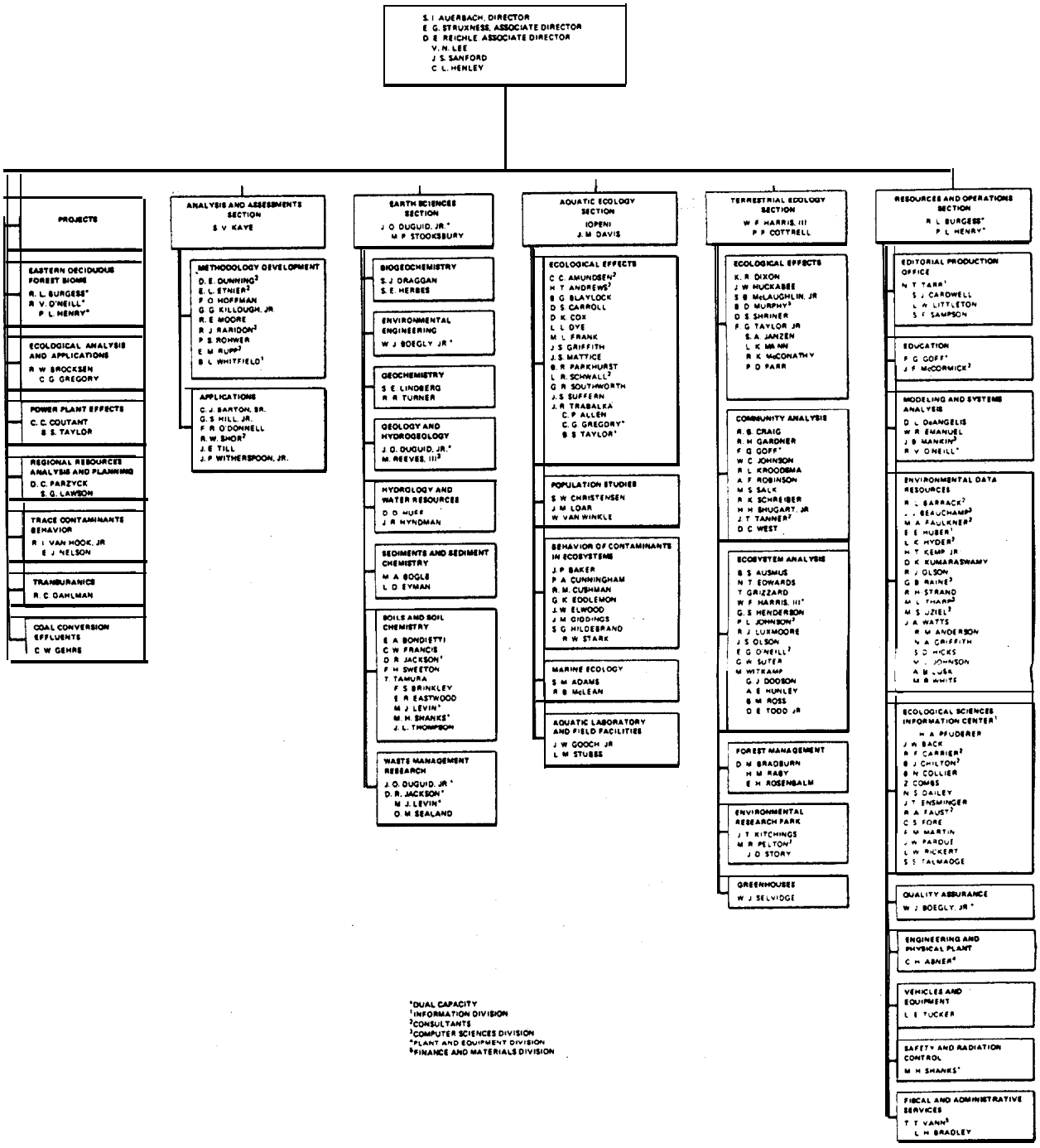
January 1975



A-I 3

ENVIRONMENTAL SCIENCES DIVISION

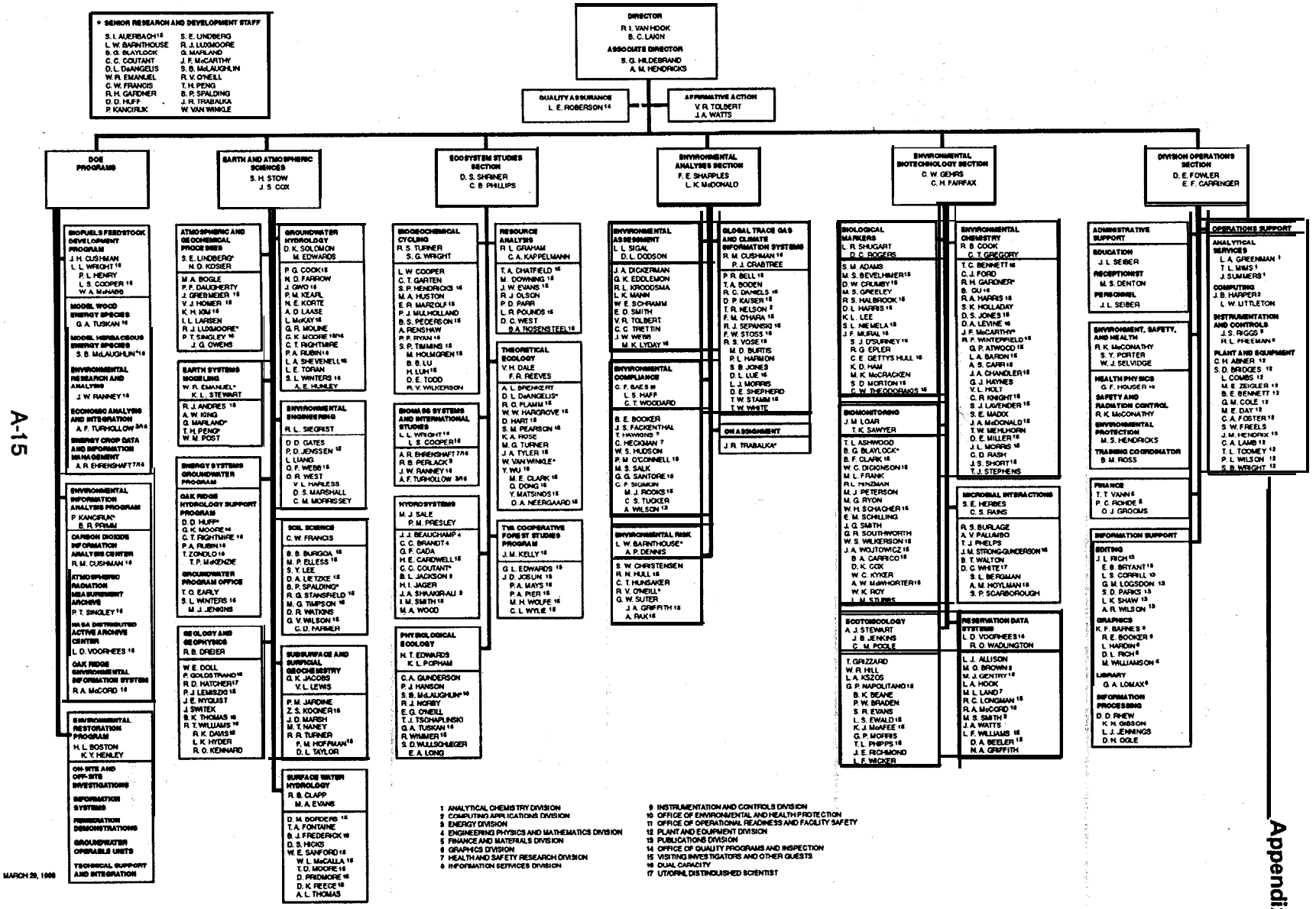
March 1976



*DUAL CAPACITY
[1]INFORMATION DIVISION
[2]CONSULTANTS
[3]COMPUTER SCIENCES DIVISION
[4]PLANT AND EQUIPMENT DIVISION
[5]FINANCE AND MATERIALS DIVISION

ENVIRONMENTAL SCIENCES DIVISION

MARCH 1993



MARCH 29, 1993

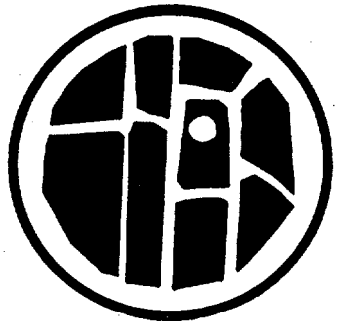
Mural lends distinction to ESL

For ORNL employees who rarely get a chance to visit the west end of the site, it's worth the time to make a special trip to the nearly completed Environmental Sciences Laboratory (ESL). On the southeast comer of the building, mounted over a 14-foot circle of light-colored brick, is a striking 12-foot circular mural that lends character to an otherwise expressionless facade.

Soon a plaque will be set on aconcrete pedestal near the sidewalk that passes in front of the mural. The plaque will bear the inscription

> The tree is our *life* and our *life* is *the tree. It* is *from this concept that my work has grown for this outdoor mural. The flat mosaics delineate my abstract visual ideas* concerning *the environment. Sketches jrom nature, the color balance in various earth tones,* and *"the sun" are* utilized to *convey* a certain *spirituality about growing things. The most powerful aspect of the mural* is *the "negative spaces" between the nine* mosaic panels *by* means *oj which I have created the essence oj my idea: Trees jor Life.*

Those are the words of the artist Charles Counts, which explain the content and meaning of the mural. Counts, who owns and operates the Rising Fawn (Georgia) Pottery Workshop, graduated from Oak Ridge High School and is a nationally and internationally recognized potterer and art teacher. He was selected to create the mural because of his success with a similar project for Oak Ridge Associated Universities and his long-standing acquaintance with Ed Struxness of the Environmental Sciences Division, who headed an ESD committee to study concepts for the design and construction of a logo carrying out an environmental theme.



The Environmental Science Laboratory's newly installed mural, shown here in silhouette, features nine mosaic panels, each composed of individually made pottery-clay tesserae cut to delineate abstract visual ideas concerning the environment.

Under General Services Administration guidelines, ½ of 1% of the costs for a federally funded building can be spent for artwork *to* make the building more attractive. To justify the expenditure (about $50001, ESD argued that the artwork would

- Enhance the appearance of the "massive, fortress-like" ESL building which, because of its location outside ORNL's security area, will have greater public visibility and interaction.
- Assist ESL in focusing attention on ERDA's concern for environmental health and public safety.
- Be consistent with the effort to change ORNL's image and reflect favorably on the emergence of ERDA (soon Department of Energy) as the "prime innovator, motivator, and developer" of the nation's energy resources.

Since the mural's installation in August, ESD has been in the process of stylizing the design for use as a divisional logo for stationery, reports, slides, etc. As Struxness said, "We wanted some special identity for the division, and this mural has given us one."

LAB NEWSLETTER/SEPTEMBER 1977

PRESIDENT CARTER'S VISIT to OAK RIDGE NATIONAL LABORATORY

MAY 22, 1978

Operated for the U.S. DEPARTMENTOF ENERGY by UNION CARBIDE CORPORATION, NUCLEAR DIVISION

United Nations Educational, Scientific
and Cultural Organization

MaB

Programme on Man and the Biosphere

By decision of the Bureau of the International
Co-ordinating Council of the Programme on Man
and the Biosphere, duly authorized
to that effect by the Council

Oak Ridge National
Environmental Research Park Unit,
Southern Appalachian
Biosphere Reserve (USA)

is recognized as part
of the international network of Biosphere Reserves.
This network of protected samples of
the world's major ecosystem types
is devoted to conservation
of nature and scientific research
in the service of man.
It provides a standard against which can be measured
the effects of man's impact
on his environment.

Dare 12 January 1989

Federico Mayor
Director-General
of Uncsco

"The Chattanooga Times"
March 15, 1970

Overproduction Kept Family Going

The mosquito fish in White Oak Lake fought back. .

White Oak Lake up at Oak Ridge has received radioactive waste for 25 years.

Mosquito fish live in the lake and feed off mosquito larvae.

Ecologists, those who specialize in the relationship of living things to their environment, studied the fish to determine what effect radiation was haying.

They found that it was causing deaths through abnormalities.

Bnt Dr. Dan Nelson, the assistant director of the ecology section at the Oak Ridge National Laboratory, said "the really interesting thing was the increase in fecundity."

The females produced many more young than normal.

"Thus puzzled us," Dr. Nelson continued, "until we went back to basics."

The ecologist said that when a look was taken at other organisms placed under stress for extended periods the scientists were reminded that they also become more fecund.

And so it was with the mosquito fish.

They overproduced, to keep the family going and offset the-increase la deaths of about 20 in 500.

Dr. Nelson, who holds degrees from Iowa State, Oregon State and a Ph. D. in ecology from the University of Georgia. is assistant director of the largest single ecological research unit in the Unit&J States today.

There are 40 stiff members and this number Is continually enlarged by visiting investigators, most of them university people who come to ORNL on their sabbaticals, and students who come in

Dr. Dan Nelson

for the summer and for undergraduate research. The National Science Foundation sends in 10 graduates each summer from universities over the United Slaies.

The 'University of Tennessee cooperates in the program and the ecology staff, in torn, cooperates with UT.

The ecology section has two basic concerns, what happens to radioactive material when it is released, bow much of it is concentrated in organisms and what effect this has on the ecological system, and what effect radiation has on individual organisms and the population of organisms.

White Oak Lake has afforded the ecologists many opportunities for studies inasmuch as organisms have been exposed to radiation and have reproduced in the lake for many years.

A promising study for developing a broad base of ecological information is getting under way, Dr. Nelson reported.

It is the Walker Branch watershed project and in this study there will be taken Into consideration wbat goes into the watershed through the atmosphere, through rainfall, through dry fallout and what effect this has on the mammals, the Insects, the organisms and other living things both on the land and in the water.

