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PROGRESS REPORT

HEALTH PHYSICS DIVISION

QUARTERLY PROGRESS REPORT
FOR
PERIOD ENDING JULY 15, 1949

K. Z. MORGAN, DIRECTOR
F. WESTERN, ASSISTANT DIRECTOR

OAK RIDGE NATIONAL LABORATORY

OPERATED BY
CARBIDE AND CARBON CHEMICALS CORPORATION
FOR THE
ATOMIC ENERGY COMMISSION
POST OFFICE BOX P
OAK RIDGE, TENNESSEE

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ORNL 375
Progress Report

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HEALTH PHYSICS DIVISION QUARTERLY REPORT*

This report covers the activities of those groups in the Health Physics Division primarily engaged in Applied Research or Development. More or less routine activities of the Survey-Monitoring Section are covered in the Laboratory Weekly Progress Report.

Instrument Development. During this period the manpower of this group has been increased by the transfer of one engineer from the Special Problems Group of the Health Physics Division and by the transfer of a draftsman from the Technical Division.

Work on a fast neutron portable survey meter during this period indicates the feasibility of a portable instrument indicating direction of source, and measuring the dosage due to neutrons ranging in energy from 0.1 Mev to 10 Mev. However, immediate attention has been given to the production of a breadboard model of a simplified version, of less weight, which indicates only fast neutron flux. This model has been well received in the field and has proved to have very stable operating characteristics. It utilizes a proportional counter, with a probe of approximately 1 in. internal diameter and 8 in. in length, filled with methane at atmospheric pressure. A central wire potential of 2000 volts renders it operative in the proportional region. Fast neutrons, of energy greater than approximately 0.1 Mev, give pulses of sufficient size to fire the thyratron after one stage of amplification. The inherent simplicity is due in part to the fact that individual secondary electrons from gamma radiation give pulses too small to operate the thyratron. In fields of radiation greater than 0.4 r/hr coincidence pulses from such electrons become significant.

Due to some reduction in local pressure for an improved low level alpha counter, this problem has been assigned secondary priority and little time has been devoted to it during the past quarter.

Recent development in the techniques of scintillation counting suggest the possibility of interesting applications in the field of Health Physics instrumentation. One member of the group has been given the assignment of studying present techniques with a view of adapting them to our problems wherever they may offer advantages.

* Due to a change in the scheduled dates for Health Physics Quarterly Reports, the period covered by this report extends from March 1, to July 15.

In studying the relative merits of various films for use as window material for the alpha survey meter, comparisons of the rates of diffusivity of moisture through nylon and pliofilm have been made. For these tests silica gel was placed in containers capped with the film under test. With the use of sealing tape around the rims of the containers, cups were formed of which the bottoms were the samples of the film to be tested. Water was kept in these cups through the duration of the tests. It was found that the rate of diffusivity of water vapor through nylon is greater than that through pliofilm by a factor of 34.

Progress in the development by a commercial manufacturer, of an improved oscilloscope, mentioned in the quarterly reports for periods ending August 31, and November 30, 1948, has indicated the desirability of some revision in the specifications for this oscilloscope. In cooperation with a member of the Physics Division, some time has been spent with the contractor in discussing the problems involved in raising the instrument from its present level of development to that desired. New specifications have been written for submission to the contractor for his consideration.

To assist in the design and testing of portable instrumentation, where we are concerned with instrumentation life expectancy and reliability, two items have been added to our laboratory equipment. These are (1) a vibration fatigue testing machine model, 25-HA, made by the All American Tool and Manufacturing Company, maximum load 25 lbs at 10 g, total displacement adjustable 0-0.125 in. frequency adjustable 10-60 cps, and (2) a stroboscope (631-B Strobotac) for visual observations of apparatus being tested.

Detailed activities of the Instrument Development Section during this period are described in a quarterly report prepared for limited distribution by W. M. Hurst.

