

0256

RDT & E PROJECT CARD CONTINUATION	REPORT DATE	PROJECT NO.
<p>23. c. <u>Tasks:</u></p> <p>7930-59622 (formerly 7930-9) "Radiobiological Effects of Simulated Primary Cosmic Radiation: AF 41(657)-305 Yale University 1 September 1958 - 30 November 1961 \$81,416 - Dr. E. C. Pollard</p> <p>1. <u>Description:</u> This task will provide the United States Air Force with a study of the radiobiological effect and mechanisms operating in tissues and tissue-like materials exposed to radiation simulating cosmic ray primaries. The following will be investigated:</p> <p>a. The delta ray effect and radial spread observed in enzyme systems such as ribonuclease.</p> <p>b. The actual temperature rise and thermal conductivity effect caused by the "thermal spike" characteristic of the termination of heavy primary cosmic ray particles.</p> <p>c. The evaluation of microbiological systems for exposure to heavy cosmic ray primaries by flight techniques in order to evaluate the effects of cosmic radiation at altitude.</p> <p>d. The feasibility of using systems such as Artemia eggs, giant squid axons, rotifers, and etc. These shall be examined using the high energy particles simulating cosmic radiation to establish feasibility.</p> <p>e. The results of experiments with biological materials will be related to theoretical analysis of the radiobiological characteristics of the densely ionizing tracks of the accelerated heavy ions. An effort will thus be made to determine the physical and physio-chemical phenomena occurring at a molecular level to produce the effects observed.</p> <p>2. <u>Progress:</u> Exposure of Artemia eggs to 160 MEV oxygen ions revealed an exponential decrease in survival indicating that the passage of a single energetic oxygen ion was responsible for the loss of activity of an egg. Studies of the damage caused by heavy ions to the cellular membranes of <u>E. coli</u> by measuring the leakage of cellular components from irradiated cells were conducted by Dr. Deering. He has concluded that under the precise conditions used in these experiments heavy ions were no more effective than x-rays, in inhibiting the growth of cells immediately after irradiation and that leakage of cell content was no more serious with heavy ions than with x-rays.</p>	15 March 1961	7930
DD FORM 1 FEB 60 613c	REPLACES DD FORM 613-1, WHICH IS OBSOLETE. PAGE 19 OF 62 PAGES	

15 March 1961

7930

23. c. Tasks (cont'd)

Studies of haploid and diploid yeast by Mr. P. E. Schambra indicate with rather convincing evidence that for yeast cells at least, the radiation damage produced by heavy ions is primarily in the cell nucleus.

Mr. Rauth has continued work on dry enzymes, particularly lysozyme indicating, contrary to an earlier observation, that the inactivation of lysozyme cannot be ascribed solely to an ionization in a fixed volume which is independent of the type of ionizing radiation used. The radio-sensitivity to heavy ions is approximately 50% more than that which would be anticipated from corresponding x-ray doses. The clear indication here is that another mechanism of inactivation is taking place. Studies to determine the mechanisms are continuing.

Dr. R. A. Deering has also developed a satisfactory mylar window tissue culture chamber which permits irradiation of HeLa cells with the very short range heavy ions. Another problem has been the accurate determination of exposure (charge accumulated during irradiation) at lower dose levels ranging between 10 and 100 rad. This has been solved with the development of a detector with an amplification factor of 1,000.

Dr. Hutchinson's group is working with a private firm "Controls for Radiation" who are studying survival of tumor ascites cells under another AF contract. They have arranged a joint project to include exposure to ions heavier than helium. This work is underway.

Dr. Lloyd Skearsgard is studying the induction of chromosomal aberrations in Tradescantia when exposed to heavy ions. Preliminary experiments have been completed.

3. Publications: Dolphin G. and Hutchinson, F.: The Action of Fast Carbon and Heavier Ions on Biological Materials: I-The Inactivation of Dried Enzymes. Radiation Research 1960.

Hutchinson and Easter: A Difference Between the Biological Effects of Gamma Rays and Heavy Ions. Science 4 Nov 60 Vol 132, No. 3436, pg. 1311.

Schambra, Rauth, Northcliffe: Energy Loss Measurement of Heavy Ions in Mylar and Polyethylene. Radiation Research 1960.

4. Monitor: Lt Col David G. Simons, Bioastronautics Branch.