Specialists in botany, entymology. microbiology, hydrology and other pertinent disciplines compose the study team.

What effect does radiation have? What effect does forest fertilization have on organisms on land and in the water?

'Through studies of this type." Dr. Nelson said, "we will be able to develop a predictive capability."

Such predictive capability is essential to man in his efforts, just beginning. to restore a health to his environment which has been severely damaged by pollutants in the air, the water and on the laud.

Among other things, it will tell the scientist what chain reactions to expect when be takes a step to correct one unfavorable condition.

This is one of the reasons Dr. Alvin M. Weinberg, director of ORNL, said in his 1969 report- on the state of the national laboratory that "the ecologists have displaced. the physicists' and the economists as high priests in this new era of environmental concern:'

What seems to be a disadvantage may, when corrected, lead to greater disadvantage. In one case, a switch was made in the upper Midwest from a certain type of detergent which foamed to a type that didn't foam because the latter was not so unsightly on the streams where the laundry waste water was emptii

However, the nonfoamiog 'type was much more toxic to the sperm of bluegill and thereby bad an adverse affect on the fish population.

The ORNL ecologists also are looking into the interaction of thermal pollution on living things.

"We are going to be faced with these things," Dr. Nelson said. "Thermal pollotion (from nuclear power plants), radiation pollution (from increased use to radioactive materials) and organic pollulion (fertilizers, pesticides).

"We should gain a predictive capability."

That is what the Oak Ridge ecologists hope to do. It is a capability that is' needed for the safeguard of man, of living things and the environment.

Oak Ridge: 'One of the Country's Largest Environmental Laboratories'

The basic mission of the Oak Ridge National Laboratory, says the guide book, "is the discovery of new knowledge, both basic and applied, in all fields relevant to the release of nuclear energy."

And, without apology — even with pride-Dr. Alvin M. Weinberg, director, comments that "we are one of the country's largest environmental laboratories."

In a day when the attention of every citizen is focused almost constantly on some phase of environmental pollution, many will find it comforting and heartening to know that the efforts and the talents of so large a concentration of scientific skills are involved in seeking solutions.

It is natural, Dr. Weinberg notes, that the nuclear energy laboratories be concerned with the environment.

"Handling large quantities of radioactivity without endangering the biosphere and particu-1 a r 1 y without endangering man," he comments, "was part of our task in 1945 when ORNL was started, and it remains an important part of our job. Our concern with the environment gradually broadened and now some 10 per cent of everything we do at ORNL ls related to the environment."

This job ls a bit complicated, the director notes, pointing out that the environment "is uncomfortably diffuse and complex."

"Achieving a better environment," he says. "is a leas definite goal than is building a reactor. We know when we have finished a reactor, but we can hardly know when we have adequately cleaned up the environment."

Dr. Weinberg, who will be 55 in April, is a native of Chicago who began his research career as a mathematical biophysicist after collecting three degrees—including a Ph.D. at age 24—at tbe University of Chicago.

For one with the responsibilities of directing a program involving the efforts of some 5,000 persons and one on whose limited time so many demands are made, Dr. Weinberg is not a hard man to see — at least for the person with a legitimate reason for seeing him.

But a visit in his office includes no small talk. He is cordial, but gets quickly to the point. Realizing that the lay visitor does not speak or understand the language of science, Dr. Weinberg obviously thinks at one level and speaks at another as he discusses the matters in which an interest has been expressed. Considerate, he's translating for his guest.

His office is large and colorful, but mathematical. Covering much of one wall is the periodic table of the atoms, as one might find in the college science department the periodic table of the elements.

Dr. Weinberg seems to try to anticipate the interests, the questions of the visitor, realizing that the visitor is too unlearned in the area of nuclear science to inquire into the really significant issues. He is almost patronizing, but in the most acceptable concept of the term.

Still smiling and gracious, he lets the visitor know without offense when the interview is over. He may go rushing from the office to an appointment elsewhere before hls guests depart.

In commenting about the environmental studies program at ORNL, Dr. Weinberg 'does not try to tick off the specific areas of activity. He knows and his visitors know where this information ls available. But he likes to give a quick justification for the efforts underway at the sprawling Oak Ridge facility.

"Our major responsibility here," he says, "is to devise new and better ways of prodncing nuclear energy. But prodnc-tio:n and transformation of energy is responsible for 95 per cent of the environmental pollution, so this is an area in which we most concentrate some of our best effort."

One of the many American scientistsmobilizeddnring World War II to work in the atomic energy program, Dr. Weinberg has been ORNL director since 1955 and since 1555 has been a vice president of Union Carbide Corp.'s Nuclear Division which operates ORNL for the Atomic Energy Commission.

Few men have spent as much of their lives ln helping to develop the peaceful applications of nuclear fission as has Dr. Weinberg. In 1960, he was a winner of the international Atoms for Peace Award for his mte in the development of nuclear reactors.

Dr. Weinberg has not let the pressures of his work prevent him from playing an active role in community llfe. He. plays the piano and is an avid tennis enthusiast. He helped organize the Oak Ridge School of Music and for eight years was a member of its board.

Many Chattanoogans will recall his appearance in 1963 at the University of Chattanooga which awarded him the honorary degree of doctor of literature and laws.

ORNL Ecologists Tell Of Grand Research Design

By PATRICK RIORDAN

There are more than 30,000 acres of environment at Oak Ridge National Laboratory, and the ecologists have the run of 25,000 of them.

They've hung "Do Not Disturb" signs on their trees, to study areas as broad as a watershed. and as small as the position of a leaf in the forest canopy.

So a group, of visiting ecologists, conservationists and miters' —luding two White House staff members — who toured ecology areas recently, were careful not Lo bother the plants and animals.

Lectures in the mornings April 29 and 30 helped the group of 18 visitors use their fieid trips to pick out specifics, some of them so technical that not everyone was able to follow the "arguments.

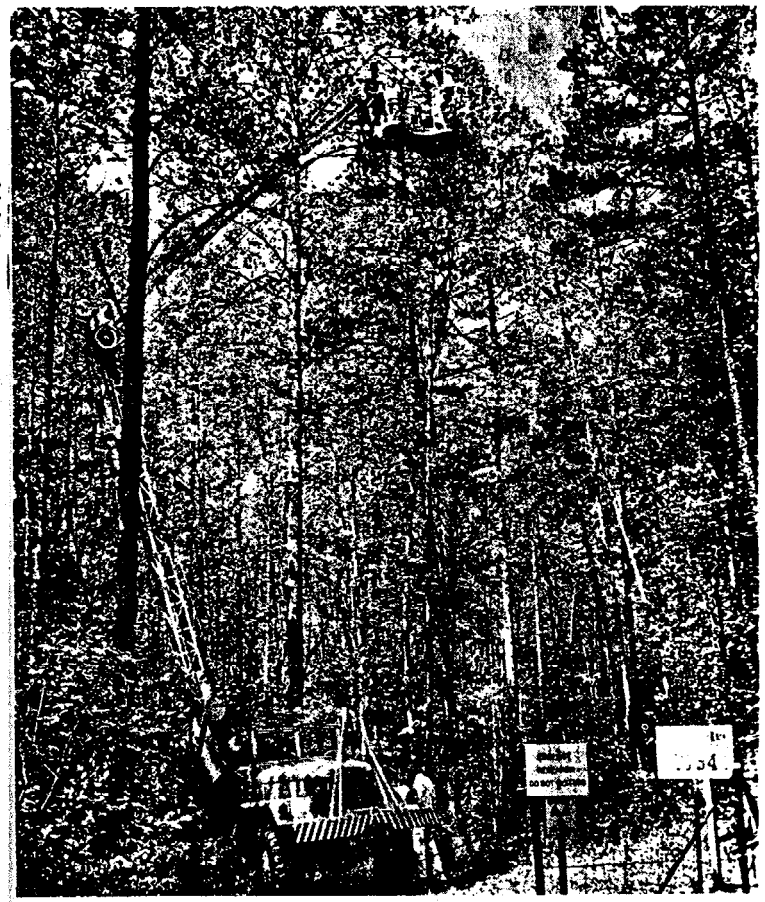
What did the two White House aides think?

"The ecology program compares extremely well with the others I know about," according to Don King, with the office of science and technology.

"The ORNL program is one of the finest, if not the finest, anywhere. This is the only place that takes the systems' view. On the university

(Continued on Page 11 No. 3)

The Oak Ridger
May 13, 1970



Collecting Leaf Samples—

Radioecologists from Oak Ridge National Laboratory collect leaf samples and insects in a forest inoculated with cesium-137 The lift truck and lower help in sampling from tall tulip poplars -among the most productive trees in the eastern deciduous forest.

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campuses. they're all divided up into departments."

And John Ford, with the National Goals Research Staff, said the program has "a beautiful 'conceptual approach. I'm very much impressed with its multi-dimensionality."

Asked about the chances of establishing a National Environmental Laboratory,? Fad said he didn't know, given current budget situations. And he added, "That's up to the Atomic Energy Commission and the National Science Foundation."

The White House aides seemed able to penetrate the technical thickets through which the guides led them, and asked rather detailed questions. Some of the group appeared a little confused at times, though.

But nearly everyone was able to appreciate one basic fact — nature does things in an immensely more complicated way than does man.

Consider the problem. of moving water through the soil. Man does it crudely and grossly, with heavy pipes of varying diameters.

Nature, it was pointed out, move8 water much more subtly, filtering it through leaves and topsoil, providing it to earthworms and insects, and letting it seep through rock formations.

Charlie Malone, who has a plot staked out with black-and-yellow rope, containing black jars and white funnels and other part ecological gadgets, likes tbe work.

"About half my work is in the field, in the spring and summar," he says. But when winter comes, "the ecology pretty well shuts down," so the laboratory work takes over.

Is it ever tedious?

"Very tedious, sometimes. The science is the most enjoyable part, planning the experiments. For a lot of the field work, you're really a technician, just making sure everything is working the way it's supposed to."

The ecology work at ORNL grew out of Atomic Energy Commission studies in the 1950s to determine what would happen if a "nuclear device," or bomb, were detonated.

Using radioisotopes as tracers in ways familiar to any visitor to the American Museum Of Atomic Energy — and certainly to any high school physics student — ecologists began to study what would happen to the radionuclides produced in a nuclear bomb blast.

Isotopes of strontium and cesium and other fallout isotopes were chosen, because of the likelihood that they would he produced in such a detonation, ORNL staff members pointed wt. In what they call the "Cesium Forest," poplar trees have been tapped to inject radioactive cesium 137.

The initial studies were to find out what whould happen to the cesium if it were released into the environment in large quantities. But eventually what happened to the cesium became a relatively minor part of the question. Using cesium, it turned out, ecologists were able to begin to study in great detail thing which happened in the trees themselves — measuring, for example, not only the flow through the tree from roots to crown, but in the opposite direction as well. And the flow from crown to roots was demonstrated to be much greater than anyone had expected.

A few miles from the "Cesium Forest" is. an open field surrounded by what a staffer frankly called an "anti-personnel chain link fence." A chilling sign near the gate reads: "Post-Attack Environment Studies."

"Do Not Disturb."

The field has been made to undergo tne effects of a serious dose of radioactive fallout.

But in addition to providing data for the Office of Civil Defense, the field also became part of the ecological sciences division research scheme.

Briefly, that strategy begins with the extremely detailed studies underway at the "Cesium Forest" and at the "Post-Attack" field, two natural environments about which a great deal is known.

Davld Reichle, an ecologist and a member of the Oak Ridge Regional Palnning Commissin, points out research in which pens about a yard square are studied to get a great deal of detailed data on the effect of different kinds of earthworms, different kinds of leafmold, different kinds of trees and "microflora" — microscopic bacteria.

This experiment, along with these in which trees were tapped to inject cesium, as well as others, will go into the first level of data. At this level, very precise statements can be man. made about very small ecosystems.

But the trouble with minute detail, Reichle points out, is that it's difficult to predict what might happen later on. When researchers are forced to extrapolate, going beyond the limits of their data, the chance of error is great. When they can interpolate, however, and use two known data points to make a guess at a third lying between them,. the chance of error declines.

Thus, the more data they have, the more accurately they can guess about the rest of the questions that perplex them.

Moving up from tbe extreme detail of the cesium forest and post-attack field studies, the next level of complexity is a watershed — an area which tends to concentrate water and determine the direction of its flow. A watershed also determines what contaminants will be found in the water flowing out of it.

A study is underway now, according to Stanley I. Auerbach, director of the ecological sciences division,. to establish "base-line conditions" in a watershed on ORNL's sprawling real estate.

Various sorts of environmental monitoring equipment is up in the watershed, checking water quality and various other factors.

After a year or two has passed, ecologists will go" in- and deliberately "perturb" the area, to use a frequently-heard word.

Then they'll measure the changes which occur.

The information they will receive won't be nearly as detailed as that obtained from the cesium forest or the post-attack field, but it will be broader, and will aliow broader generalizations to be made. Thus broader predictions can be attempted.

Ultimately, a study of various watersheds could be made — a study, for example, of the entire Tennessee Valley area, where manmade dams have had an immense effect on the envoronment.

From that sort of study. a still-broader regional research scheme could be undertaken. ultimately tackling as big a hunk of the planet as the Mississippi River and its tributaries. whkh effectively drain a good part of North Amerka.

THE OAK RIDGER, OAK RIDGE, TENNESSEE, TUESDAY, MAY 11, 1971

Ecologists Told Their Future Secure

By CAROLYN KRAUSE

Clarence Larson, member of the U. S. Atomic Energy Clmmission, predicted a secure future for radioecologists at the Monday Mght session of the Third National Symposium on Radioecology being held at the Oak Ridge Gvic cater through Wednesday,.

"I foresee that the AEC will continue to be a major supporter of radioecological research and an active participant in the future symposia," he said.

Currently, the Fallout Studies and Environmental Sciences Branch of the AEC's Division of Biology and Medicine is spending $18 million 00 finance specific radioecological research, Larson related.