Waste Disposal Studies. The Waste Disposal Research Group includes research workers and assistants employed in the Health Physics Division and also personnel assigned on loan from other agencies. During this quarter there has been no change in the permanent staff of employees. Of the assigned personnel, L. R. Setter, of TVA accepted a position elsewhere and left the group June 3, 1949. Lt. Comdr. R. B. Krum of U. S. Navy was transferred for duty elsewhere effective May 1, 1949. Additions to the group have included Lt. Thomas R. Ostrom, of U. S. Army, assigned, for a period of one year or longer, for full time work and experience in this section; and two trainees, Lt. Col. John H. Rust, III, and Mr. A. Emmons, who will participate part time for several months from about May 1.

The principal survey project during this quarter was the collection and study of an extensive sample of fish from White Oak Lake with cooperation of TVA Game and Fish Section. Fish were collected May 2 and 3, and throughout the month of May were processed and examined to determine the amount and kinds of radioactive material present in particular tissues of different species and from several locations in the lake. Lt. Col. Rust selected various specimens and several hundred microscopic sections are being made for more detailed study.

Studies of more or less conventional water treatment methods as a possible means of decontamination of radioactive liquid wastes have been continued. A laboratory with small treatment units for semi-works trials of these processes has been established in the old water plant building, pending action on a request for an experimental laboratory and pilot plant which would house an extensive projected program in the field of water plant and sewage disposal studies.

"A Preliminary Report on Studies of the Removal of Radioactivity from Waste Water by Adsorption on Clay Particles" was submitted to R. J. Morton by R. A. Lauderdale about June 1, 1949.

Considerable attention has been given to the proposed experimental laboratory and pilot plant. Since the original proposal was submitted for approval, discussions have been held with representatives of the AEC and other interested groups. The original proposal has been modified in an effort to include more adequately the probable interests of these various groups.

The question of sewage treatment for the Laboratory has been of special interest as a source of sewage materials for Waste Disposal Research studies, and close contact has been maintained with the Engineering and Maintenance Division and the Austin Company in the development of sewage plans. To assist in obtaining more adequate data on sewage flows and sanitary chemical conditions, a special project was carried out during the first two weeks of June in which members of the Waste Disposal Section analyzed hourly samples of sewage collected by the Austin Company. After assembly of the analytical data a special report was prepared and distributed and has been discussed with the design groups on several occasions.

Work on waste disposal instrumentation problems has been mainly toward the development of a satisfactory portable probing instrument for the detection of radioactivity in the water and bottom deposits of streams or lakes. Three models of such an instrument have been developed and constructed and several

testing and sampling trips on Norris Reservoir and on Clinch River have been made.

Representatives of the Atomic Energy Commission have formulated and discussed tentative plans for a comprehensive ecological and biological survey of White Oak Creek and Clinch River areas. This project is of fundamental interest and importance in relation to radioactive waste disposal research studies and, if the proposed plan is adopted, members of this Section will cooperate and participate in the project.

Detailed activities of the Waste Disposal Research Section are covered by monthly reports prepared for limited distribution by R. J. Morton.

Theoretical Physics. A preliminary report covering the proposed method for the evaluation of ionization excitation losses in tissue was submitted to the Division Director June 8, 1949. The proposed method is now awaiting appraisal by one or more consultants.

The collision density due to a beam of thermal neutrons normally incident on a half-space of tissue has been computed under the assumption of isotopic scattering and constant energy. Tolerance calculations based on this information are being computed and a detailed report will be issued upon their completion.

One member of this section is working jointly with the Physics Division on the problem of the neutron scattering coefficient of NaCl crystals at various temperatures. The other member of this section is participating in the Summer Shielding Session being held at Oak Ridge National Laboratory.

Experimental Physics. The aerial survey project in which members of this section were engaged for several months, in cooperation with the Air Forces, has been written up and a limited report, ORNL 341, has been issued.

An experimental study of the attenuation of the activity of stack gases from X-10 to K-25 is being made. Measurements are being made with an air conductivity measuring apparatus which has been developed to be used as a gaseous air monitoring device. The apparatus, essentially an ion collector, responds to the intensity of ionization in the air passing through a tube. It has the following advantages: a response proportional to the energy radiated by radioactive gases, higher sensitivity than ion chambers or G-M tubes, short time constant, and simplicity. It has the disadvantages of being somewhat affected by smoke or fog in the air and of being more difficult to calibrate.

