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PROGRESS REPORT NO. 3, June 1 - Aug. 31, 1963

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ENERGY DISSIPATION CHARACTERISTICS IN TISSUE FOR IONIZING RADIATION IN SPACE

Submitted to NASA, Washington, D. C.

By

H. J. Schaefer. Aug. 31, 1963 (NASA CR 51 826)

Hermann J. Schaefer
Principal Investigator

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U.S. NAVAL SCHOOL OF AVIATION MEDICINE,
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A Joint Report with the title "A Note on the Influence of Shield Geometry on Air Dose and Tissue Dose from Protons Within a Space Vehicle" as announced in Progress Report No. 2 (1 March 1963-31 May 1963) has been distributed in early July.

Work in the past three months has concentrated on a better resolution of the linear energy transfer (LET) spectrum of heterogeneous proton beams at the upper end of the LET scale. Contributions to this spectral region originate exclusively from the terminal sections of proton tracks in tissue where the LET passes through the Bragg peak. The LET intervals in the earlier computational analysis (Joint Report No. 24, Jan. 24, 1963) were too large for satisfactory resolution of this particular spectral section. The earlier study, therefore, had to rely upon an indirect method for estimating the comparatively small contribution from the Bragg peak to the total dose. In view of the high RBE of this contribution, a more accurate analysis is desirable. For this purpose, a graduated resolution of the LET scale has been chosen covering the Bragg peak with a sufficient number of narrow intervals, yet using larger steps in the lower region where the LET changes comparatively slowly. The analysis covers now the entire LET range of protons. So far, it has been applied only to one typical flare produced proton energy spectrum for two different depths (2 g/cm^2 and 8 g/cm^2) in tissue and to the energy spectrum of neutron recoil protons (so-called Watt-Spectrum).

The results replace the earlier estimate by accurate quantitative data on the fractional dosage effected at LET values about the Bragg peak. Though this dosage generally remains on the level of a few per cent of the total ionization dosage, it changes markedly depending on the depth in tissue for which the local spectrum is analyzed, contrary to the broad maximum in the low-LET region representing the bulk of the energy dissipation which shows only a small dependence on depth. As a consequence, it can be stated that a complete measurement of the radiation load from a solar proton beam requires separate determination of the total ionization dosage and of the second maximum at the upper end of the LET scale.

The indicated results have been submitted and accepted for presentation as a NASA sponsored study at the International Atomic Energy Agency Symposium on Biological Effects of Neutron Irradiations, Brookhaven, New York, October 7-11, 1963. The manuscript of the paper has been completed and is being printed. It is scheduled to come off the press September 27. Reference copies will be forwarded as soon as available.

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