The AEC Commissioner also predicted a trend toward more systems analysis studies (mathematical models) and "a trend toward more ecological experimentation or environmental manipulation."

He also noted that "there will be a counter trend engendered by extreme 'environmentalists' who regard the environment as sacrosanct as the human body and will wish to restrict any environmental experimentation."

Larson urged the radioecologists to encourage young people to enter their field:

"There are many youngsters now excited about the environment. What advice would you give them? Have you encouraged ecology in local science fairs? Have you participated in local school programs? Many teachers would welcome your advice and ideas about environmental study units."

He cited the present contributions of tadioecology, which, he added, have an impact on the entire fleld of ecology. "Consider, for example, the knowledge gained about the flw of materials in an ecosystem, an achievement made possible only by radioecology."

LARSON

Larson listed AEC's goals for radioecological studies :

1. To predict the movement, the fate, and the effects of radionuclides (like cesium-137, cobalt-60 and strontium-90 released from nuclear reactors) in the environment, especially the effects of these nuclides on the structure and functioning of ecosystems (like a forest or a pond).

2. To solve selected ecological problems which may be resolved through the use of radionuclides. (At Oak Ridge National Laboratory, for example, a forest was tagged with cesium-137 to find out what happens to decaying leaves in a forest ecosystem).

3. To discover and promote the peaceful uses of atomic energy for beneficial purposes *in en*-vironmental sciences.

Larson cited the work going on in ORNL's division of ecological sciences unda the direction of Stanley I. Auerbach.

"From their research in progress we are learning much about radionuclide cycling in aquatic and terrestrial systems that is applicable to reactor siting analyses.

"We are discovering the characteristics of watersheds—a contribution to better land management. We have knowledge of the responses of plants and animals to ionizing radiation — data needed for evaluating the effects of fallout, and responses of populations to radiation."

Already, he added, radioecological research has resulted in four landmark volumes in the environmental sciences: "The Environment of the Cape Thompson Region, Alaska," "A Tropical Rain Forest," "Bioenvironmental Studies of the Columbia River Estuary and Adjacent Ocean Regions," and "Radioactivity in the Marine Environment."

In other speeches Monday, Auerbach, who stated that research in radioecology is undervalued and insufficiently funded, listed the contributions of radioexology to AED mission programs since the mid-1950s:

1. Provided some information on the varying sensitivity of plant organisms such as red oaks, yellow pine and grass and

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of complex ecosystems to radiation during the period of fallout from nuclear weapon testing.

"As one rdiecb on the fallout problems of the mid-century decade, one cannot but conclude that it was a profound stimulus to tbe awakening of public awareness to environmental problems," Auerbach pointed out.

2 Obtained dab on the food chain, although Auerbach gives little credit to the ecologists far this in the 1950s:

'Learning about tbe ecological food chain was me of the greatest mass efforts in public education d all time, but I a m not sure that ecologists should be given credit far this achievement.

"I think that credit far the public Learning about the mwemeof of strontium-90 tbrougb the grass-cow-milk-man food chain properly belongs to the maior ● twn& energy authorities of those countries involved in testing."

2 Provided the hard evidence to demonstrate that the fate of certain radionuclides i n particular habitats was not predictable.

"Ecologists showed that environments diifered considerably in bow radionuclides would be fixed, altered, moved, or otherwise manipulated," Auerbach said.

4. Found no recognizable somatic biological effects or mutations that could be attributed to radiation at testing fallout levels.

5. Fought for and established the principle that such major technological undertakings such as Plowshare must have an ecological assessment prior to ib being undertaken.

6. Provided dab pertinent ta the design, construction a n d continuing safe operations d power reactors.

7. Obtained data relevant to the r e v i e w and revision of standards for r e l e a s e of radionuclides t o t h e environment.

8. Applied and refined systems analysis techniques to the human exposure problem.

L. R. Rogers, director of the AEC Division d Radiological and Environmental Protection, and c. L. Henderson, assistant director d regulation for the administration, AEC, discussed "AEC Implementation of the National Environmental Policy Act (1969) in Its Licensing and Regulation d Nuclear Facilities."

A requirement of the 1959 act (NEPA) is tbat any federal agency proposing an action that would significantly affect the quality of human environment must draft an environmental impact statement and submit tbis statement far review by other federal agencies.

According to Rogers and Henderson:

"NEPA does not specifically refer to the licensing activities of federal agencies. The AEC has, however, interpreted the act to mean that tbe licensing of the nuclear facilities -particularly nuclear power plants and plants for chemical reprocessing of nuclear fuels — is a 'major pollution problem. 'federal action significantly affecting the quality of tbe human environment'

"In accordance with this interpretation of NEPA, the AEC has assumed the responsibility for preparing for each proposed nuclear facility that may significantly affect the quality of the environment a detailed statement on environmental considerations, and for obtaining the comments of other federal agencies having environmental responsibilities and expertise."

In an interview, Auerbach said his division has been consulted on the preparation of an environmental impact statement for a new nuclear power plant. The division also has advised the U.S. Army Corps of Engineers on the environmental effects of the Tombigbee Waterway now being constructed to connect tbe Tennessee River with the Atlantic Ocean.

Auerbach considers NEPA "the most significant piece d environmental legislation since the Refuse Ad of 1899."

Frank L. Parker, professor in Vanderbilt University's department d environmental and water resources engineering a n d former ORNL employe, spoke on thermal pollution, which, he said, isn't a serious problem yet but will be in a few years.

The problem with thermal pollution is quantifying the costs and benefits, he said. For example, in the last nine years, some 700,000 fish were killed due to the release of waste kat fmm power plants to bodies d water, he related.

The cost of these fish kills, Parker explained, amounts to about $700,000. Compare this cost, he added, to the $10 million Tennessee Valley Authority spent on three cooling towers at the Paradise Steam Plant in Kentucky to avert the thermal pollution problem.

The sports fiery industry is worth $3 billion a year. Parke said To preserve this industry by installing cooling towers instead of using once-through river cooling would cost the nuclear industry from $11 to $60 billion by the year 2000.

Parker said the beneficial use of waste heat to wann cities and greenhouses will not solve the problem any more than using radioisotopes for agricultural- and medical purposes is relieving the radioactive waste disposal dilemma.

In addition to the high costs of wet and dry cooling towers, Parker cited such technical problems as:

1. The me of salt water for ceding, considering it is known that, at the Turkey Point power plant on Biscayne Bay, three pounds of salt per acre have been deposited per year within one mile of the cooling tower, resulting in the destruction of plant life.

2. The possibility that the latent heat rising from cooling towers has sufficient concentrated energy to approach the energy of thunderstorms, thus causing large scale weather modification.

Parker said thermal pollution is being studied at Vanderbilt, which has the national center for hydraulic and hydrologic research and training in water pollution.

E. P. Odum, professor of zoology at tbe University of Georgia in Athens, said the limiting factor for man is not energy and resources but the pollution consequences.

Defining ecology as "the totality of man and his environment," Odum said he sees society as making the transition from its adolescent to a more mature Stage as people realize that fortunes should be made not from exploiting resources bat from recycling them.

The Georgia professor explained that we have three options for dealing with pollution. First, he said, we can dump all our waste into the nearest natural environment and hope It will spread out and go away. "The solution to pollution is dilution," be called this option.

Second, he added, we can let nature de much d tk waste disposal work by building semi-natural waste management parks with cooling ponds and lakes, which could also be used far recreation

Third, he suggested, we can design artificial systems to work with nature, wuch as expensive cooling towers.

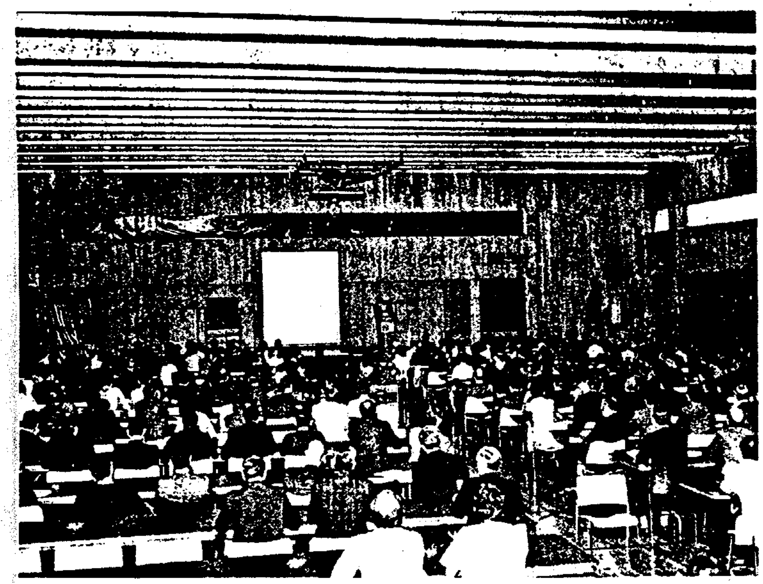
Saul Strauch, d tk AEC's Division of Reactor Development and Technology, described a computer model being applied initially to the Upper Mississippi River Basin for the nuclear facilities which, it is projected, will be located in that region by the year 2000.

The study is being conducted by the Hanford Engineering Development Laboartory at Richland, Wash., with the assistance of Battelle Memorial Institute under the direction of the AEC.

The purpose of this study, initiated in January 1970, is to provide knowledge of use in establishing standards and guidance in the planning, design, construction and operation of nuclear power and fuel reprocessing plants now in the planning stages, Strauch said.

Ecologists At Civic Center—

Three participants in the Third National Symposium on Radioecology enjoy the outdoors al the Civic Center, scene of a large three-day conference, which began Monday. They are. from left, Paul S. Robwer, of Oak Ridge National Laboratory's health physics division, Stephen V. Kaye. of ORNL's division of ecological sciences, and Ed Fleming, of the Lawrence Radiation Laboratory, Livermore, Cal. The symposium, which closes today, has been sponsored by the U.S. Atomic Energy Commission, ORNL and the Ecological Society of America. It is held every four years, This is the first major scientific meeting sponsored by ORNL to be held at the new Civic Center.



In Session In Shep Lauter Room—

This has been the scene in the Shep Lauter Room of the Civic Center since Monday as about 400 have attended sessions of the Third National Symposium on Radioecology there. ORNL officials staging the meeling reported Monday and Tuesday that the Center is proving itself well as a good place to hold this type of scientific gathering — the kind that often. in the past. has been schedded for Gatlinburgor Knoxville becauseof lack of facilities here.

"The Oak Ridger"
August 31, 1971

The Calvert Cliffs Decision— 2

Scores At ORNL Writing On Environment Impact

Editor's note — This is the second of two articles about the latest precedent-setting court decision relative to nuclear power — the so-called Caivert' Cliffs, Md. reactor decision in the U.S. Court of Appeals in the District of Columbia. Today's article tells how that decision has affected the work of some 85 employes at Oak Ridge National Laboratory. As a, result of the Court's ruling, ORNL scientists and engineers have been drafting environmental impact reports for six nuclear power plants. This is in compliance with the National Environment&' Policy Act of 1969 as it has been newly interpreted as a result of the July 23 court, decision.

LIVERMAN

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"The Oak Ridger"
August 31, 1971

By CAROLYN KRAUSE

The U.S. Atomic Energy Commission has called upon Oak Ridge National Laboratory and two other AEC laboratories, to commit a substantial portion of their staffs to assisting the AEC regulatory staff in writing environmental impact statements now required for nuclear power plants in the construction or final licensing stages.

The action is the result of a landmark court decision on July 23 in which the U.S. Court of Appeals for the District of Columbia ordered the AEC to consider the environmental impact of the Calvert Cliffs, Md. nuclear *power* plant *now* being constructed.

The Court, in effect, ruled that the AEC had failed to comply fully with the intent of the National Environmental Policy Act of 1969 (NEPA), *in* its nuclear power plant licensing procedures involving many plants.

It ordered the AEC to quit foot-dragging and making a "mockery" of NEPA. As one result, the AEC has begun action to produce more written reports required by NEPA determining the environmental impact of developing nuclear power stations and recommending technological changes, if possible, to reduce further environmental damage.

Helping the AEC meet the requirements of law are ORNL, Argonne National Laboratory near Chicago, and Pacific Northtest Laboratory, Richland, Wash. ORNL is carrying 40 to 45 percent of the burden.

At ORNL, about 45 people will be working full time for the next six to nine months developing new environmental impact statements for six nuclear power plants under construction, or in the final stages of licensing.

Another 20 people are serving as part-time consultants and 20 more are members of review boards (conservation, technical and editorial).

ORNL's Environmental Impact Statements Project, expected to require 37 man years of work, is being directed by Edward Struxness, with Tom Row as his deputy project director. These men and the members of the project will report to James L. Liverman, associate director for biomedical and environmental sciences at ORNL.

On Aug. 23, a month after the District of Columbia Court decision, Liverman explained to the project' members gathered together at ORNL why they had been chosen for the project as well as the project's origins.

He said that the AEC began providing funds to ORNL, Argonne and Pacific Northwest Laboratory last spring to help in the preparation of environmental impact *statements* — about 12 to 14 statements per year.

But when the Calvert Cliffs decision dropped a legal bombshell into the AEC's lap, *more* complete statements against tighter deadlines were required, resulting in a flurry of activity, Liverman explained.

The AEC, he added, decided to meet this crisis by calling upon AEC program divisions — reactor, research, biology and medicine — *to slow* down some of their laboratory research programs, thus freeing a number of people to devote full time to preparing environmental impact statements.

As a result, Liverman said, ORNL was asked to provide 20 to 30 man years of effort over the next nine months.,.

How does AEC headquarters feel about the consequent deceleration of some of their reactor research and development programs — deceleration while thdse environment reports are written: According to Liverman:

"The Headquarters divisions do not view this impact as negative, and in fact, quite to the contrary, they feel that from these efforts (preparing environmental statements) we should be able to better understand the real basis for public concern and perhaps to identify new and yet unmet research needs. Put another way — this very temporary slowdown in research may turn out to be a valuable exercise in long range planning."