A continuous recording moving filter unit with beta and alpha counters measuring particulate activity continuously at periods of 20 minutes and 4-1/2

hours after collection is in process of construction. This will give valuable data on the variation of natural background activity of radon and thoron, by measuring their decay products, as well as on other particulate activity.

A cooperative effort with the Weather Bureau is getting underway. A study of the activity of the stack effluent at different locations and meteorological conditions is anticipated. At present six balloon borne beta G-M counters have been constructed and a balloon ionization chamber is being developed where the balloon itself is the ion chamber.

Special Problems. Two members of the Special Problems Section have devoted their efforts to the design and assembly of instrumentation for the Waste Disposal Research Section. One of these members has recently been transferred to the Instrument Development Section.

A number of activities have been in connection with problems of interest to the Division and to the Laboratory. These have included accurate measurements of radiation from cobalt and tantalum sources; observations of scattering of radiation from floor and walls during calibration of instruments; perfection of a convenient vacuum tube electrometer for accurate radiation measurements and the construction of various thin-walled ionization chambers for measurement of β radiation.

A preliminary redetermination of the radiation from the surface of natural uranium metal gives a value of 240 mrep/hr in close agreement with the value reported at the last Health Physics Information Meeting by Bass, DiGiovanni, and LeVine of the New York Office of Directed Operations, AEC. An improved extrapolation chamber has been designed and is under construction. Detailed studies have been made of the absorption of β radiation from uranium, P^{32}, Sr^{90}, and Bi^{210}, by a number of absorbers including Al, Ni, Cu, Mo, Cd, Pb, polyethylene, cellulose acetate, cellulose, cellophane, teflon, glygerine, rubber and a black conducting paper which has been found useful for the construction of thin-walled ionization chambers.

Urinalysis. A program directed at the development of methods of analysing body fluids for low tolerance concentrations of some of the β-γ emitting radioisotopes which are considered most hazardous in ORNL operations has progressed to the stage that the method can be used for analyses of urine specimens for these radioisotopes. Development of these methods has been done by the Radiobiochemistry Group of the Biochemistry Section of the Biology Division, with the cooperation of one member of the Chemistry Group of the Health Physics Division. Procedures will be published soon in a report, ORNL 368, entitled "Procedure for the Radiochemical Analysis of Barium, Strontium and Rare Earths in Human Urine" by Paul C. Tompkins, L. B. Farabee and J. X. Khym.

The procedure is essentially quantitative for lanthanum and yttrium. The recovery of barium was found to be around 95%, while that of strontium was approximately 90%.

Consultation and Radiation Protection Engineering. One member of the section has been on loan to another AEC operation since April 26, 1949.

Major activities have included study and consultation on possible radiation hazards involved in the recently constructed evaporator for concentration of radioactive wastes, the new Isotopes Separation area, the projected Research Laboratory, and the Physics of Solids Building.

Field tests for possible flaws in lead slabs to be used in numerous shields in the Isotopes Separation Area have been made using a nine curie cobalt source of radiation.

Education and Training. Current training in Health Physics includes three more or less formal programs for the following groups:

(1) Nine N. R. C. Health Physics Fellowship Students for a 12 months period from November 1, 1948.

(2) Eight Medical Officers for a six months period from April 11.

(3) Fourteen officers from the Armed Forces engaged in a three year program in radiation and assigned to this laboratory for an eight weeks' period of field training, from July 7.

During this period three persons from Brookhaven spent ten days each with this Division and one person from New York Directed Operations spent five days.

Substantial contributions to the success of the Health Physics Training Programs has been and continues to be made by the cooperation of other laboratory groups. In addition to the field work made possible by the operations of the laboratory and production groups, personnel from some of these groups have given lectures on specialized subjects. The Biology Division has been especially generous in this respect.