In an interview a day after his talk to ORNL employes, Liverman said the project members responded enthusiastically to the call from the AEC for help.

He speculated that the members saw the urgency of getting the environmental statements done as soon as possible so as not to hold up too long the production of 80 million kilowatts, which represents a projected 25 percent increase in the nation's total electrical production from all sources — now about 340 millfon kilowatts.

Liverman compared the Calvert Cliffs decision to a kind of technological Pearl Harbor that "strongly encouraged the whole AEC

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Appendix

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Calvert Cliffs. —

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community 10 mobilize around the issue."

Six task groups, each having about nine men, have been formed and each group has been assigned lo draw up an environmental statement for one of six plants.

These plants are the Palisades plant in Covert Township, Mich.; Oconee No. 1. Oconee County, S.C.; Indian Point No. 2, Buchanan, N.Y.; Vermont Yankee, Brattleboro, Vl.: Hatch. Baxley. Ca.. and Arkansas, Pope County, Ark.

The task groups are headed by R. E. Thoma, J. R. McWherter, W. C. Yee, W. E. Browning, J. P. Witherspoon, and W. G. Stockdale. Members of each group will travel lo the power plant the group is responsible for evaluating.

Each of' the task group members belongs to one of seven problem position groups; which deal with specific problem areas lo be considered in environmental impact statements.

Explaining the organization, Struxness said:

"We've organized 'into problem areas and we have a leader in each of these problem areas. The leader's primary responsibility is lo help the people writing this part of the environmental report. Some problems are to directly assess the impact lo be certain that the report is technically correct."

One problem group. led by Marvin M. Yarosh. will consider thermal effects — the impact of the discharge of heated cooling water on the environment — as well as reactor cooling systems and the power station's description and engineering.

F. T. Binford's problem group will deal with air and gas cleanup systems and the handling of radioactive gaseous effluents

0. S. Sisman. is heading a group concerned with liquid radwaste systems and liquid effluents

F. N. Browder's group will consider the site and environment of the plant in drawing up impact statements. That means the members will examine whether the plant location has an effect on studies that might be done in history, archeology, demography, geology, hydrology, ecology and meteorology of the area.

Browder's group, for instance, would consider whether there migbl be artifacts, such as Indian graves, that would be destroyed by further construction of a power plant. The group might also 'make statements about what kind of plant architecture would fit in best with the surroundings.

D. D. Nelson's group will calculate the impact of radiation from the power plant on surrounding human populations.

Paul B. Dunaway's group will consider the biological and environmental impact of the power plant and its relation lo land, water and other resources.

Finally, Miie Bender and his group will concern themselves with &awing up the balance t-3 tween environmental costs and economic and technical benefits of nuclear power plants under consideration. Tbey also will consider alternatives.

These full-lime project members will get additional help from a review group charged with making sure the environmental statements are technically correct and a review group of conservationists whose duty is lo raise as many environmental questions as possible.

Liverman said the tab is drawing on the "I don't want the Obed dam" types of conservationists among those employed at ORNL for special help.

These local environmental activists. he said, "will raise most of the questions that are going to be raised (say, by possible intervenors) and. therefore, help make our statements much better.

"It's entirely possible," ha added, "that as a result of the questions they raise and our technical team looking at how do we overcome those impacts, some plant might have lo add $5 million worth of cooling towers."

"I think you'll see intervenors more satisfied," said Deputy Project Director Row. "We'll answer a whole lot of questions that were bothering people."

After the technical and environmental teams have completed their reviews, an editorial group will put the entire environmental statement in final order.

Struxness said the project members are on a tight schedule, which he explained in detail.

The staff, he added, has six weeks lo write a draft statement which must then receive comments in an internal review by the AEC regulatory staff. ORNL will get the comment.3 back and then re-write a final. draft statement, copies of which will be mailed lo some 40 states and federal agencies for comment.

After a 45-day review period for federal agencies and a 75-day period for state agencies, comments and questions will come back lo ORNL. These questions and comments will be taken into account as the ORNL staff prepares the final environmental statement.. which has to be approved by the AEC and sent lo the Council on Environmental Quality, the three-man body created by NEPA.

It is ironic, considering the Court's criticisms of AEC regulations in implementing NEPA, that Gordon MacDonald, member of the Council on Environmental Quality, recently said:

"The AEC has by far the best record of any federal agency In submitting environmental reports under NEPA. The AEC reports are the most complete, the best thought-out, and the most sophisticated of any agency."

Judge J. Skelly Wright, the judge in the Calvert Cliffs case, apparently didn't see it quite this way.

NUCLEAR DIVISION NEWS Thursday, August 24, 1972

Earth's forests topic for ORNL workshop

More than 50 ecologists from 18 countries will share information on the world's forests from a unique workshop being held at -Oak Ridge National Laboratory.

As a part of the International Biological Program, a joint ecological effort by 57 countries, the scientists have brought global data to be fed into the computer systems at Oak Ridge. The purpose is to develop preliminary mathematical models of the earth's forests for future study. The United States is a major participant in the International- Biological Program and Oak Ridge National Laboratory plays a key role as the directing institute for the analyses covering the Eastern United States.

Scientists from Europe, Asia, and Australia have brought data on tropical, subtropical, evergreen and deciduous forests. Working with the staff of the Environmental Sciences Division they propose to construct first order simulation models of the functioning of these systems.

The "International Woodlands Workshop on Ecosystem Analysis" is the first of its kind. Objectives of the Workshop are to initiate data summaries for primary production and mineral cycling in forest ecosystems, and the application of systems analyses techniques for modeling dynamic behavior. Special work groups are concentrating on interpretation and comparison of ecosystem data on a global scale. Attendees will visit the Ocoee Gorge near Copper Hill, Tenn., the Coweeta Hydrologic Laboratory at Franklin, N.C., and the Great Smoky Mountains National Park.

Participants are from Sweden, Canada, Malaysia, Belgium, the Netherlands, the USSR, Germany, Finland, Czechoslovakia, India, Poland, France, the Congo, New Zealand, Japan, Australia, the United Kingdom, and Italy as well as the United States.

Literally A New Environmental Building

By KAREN OLSON

Oak Ridge National Laboratory may have a new three-story Environmental Sciences Division building within the next four years. Alvin M. Weinberg, director of ORNL, mentioned this possibility in his State of the Laboratory address last week.

The structure is "very badly needed," according to Stanley Auerbach, head of the Environmental Sciences Division. His current proposal, which would cost around $9,000,000, would feature a special office and lab arrangement designed to promote inter-disciplinary cooperation.

It would also provide separate greenhouses, climate chambers and animal housing, all to be blended into a natural forested area on a land parcel adjacent to White Oak Avenue in the ORNL area.

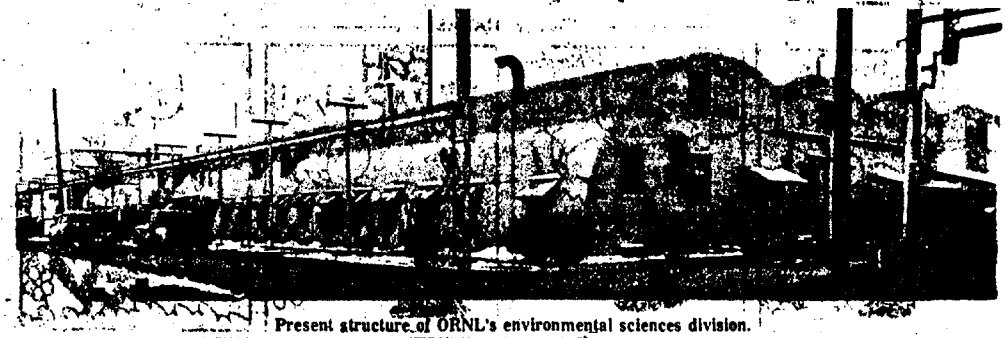
None of these plans will become close to definite, however, until President Nixon issues his budget to Congress in January. "We're hopeful that it will be approved, but there's nothing ORNL can do now except eagerly await the President's message," stresses Dave Sundberg, director of Public Information for ORNL.

Should the new building be recommended in the President's budget, it would be only a first — if important step. The budget must then go through the approval process but usually if a capital improvement project of this type is in the budget as submitted by the White House, it usually stays in through the Congressional process.

"The building has been badly needed for some time," says Auerbach. "We need to consolidate all our environmental programs at the laboratory into a single structure to house new experimental facilities that would be incorporated."

He and his colleagues have been lanning for a new building peri ically for ten years. One early called for a circular building with pie-shaped moms. A later design was more conventional. Both of these plans were overshadowed by more pressing budgetary matters, and the Environmental Sciences Division remained in their original quonset hut, built in 1948.

The 100-or-so members at the ecology staff also spent many years as part of the Health house from 100 to 270 worker Physics Division, before form- Auerbach's preliminar ing a new und separate concept is about 300 by 100 feet department three years ago. concrete and brick constructio "Ten years ago we predicted "The building will to ever that new problems would arise, extent possible be built in a w including pollution, and we to 'harmonize with the e prepared longrange plans and vironment. It will be put in th outlined the future roles of the midst of a heavily forested are environmental group. It ap- shielded by trees, leaving la peared to us at the time that we around It lna natural condition would need a separate he says. "This Would probab building," says Auerbach. be the first major laborato "ORNL has one of the largest building that will be set in ar environmental research groups among the. trees rather tha in the country," he adds. And have a big front lawn." since the. staff is projected to Even the site has been chos increase, the new building could (Continued on Page 11 No. 9)



Present structure of ORNL's environmental sciences division.

with regard to leaving nature intact: "The area that will be cleared contains a lot of overage pine as well as scrubby vegetation, but the better forest, in front of the building, will be untouched."

If the building appears in the President's budget and if Congress approves it, an architect-construction company will be chosen to begin the design in earnest. The current conceptual design was planned in order to help determine a budget.

The $9,000,000 would, according to Auetbach, take care of everything, including inflation over the next four years and a paved driveway.

While rear service facilities and greenhouses would probably be fenced in, Auerbach hopes to leave the front open to the public. The location is across the street from the 'Oak Ridge Linear Accelerator and the Cyclotron, in a parcel of unused land.

One facility a visitor might see would be the climate control chambers, where different habitats could be simulated and their effects could be measured on plants and animals.

Around the labs would sit the offices. "Our present design calls for an internal arrangement that will take advantage of some of the concepts we developed in our earlier circular plan. The offices would mass groups close together. Labs will be in the center, with cross corridors to the offices. The length-to-width ratio will be such that people will be able to interact," says the Environmental Sciences Division head.

"In an interdisciplinary work," he explains, "you need to have your scientists develop an attitude of frequent discussion between peers and colleagues. This is a challenge, because science has traditionally been based on individuals."

Auerbach's original circular idea took into accoint a similar interaction concept: "This design preceded the one of the highschool, hut came up with the same sort of thing — volume to surface ratio advantageous, with people in close proximity. However. ever since the round building at the high school we noticed the community baa bad mixed reactions about round buildings."

"After our first proposition we switched to planning a mom conventionally-shaped building. However, it was not until this year that we received serious interest. Earlier there had been higher priorities," Auerbach adds.

NUCLEAR DIVISION NEWS September 19, 1974

MICROCOSM IN A **VIAL** — *Sidney Draggan, ORNL's Environmental Sciences Division, is shown with the components he uses in constructing his research microcosms. Completed* microcosms are shown to his right.

Fate of radioelement determined in ORNL studies

For many years scientists in the Environmental Sciences Division at Oak Ridge National Laboratory have studied the process of element cycling in the environment. Recently, emphasis has been placed on how radioelements and toxic chemicals are cycled in the soil, since soil is a medium through which elements subsequentiy become available to growing plants and man.

Studies. of the input, output and retention of elements in the soil may be done in several ways. One approach involves taking samples from a landscape area like the Walker Branch Watershed (a relatively undisturbed forest system located in the ORNL complex). Another approach involves the use of tiny ecosystems or microcosms which simulate the natural environment in a laboratory setting.

Microcosm is old concept

Sidney Draggao, a microbial ecologist (Ph.D. in ecology from Rutgers University), explains: "The use of microcosms is not new; it is not even restricted to research. Lots of people have them without realizing it. For instance, a balanced aquarium is a microcosm - a small self-sustaining replica of a lake or stream. In the 1960's there was a flurry of interest in microcosms because of the space program. NASA recognized that if a space station were to be self-sustaining it would have to be a microcosm of the earth's system."

In studies with microcosms, Draggan and his colleagues, Martin Witkamp and Beverly S. Ausmus, have shown that when elements are introduced to the soil, they may be taken up by the microorganisms which exist there. The elements may be. accumulated and used in the growth, maintenance and reproduction of the organisms, in many cases, and' may be transported from the original area of uptake. (Contrastingly, elements are often effectively retained in the soil which removes them from biological circulation.)

Contents of microcosms

The types of microcosms Draggan constructed for these particular experiments contained a simple soil (ordinary sand), dead plant material (leaf litter) and live plants all of (light) and night (dark) cycles, weather and temperatures occurring in this area. Keeping the microcosms under nearly the same conditions as those existing outdoors enabled Draggan to better relate the results of his studies to the real environment.

Use of microprobe system

After the seven days were up, Draggan removed sand grains from the microcosms and observed them with the microprobe analysis system, a special feature of the scanning electron microscope. He was able to gather several types of information from the interaction of the specimen and the beam of electrons, which included photographs, elemental spectra and elemental maps of the specimen. "Microprobe analysis in which elemental analysis is done by measuring the energies and intensities of characteristic x-rays, was used in this study to estimate elemental concentrations in soil microorganisms," said Draggan.

With this technique, Draggan looked at four components of the sand grain: bare sand surface, fungal hyphae, fungal sporangiophores (spore holders) that contained immature spores or seeds, and mature spores that had been liberated from the holders.

Cobalt in spores

The bare sand surface had no living organisms on it and showed only silicon; the fungal hyphae 'and sporangiophores showed the elements potassium, calcium, phosphorus and sulfur; the fungal spores contained the same elements in addition to the cobalt-60 which had been introduced into the microcosm.

This experiment showed how a radioisotope, namely cobalt-60, moved and-or was accumulated by fungus from contaminated soil in a microcosm. Draggan explained: "After the cobalt was put into the microcosm, it was taken up by the microbes (in this case, *Trichoderma)* which were growing in close association with the soil surfaces. Since cobalt is a normal constituent of vitamin B-12 the fungus took the, cobalt into its body and incorporated it into the vitamin needed for its growth, maintenance and reproduction. The most important point to remember is that when any organism which are common to this area. These components of the ecosystem were placed in small containers. Microorganisms included three types of fungi, *Aspergillus niger* (black bread mold), Trichoderma viride and *Mucor sp.,* which were added to create an active microbial community. Microbes play a very important role in decomposition and mineral transformations involved in element cycling.

Since microbes need "energy" in order to do their work, Draggan added a nutrient mixture made up of essential salts and sugars to his microcosms. He also added a radioelement, cobalt-60.

The small containers were placed in a programmed incubator for seven days. The incubator was used to simulate physical factors that affect the outside environment, such as day goes through its reproductive stage, most of its resources are given to it5 offspring. The fungal spores, therefore, probably received a large amount of the cobalt that had been incorporated into vitamin B-12.

Transport is through dispersion

"The fact that the cobalt was taken up as a vitamin does not seem too bad, but we must remember that it is still a radioisotope. The cobalt is further transported in the cycle when these spores are dispersed. The fungus which I was working with disperses its spores much like the common puff-ball. Most people have taken a puff-ball and squeezed it only to watch the spores fly away."

Draggan does not *know yet* what the magnitude or importance of this pathway of cobalt transport is, but he has shown through his research that it does occur.

The transport of radionuclides and toxic chemicals is a subject which is of interest to many people in their concern for the environment. "People are beginning to realize that you can not put something down in the environment and expect it to stay at the point of input," said Draggan. "It has been stated that microorganisms can immobilize, break down or recycle

most compounds, except molecular oxygen." Even DDT, which is a very persistent chemical, may be degraded by a variety of microbes acting on the DDT molecule under differing conditions of oxygen availability. This means simple that almost anything that is put in the environment, whether good or bad, will eventually be recycled back to the system and used again because of the work of microorganisms.

studies for EPA

Draggan and other environmental scientists at ORNL are evaluating testing procedures that explain transport of toxic substances for the Environmental Protection Agency. The EPA is supporting the passage in Congress of a Toxic Substances Act. This Act would require that any chemical produced in excess of 1,000 pounds per year undergo some type of testing before it is put on the market. ORNL's report to EPA will deal with those test procedures that best tell what happens to toxicants in nature.

The problem is to devise tests which can be used by industry that are simple, inexpensive and that give some idea of what will occur in the real environment. The use of microcosms, in an intelligent manner, may be the solution. "Testing a potential candidate substance in a microcosm, which may be as tiny as a pill vial or as large as a few acres, would certainly be better and cheaper than spraying it on a large landscape area to test the environmental effects," said Draggan.

JUCLEAR DIVISION NEWS June 19, 1975

Struxness receives waste disposal award from ANS

tdward G. Struxness, assistant director of the Environmental Sciences Division at Holifield National Laboratory, received the American Nuclear Society's 1975 Special **Award** for Waste Disposal and Management.

The award, consisting of an **engraved** certificate and **$1,000,** was presented at the ANS **21st** annual meeting in New Orleans. Struxness was cited "for his experimental and analytical contributions to the science and technology of radioactive waste management, and for his ability to advance the knowledge base by constructive cooperation with other institutions and individuals, both domestic and foreign, in this important field of endeavor."

For more than 20 years Struxness has been involved in various low- and high-level waste disposal projects. His contributions in radiological **assessments of waste disposal** practices have been particularly outstanding, **and have earned him** wide recognition both in this country and abroad.

Certified health physicist

A native of Minnesota, Struxness received his B.S. degree in biology and chemistry from Luther College, **Decorah,** Iowa, in 1935. He was certified by the **American Board of** Health Physics in 1960, and has done graduate study at Northwestern **University and The** University of Tennessee.

Prior to joining the Nuclear Division staff at the Y-12 Plant in 1943, Struxness was a senior instructor with the Inspection Division of the Army Air Force Technical Training Command. He served in various supervisory positions at Y-12 before transferring to the Laboratory's Health **Physics** Division in 1953. He was assistant director of Health Physics from 1962 to 1973, and directed the Laboratory's Environmental impacts Project from 1971 to 1974. In addition to being assistant director of Environmental Sciences, a position which he assumed in 1973, **Struxness** currently serves as manager of the environmental assessments programs.

Edward G. Struxness

U.S. delegate

Struxness was a U.S. delegate to the Second International Conference on the Peaceful Uses of Atomic Energy which was held in Switzerland in 1958. He was also a member of the U.S. delegation to the U.S:-Soviet Union Bilateral Talks in 1970 and **1972.**

Struxness is currently a member of Committee 4 of the International Commission on Radiological Protection (ICRP) and serves as chairman of its task group on "Evaluations Related to Planned and Unplanned Releases of Radioactive Materials into the Environment." He is also a member of the Health Physics Society of America and the East Tennessee Chapter of HPS.

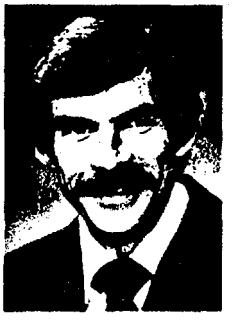
A member of the board of directors of the Anderson County Communitv Action Commission, Struxness also serves on the Oak Ridge Human Resources Board. He resides with hi5 wife, Pat, at 126 Carnegie Drive, Oak Ridge.

NUCLEAR DIVISION NEWS

March 3.1977

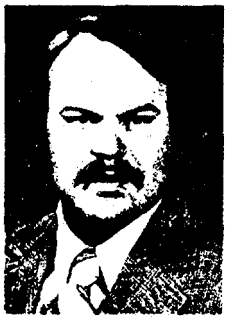
Environmental scientists promoted

The promotion of four staff members in ORNL's Environmental Sciences Division has been announced by Stanley I. Auerbach, division director. Robert W. Brocksen was named section head for Aquatic Ecology; Roger L. Kroodsma is manager of the Ecological Analyses and Applications Program (EAAP); and Robert B. Craig and Stephen G. Hildebrand were appointed group leaders in the EAAP.

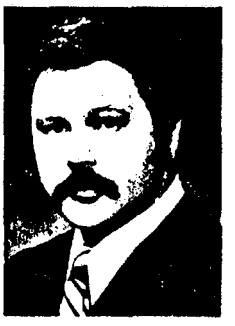


Brocksen

Kroodsma



Craig



Hildebrand

Brocksen

As head of the Aquatic Ecology Section, Brocksen will have responsibility for both basic and applied programs, and will be responsible for aquatic contributions to multidisciplinary research efforts both within and outside of the Environmental Sciences Division.

Brocksen attended Oregon State University where he received a bachelor's degree in fisheries, an M.S. in toxicology/fisheries, and his doctorate in physiology and limnology. He joined the ORNL staff in 1975 as manager for the Division's Ecological Analyses and Applications Program.

Kroodsma

Kroodsma succeeds Brocksen as head of the EAAP, and will be responsible for the development and preparation of ecological and related environmental assessments for the Nuclear Regulatory Commission and ERDA.

He joined the Environmental Sciences Division staff in 1974, after receiving his bachelor's degree in biology from Hope College, and his MS. and Ph.D. degrees in zoology from North Dakota State University.

Kroodsma was involved in the preparation of environmental statements on nuclear power plants for NRC, and was an EEAP task group leader prior to his recent appointment.

Craig and Hildebrand will be responsible for the coordination of the nuclear and non-nuclear assessment activities within the Ecological Analyses and Applications Program, and will report to Kroodsma.

Craig

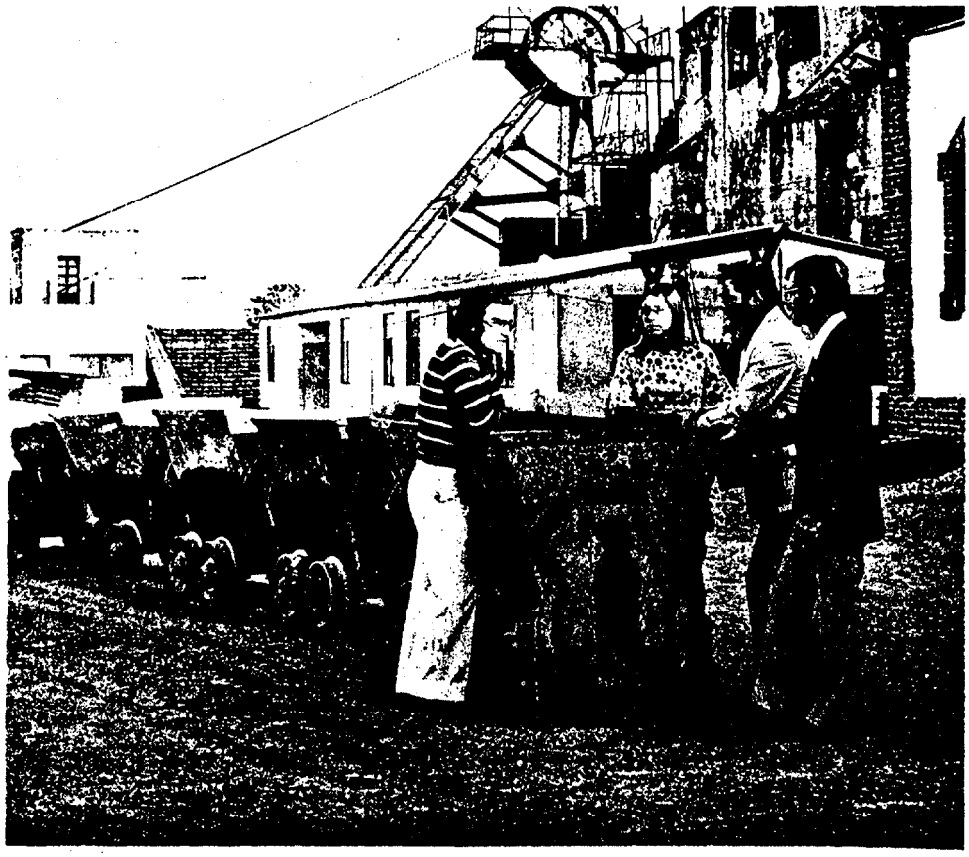
Craig, a native of Washington, D.C., joined the ORNL staff in 1974. He has B.S. and M.S. degrees in zoology and a doctorate degree in ecology from the University of California at Davis. In his new position, he will deal with ecological consequences related to geothermal energy, coal conversion, uranium enrichment and other expanding technologies.

Hildebrand

Hildebrand received his bachelor's degree in zoology and chemistry from Wabash College, and M.S. and Ph.D. degrees in fisheries from the University of Michigan. He has worked in the general area of aquatic ecology and effects of energy technology development on aquatic systems since ioining the staff in 1973.

NUCLEAR DIVISION NEWS May 26, 1977

ORNL ecologist visits Spain, studies mercury-polluted region



MERCURY EXPRESS-Gathered around the large buggies used in transporting mercury-rich cinnabar and quicksilver ore from the mines, are, left to right: Juan Pablo Garcia Frades, Almaden Mine metallurgical chief; Sherry A. Janzen, ORNL lab technician; Steve G. Hildebrand, ORNL ecologist; and John W. Huckabee, ORNL ecologist and group leader,

Appendix

by John R. Hughes

When ORNL ecologist John W. Huckabee, ORNL Environmental Sciences Division, was wading knee deep in the North Fork Holston River, he expected his interest in mercury might keep him collecting fish and plant samples. What he didn't anticipate was that the next river he would wade in was not in the foothills of Tennessee, but near a mining town in Almaden, Spain.

Huckabee specializes in mercury pollution and its effects on the environment. Since the late 1960's and early 1970's, when more than 50 Japanese citizens died of eating fish contaminated with mercury, this form of environmental pollution has become a significant. ecological problem.

Tennessee to Spain

But how did an ecologist from Texas, working in Tennessee, end up in Spain?

Huckabee explained that due to the mercury scare in Japan, the Spanish mine experienced a decrease in demand for its products. "The Spanish government wanted the Almaden mine surveyed in order to determine the extent of mercury poisoning to the environment. They hoped that if it could be proven that the mine's mercury wastes were not poisoning the area's ecosystem, demand might increase," Huckabee said.

Huckabee's involvement began in 'May of 1974, although other studies by the Environmental Protect/on Agency (EPA) and the 'University of Rochester Medical School had been under way since 1973.

After some initial research had been conducted by the Spanish government, Huckabee was asked to work on the project because of his previous studies on the effects of mercuryon'the environment.

Following his participation in the First International Mercury Congress in Barcelona, Huckabee agreed to examine the mine site. The Spanish government requested later that he return to Spain and conduct extended experiments.

The ORNL Environmental Sciences Division was awarded the research contract through an interagency agreement between the National Science Foundation's Office of International Programs and ERDA.

The Almaden mine is 'not only the world's largest natural mercury mine, but also the oldest, dating back at least two centuries before the Christian era. Consequently, the area surrounding Alniaden has been exposed to mercury waste effluents for more than two thousand years.