Divisional Organization. To provide a bird's eye view of the activities of the Division, a divisional organization chart is appended to the current report.

HEALTH PHYSICS DIVISION ORGANIZATION CHART

July 1, 1949

Director - Karl Z. Morgan

Ass't Director - Forrest Western

Assistant to Director - C. E. Haynes

Office Staff to Director -
Kay Dixon, M. Farabee, M. Wright

Secretary to Ass't Director - E. McBee

Librarian - C. Long

Procurement and Supply - R. C. Andrews

PBX Operator - T. Henderson

CONSULTATION AND RADIATION PROTECTION ENGINEERING

W. H. Ray
H. J. McAlduff
T. H. J. Burnett

RADIOISOTOPES - COMMITTEE ON PERMISSIBLE INTERNAL DOSE

C. H. Perry
M. Doherty

WASTE DISPOSAL RESEARCH

R. J. Morton
B. Beasley
T. A. Brockett
R. A. Lauderdale
V. I. Knobf
K. S. Lyle
T. R. Ostrum*
O. R. Placak**

EDUCATION AND TRAINING

R. S. Thackeray
B. Helton
M. F. Fair
M. R. Ford
L. C. Leibowitz

EXPERIMENTAL PHYSICS

F. J. Davis
R. Roberts
P. W. Reinhardt

SPECIAL PROBLEMS

F. Western
T. E. Bortner
J. S. Cheka
J. M. Garner

THEORETICAL PHYSICS

J. Neufeld
W. S. Snyder

INSTRUMENT DEVELOPMENT

W. M. Hurst
B. Helton
G. S. Hurst
J. A. Harter
W. B. McDonald
R. C. Elerbee
E. B. Wagner
E. G. Purdom***

* On loan from USMSC

** On loan from USPHS

*** Summer Visitor - Guilford College, N. C.

ORINS

Director - K. Z. Morgan

Ass't Director - Forrest Western

SURVEY MONITORING SECTION

J. C. Hart
C. Scott
A. Canfield

SURVEY GROUP A

O. D. Teague

100 AREA
R. L. Clark
W. H. Table

200 AREA
L. C. Johnson
J. P. Lane

9207 BIOLOGY
P. C. McRee

SEMI-WORKS
H. A. McClearen
J. C. Davis

GENERAL SURVEY
E. J. Kuna
R. L. Lindsay
P. O. Martin

706 A AREA
G. R. Patterson
T. G. Pappas

SURVEY GROUP B

A. D. Warden

706 C-D
E. L. Sharp
C. A. Golden
Geo. Hall
R. S. Parker

SHIFTS

"A"	G. A. Cain	
	B. C. Bartley	
"B"	C. S. Bensey	
	J. Burden	
"C"	D. E. Arthur	
	R. T. Wiggins	
"D"	C. R. Guinn	
	D. C. Nichols	

PERSONNEL MONITORING GROUP

J. C. Ledbetter

X SHIFT - H. R. CRAFT

J. Tench	J. Soard
N. Conant	G. Reeves

Y SHIFT - H. T. WALTERS

W. Bowelle	J. Huff
R. Cobb	D. Soard

Z SHIFT - H. H. ABEE

N. Fields	G. Lee
P. Reese	S. Terrell

NON-ROUTINE PROCESSING

E. Bardill	M. Johnson
C. Henson	F. Thomas

ASSAYS - INSTRUMENTS

D. M. Davis

AREA MONITORING

W. D. Cottrell

FIELD ANALYSES
R. G. Lawler
W. D. Neely
R. Stepp

LABORATORY ANALYSES
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C. E. Vaughn

ASSAYS - P. E. BROWN

BODY FLUID ANALYSES
A. M. Smith
A. E. Flynn
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COUNTING ROOM
J. Anderson
K. McDaniel
H. Barker
M. Tiller

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M. Hagood
B. LaCook
M. Hill

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A. E. Carter
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CALIBRATIONS
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A. C. Butler
J. P. Sprain
H. J. Wyrick