Dangers of mercury

"Mercury is potentially dangerous because it is easily absorbed into living tissues where it cannot be readily expelled. After several years these mercury deposits may build up in an organism's tissue, possibly reaching a toxic level," Huckabee said,

Working with Huckabee are Sherry A. Janzen, lab technician, and Steve Hildebrand. ecologist, both of the Environmental Sciences Division. Huckabee noted that he and the other participants were not in Spain to observe the effects of mercury on humans who had eaten contaminated fish or fowl. "I'm an ecologist, not a toxicologist," Huckabee said. "In any case the Rochester University group was studying that relationship, Our Primary concern was the extent to which the mercury had contaminated the mine's environment."

The ORNL team had very little tim for sightseeing while in Spain. Eac day they were out in the field collec ting fish, plant, bird, soil, water an sediment samples for laborator analysis in Spain and at ORNL.

"During the 1975 trip we set mor than 350 mousetraps at thre locations, just keeping ahead of th ants stripping the bait," Huckabe said. Bird samples were also difficu: to come by.

Experiments benefit others

For the government of Spain the goal of the research is economic in nature. If the findings show no ill ef fects to Almaden's environment business at the mercury mine might improve. But for Huckabee. the Almaden mine provided perhaps the world's best experimental station for mercury pollution experiments.

In April, Huckabee returned tc Almaden for the final time to wrap up the four-year experiment. This trip will conclude the sample gathering. In the months ahead ORNL scientists will analyze the remaining samples then organize and correlate all the in formation from laboratories at ORNL and Almaden to, hopefully, find an an. swer to Spain's question.

Spain might get some good news. Early findings indicate that most of the samples analyzed contain acceptable levels of mercury by U.S. standards. Regardless, Huckabee said he believes it was a worthwhile experiment in terms of acquiring Information into the environmental distribution and effects of mercury that could benefit the whole world.

KNEE DEEP-Researchers collect aquatic samples, used to determine mercury levels in water, from the North Fork Holston River. Waders, left to right, are: Sherry A. Janzen, ORNL Environmental Sciences Division; Paco San.?, Spanish biologist; and John W. Huckabee, ORNL ecologist.

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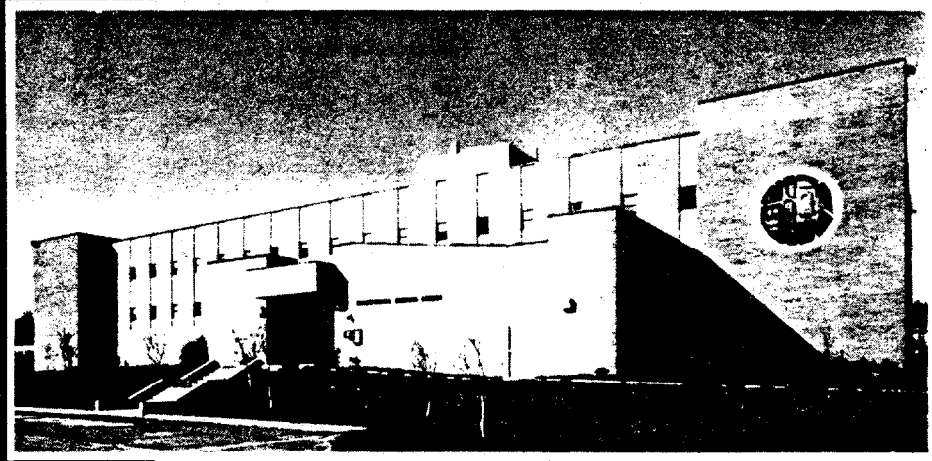
ENVIRONMENTAL SCIENCES LABORATORY



Dedication
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ENVIRONMENTAL SCIENCES LABORATORY

OEOICATION

Daniel J. Nelson Auditorium
February 26 and 27, 1979

S. I. Auerbach and N. T. Millemann
Editors

Date Published: September 1980

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Appendix

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The Oak Ridger

32ND YEAR-NO. 28—482-1021 OAK RIDGE. TENN., WEDNESDAY, FEBRUARY 27, 1980 15 CENTS

Short winter

A short spell of spring followed by a short return of winter and now more spring-like ogoin. Continued fair and mild through Thursday. High todoy and Thursday obout 50; low tonight near 30.

RATHER

CBS News to film at ORNL

Dan Rather, one of the correspondents on CBS's "60 Minutes," will be in Oak Ridge Monday afternoon to interview two scientists at Oak Ridge National Laboratory.

Rather will interview Stan Auerbach and John R. Trabalka, two of tbe authors of a report analyzing the purported Soviet nuclear accident in the late 1950s.

The Soviets have never acknowledged the accident, and refuse to comment on it.

The report of the accident seems to continue to resurface after its first report in 1977, and the interest of "60 Minutes" may have been sparked by the release of the ORNL report back in December. That report circulated through the Department of Energy network, and was released to press in Washington by a member of Critical Mass, ananti-nuclearorganization.

Ruby Miller, of ORNL public relations, who is arranging the CBS interview, said today that she had not yet been given a date for thesegment to be aired.

And. savs Harvev Cobert, head 'of public relations for Union Carbide Nuclear Division, UCND will be filming whatever "60 Minutes" tapes, in light of the recent "60 Minutes" broadcast on Illinois Power Co. (See separate story.)

Trabalka told The Oak Ridger that he and others at ORNL became interested in the alleged Soviet accident when Soviet scientist Z.A. Medvedev visited at ORNL and spoke about the accident. Trabalka had read Medvedev's paper on the accident before Medvedev arrived, and was able to question him further about it, he said.

Medvedev had reported that in late 1957 or early 1966. a nuclear explosion apparently took place in the area of Russia east of the Ural Mountains. "There was a news report in a newspaper in Australia in 1959," Trabalka said, adding that Medvedev had been surprised when he came here in 1977 that so few scientists knew about the explosion at all.

The blast apparently caused the evacuation of five small towns and about 25 smaller communities in the area, which is in the southern part of Russia near Kasli in the region known as Mongolia.

Scientists here are interested in knowing how the accident was handled, and have asked the Soviets to reveal information about it.

AUERBACH

TRABALKA

Page 22 THE OAK RIDGER, OAK RIDGE. TENNESSEE, FRIDAY, SEPTEMBER 23, 1983

Eight ORNL staffers recognized

Eight Oak Ridge National Laboratory staff members have been elected fellows of the American Association for the Advancement of Science. The designation recognizes members "whose efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished."

COUTANT

DYER

FRANCIS

O'NEILL

SHUGART

VAN HOOK

VAN WINKLE

The new fellows, who bring the total so honored at ORNL to more than 100, are: Charles C. Coutant, Melvin I. Dyer, Chester W Francis. Robert V. O'Neill, Herman H. Shugart, Jr., Robert I. Van Hook and Webster Van Winkle. Jr.. all of the environmental sciences division; and Michael K Wilkinson of the solid stale division.

Coutant, a senior research ecologist. specializes in fisheries evaluation and temperature effects on fish. He holds the B.A.. M.S., and Ph.D degrees in biology from Lehigh University. and joined Union Carbide in 1970 He is 1983 program chairman for the American Fisheries Society and chairman of the Environmental Quality Advisory Board for the city of Oak Ridge. He and his wife. Nancy, reside at 120 Miramar Cr They have two children

Dyer. who joined Union Carbide in 1980, studies interactions among plants and animals. He holds the B.S. in zoology from the University of Idaho and M.S. and Ph.D. degrees from the University of Minnesota. He and ha wife, Barbara, live in Roane County. They have two children.

Francis, a group leader and solid waste program manage,. joined the former health physics division in 1969. His research has focused on radionuclides and toxic contaminants in soil, denitrification, wastewater processing and solid waste management. He received the B.S. in agronomy from Iowa State University and the M.S. and Ph.D. in soil science from the University of Wisconsin. He and his wife. Norma. live at 102 Brentwood Dr. They have one child.

O'Neill, whose specialty is mathematical modeling of ecological processes. first Joined Union Carbide as a Ford Foundaton postdoctoral fellow In 1968 and has been a research ecologist since 1970. O'Neill received the B.S. from Cathedral College and the Ph.D. in ecology from the University of Illinois He and his wife, Elizabeth, live at 53 Outer Dr.

Shugart. a staff member since 1971, holds B.S. and M.S. degrees in zoology from the University of Arkansas and the Ph.D. in zoology from the University of Georgia. His current work is on computer simulations of long-term forest dynamics. He serves on the editorial boards of the Ecological Society of America and Annual Reviews of Ecology and Systematic% He and his wife. Ramona, and their two children live at 108 Mohawk Rd.

Van Hook, head of the terrestrial ecology section. Is responsible for research on air-pollution effects, biogeochemical cycling, and effects of trace elements in the environment lie has B.S. and Ph.D. degrees in entomology from Clemson University and has held both National Institutes of Environmental Health and Atomic Energy Commission fellowships. He and his Wife. Nancy. live at 102 Neville La. They have two children

"an Winkle, a group leader In the aquatic ecology section, joined Union Carbide in 1972, where he specializes in studies of fish populations and ecosystem dynamics and modeling. He received the B.A. from Oberlin College and the Ph.D. In zoology and physiology from Rutgers University. and was a Public Health Service and NSF fellow in biomathematics. He and his wife, Judy. and their three children reside at 37. Montclair Rd

Energy Systems People

Three ORNL staff members—Frances E. Sharples, Judy L. Trimble and Robert B. Fitts—have been named to new research and program management responsibilities in the ORNL Environmental Sciences Division.

Sharples becomes group leader for environmental compliance in the Environmental Analyses Section. Previously, she was manager of program strategy for the ORNL Remedial Action Program and a regulatory specialist in the Hazardous Waste Remedial Action Program.

Trimble will serve as the division's manager of technical and administrative services. Most recently, Trimble has been technical assistant to the ORNL associate director for biomedical and environmental sciences and managed technical and subcontract research under the DOE-sponsored Biomass Production Program at ORNL.

Fitts will be program manager for the DOE Environmental Survey at ORNL. Previously, Fitts worked in the DOE Hazardous Waste and Remedial Action Programs at ORNL.

Robert I. Van Hook has been named associate director of the Environmental Sciences Division at ORNL. Previously, he was head of the division's terrestrial ecology section.

The division's specialized capabilities include ecosystem analysir, environmental toxicology. hydrology and geoscience. In addition to managing national and international collaborative programs conducted at field sites throughout the United Statesand abroad, the division oversees the 12,000-acre Oak Ridge National Environmental Research Park for DOE. The division has a full-time staff of 200, some 180 visiting scientists and research -participants annually and an operating budget this year of $37 million.

Sharples

Trimble

Fitts

Van Hook

Soviet lichenologist visits ORNL research project

Oleg Blyum (left) and Lorene Sigal examine a lichen sample that was taken from the Smokier in the 1930's.

What do ORNL environmentalists and researchers in the Soviet Union have in common? As a starter, both groups have an interest in research in the Great Smoky Mountains National Park (CSMNP). Oleg Blyum and Lorene Sigal are lichenologists studying the effects of pollution there.

Blyum visited Sigal at the Environmental Sciences Division last month from the Ukrainian Academy of Sciences at Kiev. His visit was arranged under the auspices of the 1972 agreement between the United States and Soviet governments for cooperation in environmental protection, particularly the project dedicated to air pollution effects on vegetation, including forest ecosystems.

During Blyum's visit, laboratory work was completed for a project that compares the trace metal content of lichen species collected in the CSMNP in 1939. 1966 and 1982. Lichens are good indicators of atmospheric pollution because they are long-lived and they absorb contaminants readily from the air, rain and fog. The results of the study will be compared to studies of the trace metal content of tree rings from conifers in the CSMNP.

August 11, 1988

Program gives students new perspective on science

They came from the 50 states, the District of Columbia, Puerto Rico and five foreign countries, but the 57 DOE High School Science Honors Program participants had a lot in common.

For some, their two weeks at ORNL's Environmental Sciences Division (ESD) was just one of many activities programmed for them during this summer. For others, the opportunity to learn about environmental sciences opened their eyes to some of the challenges facing their generation. A few who had participated in similar programs relayed interesting perspectives.

Katherine Shiue, from Henderson, Nev., and Kristie Willert, from Wooster, Ohio, participated in fast year's honors program at Lawrence Livermore and Lawrence Berkeley laboratories, respectively. "We had a lot more free time last year, but we had four-hour lectures with no breaks in between-and the weather was terrible," Shiue said. "I like the lab work here because it's hands-on and I want to go into environmental sciences," Willert explained. Her interest in the environment had been stimulated by a science fair project she did on PCBs.

For Holly Mills, a San Diego native, previous lab experiences helped prepare her for research at ORNL. Last year, she helped compile a DNA library to isolate genes in research into the causes of tumors at the University of California at San Diego. She will also be working this summer on a March of Dimes project and with a doctor researching Alzheimer's Disease. "The honors program gives me a broader perspective on science," she said. "I've never had any environmental science classes."

Mosr studentsagreed that they gained a different perspective on science research because of the program. James Sumner, from Narragansett, R.I., found that there wasnotalwaysonesolution to problems. Jason Ripley, of Sioux Falls, S.D.. said, "It gave me a feel for field work and an appreciation for the hard work involved in data analysis."

Lan Van, from Philadelphia saw science from a different viewpoint. "Now I know a little of what it's like being a scientist working in the field, getting dirty and wet."

Douglas Chen, from Potomac, Md., said working with ESD researrhers was a great opportunity. "They've been very understanding and eager to teach students because rhey know that we'retheoneswhoare going to need to clean up rhe environment," he said. Regina Verow, of Veazie, Me., agreed and said she was surprised the researchers were so relaxed and personable. "I thought rhey would be much more stiff."

ESD researchers Gregg Marland and Bob Cushman said the added work of coordinating lectures, research assignments and field work between the students and more than 100 ESD' staff members was a worthwhile experience. "It's always invigorating to see things from a student's perspective." said Cushman. "It also gave me a chance to see what was going on throughout the division and how the work done here interrelates to help solve environmental problems," he added.

Students unanimously praised ESD efforts to make the fwo weeks productive yet enjoyable. Ripley probably summed up the experience best. "The work wasn't work," he said. "The time in the field was a lot of fun, but you learned something while you were out there."

Harry Boston, right, research staff member in ORNL's Environmental Sciences Division, describes "The Living Stream," an experiment being conducted in the Aquatic Ecology Laboratory, to honors students, from left, Albert Chow, Diane Dybalski and Susanna Mac as Kathy Blair (partially hidden). director of the Ecological Study Center at Oak Ridge National Environmental Research Park, listens.

Students, from left, Christine Seidier, Marianne Donohue, Geoff Lloyd, Camilla Cheatham and Yvonne Nicholson play the parts of public activists during a role-playing presentation through which they represent problems researchers face in cleaning up contaminated streams.

April 19, 1990

Reichle, Van Hook'named to new posts

David Reichle, director of the Environmental Sciences Division at ORNL, has been named associate director for Biomedical and Environmental Sciences at the laboratory, succeeding Chester Richmond.

Appointed acting director of the Environmental Sciences Division is Robert Van Hook, who also will continue to serve as director of the Center for Global Environmental Studies.

Reichle will administer life sciences research and development programs in the Biology, Environmental Sciences and Health and Safety Research divisions, and programs of the Center for Global Environmental Studies.

A member of the ORNL staff since 1966, Reichle holds bachelor's, master's and doctoral degrees in biological science and is a recipient of the scientific achievement award of the International Union of Forest Research Organizations.

Reichle

Van Hook

Van Hook was named associate director of the Environmental Sciences Division in 1988 and director of the Center for Global Environmental Studies in 1989.

He has been a member of the Environmental Sciences Division since 1970. He holds BS and PhD degrees in entomology and has completed studies in the executive development program of the University of Tennessee.

Van Hook named to head ESD

Robert I. Van Hook has been named director of the Environmental Sciences Division at ORNL, and Michael P. Farrell and Steve Rayner have been named acting director and director, respectively, of the Center for Global Environmental Studies.

Van Hook

Farrell

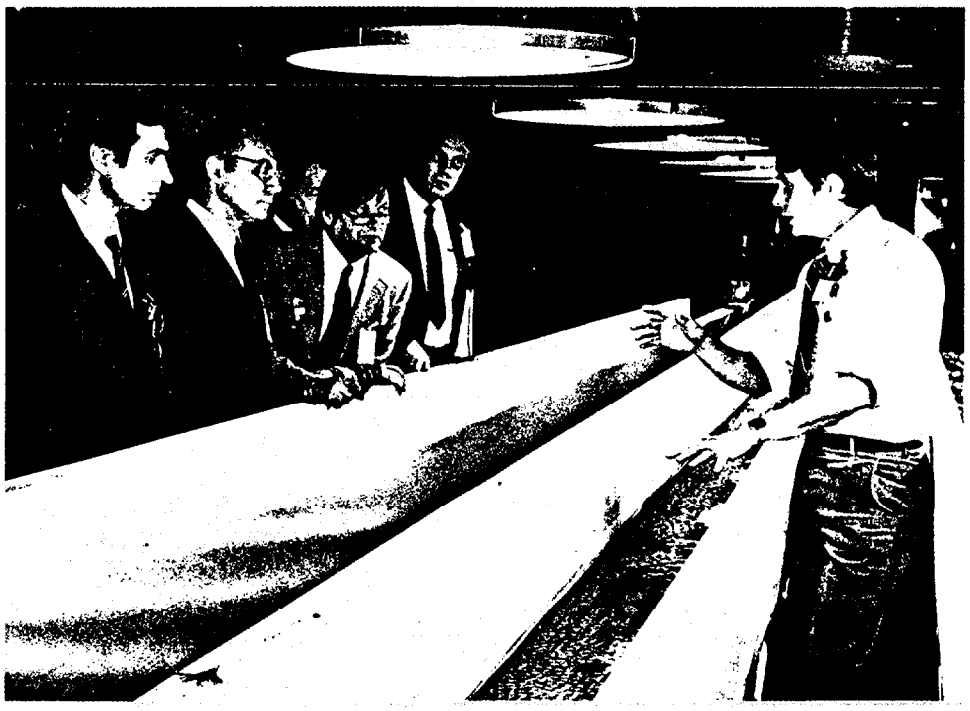
Van Hook's previous post was as acting division director and director of the Center for Global Environmental Studies. He holds a BS and PhD in entomology from Clemson University, where he was a National Institutes of Health environmental health trainee. He came to ORNL in 1968 as an Atomic Energy Commission predoctoral fellow. He also has completed the University of Tennessee executive development program.

Van Hook, who joined the Environmental Sciences Division in 1970, has served as head of the division's terrestrial ecology section, as technical assistant to the ORNL associate director for Biomedical and Environmental Sciences, and as program manager for Ecosystem Studies and Biomass Production.

Farrell holds a BS in biology and chemistry and an MS in ecology from the University of Dayton and a PhD from Mississippi State University;' where he was an Atomic Energy Commission fellow. He joined the ORNL staff in 1979 and most recently has served as deputy director of the Center for Global Environmental Studies. Farrell also serves as director of the ORNL program in carbon dioxide information analysis and research.

He is a member of the executive committee of the SAS Users Group International of the SAS Institute and is a fellow of the Institute of Environmental Sciences. He is a recipient of an Energy Systems Operational Performance Award.

April 19, 1990



Technical exchange

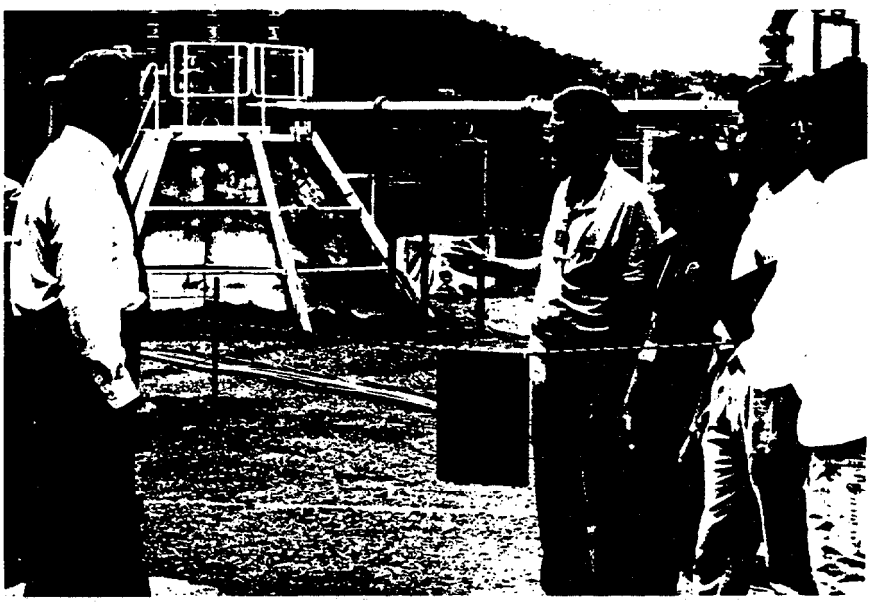
Boris Nikipelov, first deputy minister of the Soviet Ministry of Atomic Energy and Industry, second from left, listens along with other Soviet environmental and waste management specialists as Art Stewart of the ORNL Environmental Sciences Division explains how biological monitoring of streams and wastewaters from waste treatment operations is used to improve waste management practices and verify the effectiveness of environmental restoration. The nine-member Soviet delegation toured the Oak Ridge Reservation as part of a technical exchange on environmental restoration, radioactive waste management and associated environmental issues. Also on the delegation's agenda were stops at the Savannah River Plant near Aiken. S.C. and the Waste Isolation Pilot Plant at Carlsbad, N.M.

In situ vitrification

ORNL researchers demonstrate new technology

New in situ vitrification (ISV) technology beingdeveloped by the DOE Office of Technology Development to stabilize material deposited in old radioactive waste sites was demonstrated on radioactive material at ORNL in May.

The technique, developed at Battelle Pacific Northwest Laboratory, employs electricity to heat the materials intoamoltenmass at temperatures up to 1,400" Celsius. When the molten material cools, it becomes a glass-like substance similartoobsidianrock formed in volcanic eruptions. Having been sealed inside the glass-like formation, the radioactive material is immobilized and cannot escape into the surrounding area or be carried away by water.



Brian Spalding, project officer for a recent test of in situ vitrification technology. explains the workings of the demonstration containment area. The technique converts *old* radioactive *waste* into glass *by melting the contents of* burial *pits and trencher.*

Anthony Malinauskas, ORNL director of Waste Research and Development Programs, said ORNL researchers were "extremely pleased" with the results of the 128-hour test and that "we were able to achieve some key objectives."

When analyses of the data are complete, Malinauskas said, a report on the project will be prepared and submitted to DOE. The researchers hope to have assessed the effectiveness of the technology by September to determine whether it will be applicable for waste deposited in burial pits and trenches at ORNL.

"Should ISV prove to provide a viable solution and assuming follow-up studies go well, we may be using this process on laboratory waste pits by the mid 1990s," he said.

In the demonstration conducted by personnel from ORNL and Pacific Northwest Laboratory, a 20-ton block of glass was produced in a simulated seepage pit containing a sample of sludge from an ORNL pit.

The sludge contained a small amount of radioactive cesium-137 and strontium-% Up to 500 kilowatts of electricity was applied to the simulated seepage pit through four graphite electrodes for about 90 hours, melting the pit to a depth of nine feet. A large hood was placed over the simulated pit to ensure that no radioactive material escaped in gaseous form.

The melting essentially is confined to the trench because the material in the trench melts before the heat spreads significantly into the undisturbed soil.

Following the demonstration, researchers estimated that more than 99.99 percent of the radioactive material was retained in the glass.

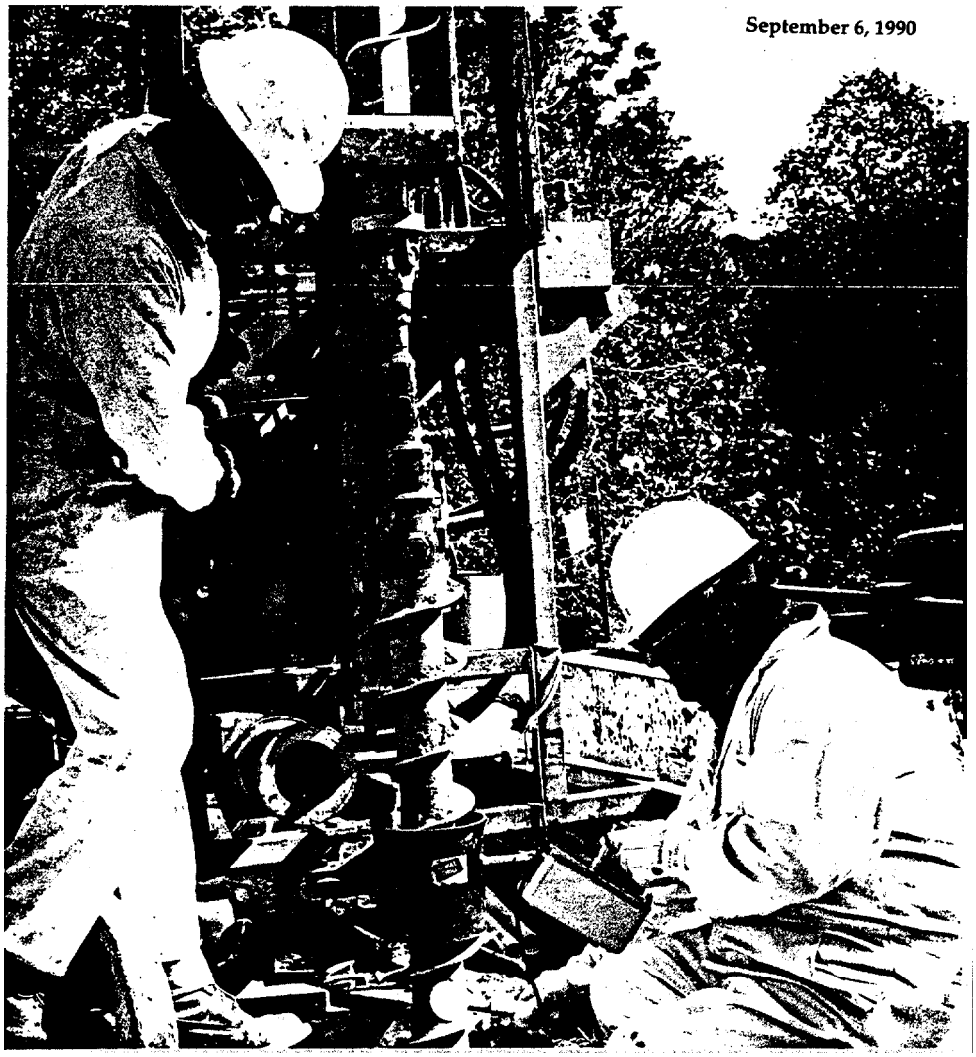
After the glass is cooled-a phase that takes several weeks—core samples are taken for evaluation of the durability of the material and its ability to retain the wastes when exposed to groundwater.

The demonstration was designed to test both the radiological safety of the vitrification process and a newly developed electrode feeding system in which the graphite electrodes areallowed to slide into the melting material. The previous system involved placing electrodes deep in the ground before the electricity was applied, which would have required the hazardous operation of digging into contaminated waste.

Another goal was to test various nondestructive techniques for monitoring the shape and temperature of the molten material. These included computer manipulation oi transmitted sound waves to construct an "image" of the molten material as it grows. Techniques tested included one developed by ORNL researchers.

In situ vitrification was first tested at ORNL in 1987 on a pilot-scale trench that contained no radioactive materials. Analysis of the 1987 demonstration data revealed that 99.88 percent of the nonradioactive cesium was retained in the glass block, and 99.9% percent of the strontium was retained.

If the demonstrations are found to have been successful, the technology may be used to provide permanent entombment for some 800,000 curies of strontium-90 and cesium-137 placed in seven trenches at ORNL between 1951 and 1966.



Monitoring wells

David Farmer, left, a technician in the Environmental Sciences Division *at ORNL, augers a hole for placing a groundwater* monitoring well as *Milo* Ward, a *radiation protection* officer *on subcontract to ESD, monitors soil cuttings forpotential radioactive contaminants. Data from monitoring wells in Solid Waste Storage Area 6* are *used in* detennining *distribution* of *contaminants and in assessing the effectiveness* of *corrective action.*

OAK RIDGE NATIONAL LABORATORY
MANAGED BY MARTIN MARIETTA ENERGY SYSTEMS. INC.
FOR THE U.S. DEPARTMENT OF ENERGY

POST OFFICE BOX 2008
OAK RIDGE. TENNESSEE 37831

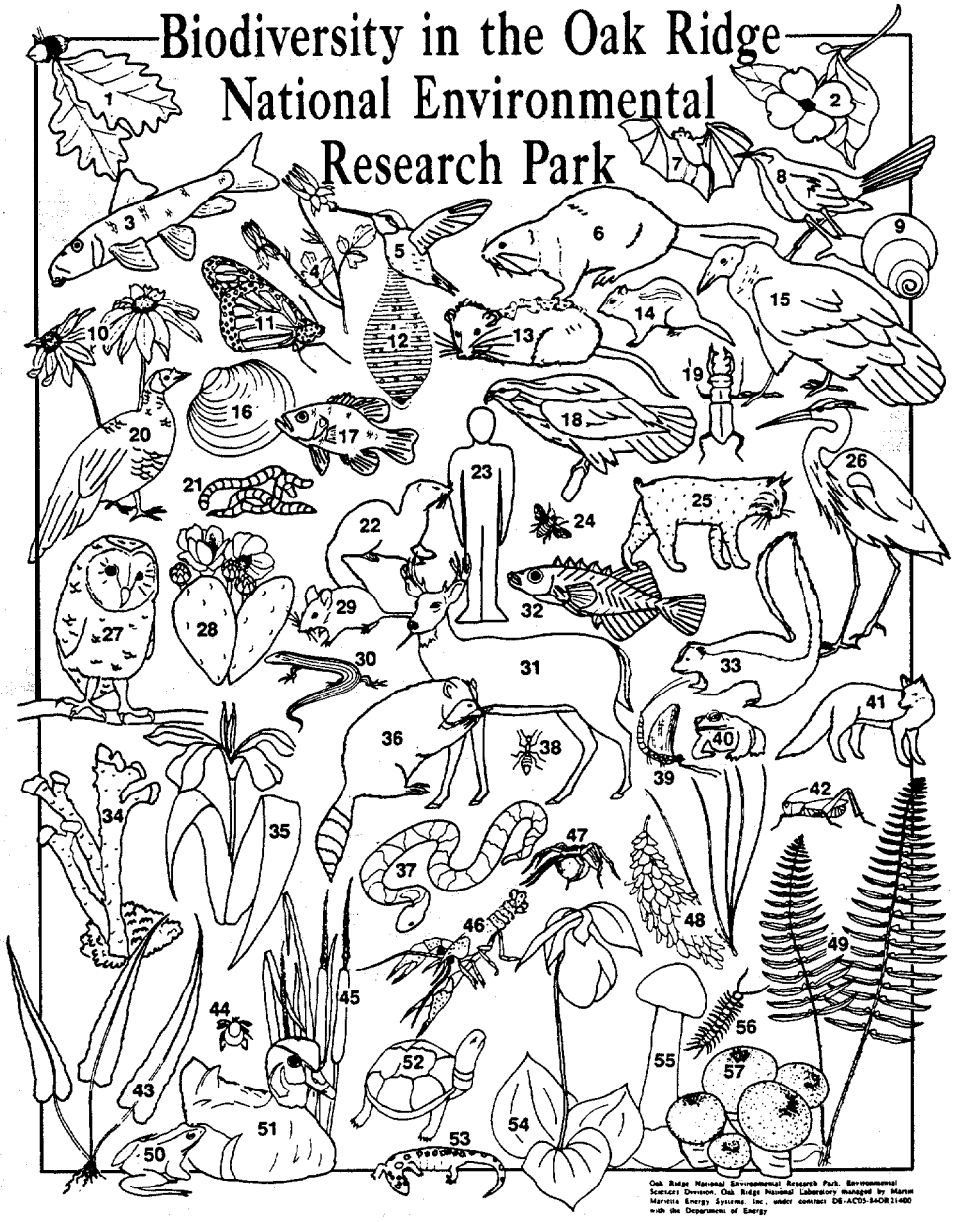
Thank you for your interest in our poster "Biodiversity in the Oak Ridge National Environmental Research Park".

The poster not only illustrates some of the biological diversity in the Research Park, but can be used as a learning tool. Uses include: coloring only mammals, or birds, or plants, etc; coloring the predators, herbivores, nocturnal animals: coloring species found in particular habitat types; coloring plants and animals that are rare; researching life histories of particular species; identifying plants and animals without the key; determining other species that could have been included; learning what certain plants or animals may look like in different seasons; or, coloring the plants and animals that occur in your area to determine similarities and differences. Maybe your class could make their own poster! As an educator you will likely have additional creative uses- I'd appreciate learning of them!

The Oak Ridge National Environmental Research Park is located on the Department of Energy's 35,000 acre reservation in Oak Ridge, Tennessee (near Knoxville). The area lies in the heart of an Eastern Deciduous Forest area of streams and reservoirs, mesic hardwood forests, and extensive upland mixed forests. The combination of wooded and open areas and the broad peripheral communities create favorable habitats for a wide -variety of wildlife species. Bordered on both sides by water and dissected by many spring-fed streams, the reservation provides wetland habitat for many aquatic communities. The Oak Ridge National Environmental Research Park is one in a network of seven Research Parks established by the Department of Energy to provide protected land areas for research and education in the environmental sciences, and to demonstrate that energy technology and use can be compatible with a quality environment. Please contact me if you are interested in additional information on the Oak Ridge National Environmental Research Park.

Pat Parr

Patricia D. Parr
Oak Ridge National Environmental Research Park
Environmental Sciences Division



Key to Biodiversity Poster

1. oak
2. dogwood
3. northern hog sucker
4. columbine
5. ruby-throated hummingbird
6. beaver
7. eastern pipestrelle bat
8. mockingbird
9. snail
10. black-eyed susan
11. monarch
12. leech
13. opposum
14. chipmunk
15. black vulture
16. freshwater mussel
17. warmouth sunfish
18. red-tailed hawk
19. stag beetle
20. wild turkey
21. earthworms
22. mink
23. human
24. hornet
25. bobcat
26. great blue heron
27. barn owl
28. prickly pear cactus
29. white-footed mouse
30. skink
31. white-tailed deer
32. brook stickleback
33. skunk
34. British soldiers lichen
38. dwarf-crested iris
36. raccoon
37. copperhead
38. ant
39. mayfly
40. toad
41. red fox
42 grasshopper
walkingfern
44. deer tick
49. cattail
46. crayfish
47. nursery spider
48. pine
49. christmas fern
50. frog
51. wood duck
box turtle
53. spotted salamander
54. pink-lady's slipper
55. mushroom
56. millipede
57. puffballs

20 DEC 90

Hollaender Fellow

Researcher studies effects of CO, on plants

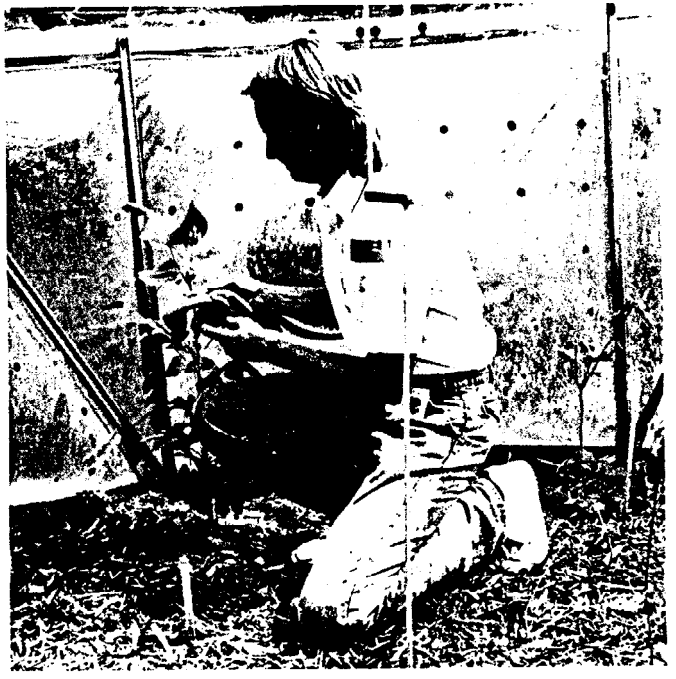
by Susan McNutt

Stan D. Wullschleger, one of two recipients of DOE 1990 Alexander Hollaender Distinguished Postdoctoral Fellowships, is studying the effects of elevated atmospheric carbon dioxide levels on tree physiology as part of an ORNL Environmental Sciences Division program in physiological ecology research.

Research on elevated carbon dioxide is relevant in light of documented evidence of increasing amounts of carbon dioxide in Earth's atmosphere.

"People here have established a national and international reputation for this kind of work with respect to plant response to atmospheric chemistry. That, combined with the facilities and the staff here, contributed to my decision to come to Oak Ridge," he said.

"These are state-of-the-art facilities," Wullschleger said. Most climate change experiments are confined to labs or greenhouses. The Global Change Field Research Site is one of the few places where this type of research is conducted out of doors.



Stan Wullschleger

With Richard J. Norby and other staff members, Wullschleger analyzes data obtained from a series of open-top chambers containing white oak and yellow poplar seedlings.

The growth of the plants in environments with elevated carbon dioxide levels is compared to growth in the presence of ambient levels of carbon dioxide. The plants are exposed to normal amounts of rainfall and grow in their natural medium.

While the emphasis of the long-term project has been on plant growth above the ground, Wullschleger will extend the analysis to growth below the ground. He will study growth by photographing the roots in Plexiglas tubes.

The photographs will provide data that will be used to determine the effect of the elevated carbon dioxide levels on the rate, location and type of root growth. He also will conduct additional physiological experiments in the laboratory.

'The results of these studies will give us a good understanding of the response to stress both above and below ground."

Plant physiologists and other scientists will use these data for computer modeling to predict the effects of global change.

Wullschleger completed a doctorate in agronomy at the University of. Arkansas this year. His research interests include plant response to environmental stress, water use efficiency, stomata1 physiology, photosynthesis and anatomical factors in gas-exchange processes in leaves.

The focus of his master's program at Colorado State University was tree physiology.

The $35,000 fellowship was created in honor of Alexander Hollaender, a pioneer in biomedical research and radiation biology and former director of the ORNL Biology Division. The fellowships support study in biomedical, life and environmental sciences.

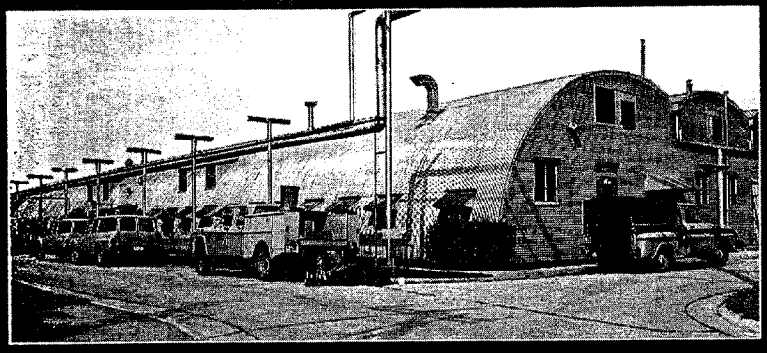
The first picture of the ecology research group was taken in the summer of 1955, one year after the program had started. This began an annual summer photo-session tradition. The individuals in this 1955 photo are, from left. first row, Robert Davis (graduate student), Stanley Auerbach, and Orlando Park (Northwestern University); second row, Victor Sheldon (University of Missouri), Henry Howden (The University of Tennessee), Manfred Engelmann (graduate student), and Edward Struxness (Health Physics Division Program leader).

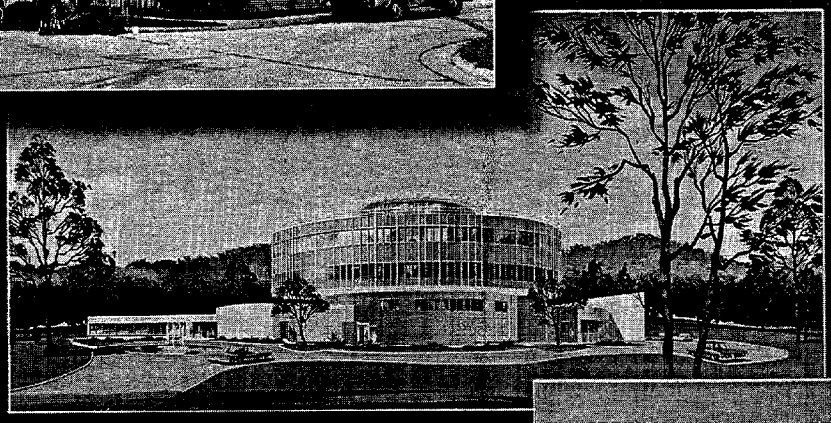
Building 2001 (Quonset Hut) was the initial site for the ecology program. The program was moved to Y-12 (Bldg. 971 l-l) in 1956 and remained there until 1961, when it was reestablished in Bldg. 2001. Conceptual design was started on a new facility for ecological research in 1963. This advanced concept was completed and proposed in 1965 but was not funded. Funding was approved in 1975 for construction of the present facility, which was completed and occupied in 1978.

1955

1992

1954-55 1961-1978





Proposed
1963

1978-Present