extrapolated ranges obtained from the corrected number plots were not significantly different from those obtained from the original ionization distribution data.

These extrapolated ranges should correspond to the "practical maximum range" defined by Bleuler and Zünti.[4,5] The "absolute maximum range" is greater but is not as easily determined experimentally. In Fig. 3 the extrapolated ranges determined from plots similar to those in Fig. 2 are plotted as a function of the kinetic energy of the electrons. The extrapolated ranges appear to be independent of field size. The "absolute maximum ranges" would be a few millimeters longer.

Fermi[6] and Halpern and Hall[7] have discussed the polarization effect of materials in a condensed state on the energy loss of electrons. The upper curve in Fig. 3 is a plot of the ranges to be expected on the basis of Halpern and Hall's[7] treatment of density effects in water. This curve was constructed from their results for water by numerical integration. The lower curve was constructed in a similar manner from the predictions of the Bethe-Bloch formula as represented by Halpern and Hall.[7] The calculated ranges which include density effects approach the experimental ranges more closely. The experimental "absolute maximum ranges" would, moreover, be slightly greater than the extrapolated range points shown.

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Low States of F^{17} and Neutrons from $O^{16}+D$

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(Received June 18, 1951)

A THIN (<80-kev) tungsten oxide target, (prepared by electrolysis) was bombarded by 3.083-Mev deuterons from the Wisconsin electrostatic generator. The resultant neutron spectrum was observed by means of Eastman NTA nuclear emulsions, 100 microns thick, mounted 10 cm from the target and at angles of 0°, 10°, 20°, 30°, and 90° to the direction of the beam. A total of 1700 tracks have been measured. Both the criteria[1] for the measurement of the proton recoil tracks and the range-energy relation[2] have been discussed elsewhere. The data, plotted in 50-kev intervals, and corrected for geometry[3] and for variation of the neutron-proton scattering cross section,[4] are shown as Fig. 1.

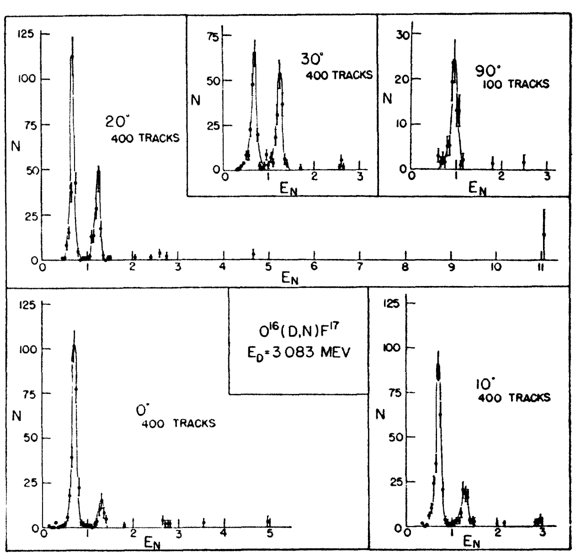

FIG. 1. Neutrons from the deuteron bombardment of O^{16} at 0°, 10°, 20°, 30°, and 90° to the incident beam. N is the relative number of neutrons per 50 kev, and E_n is the neutron energy in Mev.

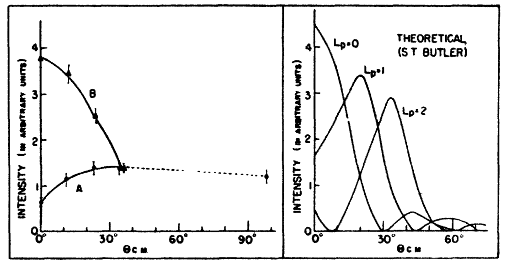

FIG. 2. $O^{16}(d, n)F^{17}$ angular distributions in the center-of-mass system. Curve A is for formation of F^{17} in the ground state, and curve B is for the 536-kev excited state. Butler's theoretical curves for high energy deuterons on O^{16} (see text) are shown for purposes of comparison.

Neutron groups corresponding to a first excited state of F^{17} at 536±10 kev are observed. These groups occur at approximately 0.7 Mev for the 0° to 30° data. The group at 90° corresponding to this first excited state would have an energy less than 0.5 Mev, and no tracks due to neutrons of energy less than 0.6 Mev were measured at that angle. The neutrons of energies 2.5 to 3 Mev at the various angles are possibly from carbon contamination (ground-state neutrons from the $C^{12}(d, n)N^{13}$ reaction). Neutrons from the first excited state of N^{13} would appear well below the lower limit of observation.

Figure 2 shows the relative intensities of the ground-state neutron groups (curve A) and of the 536-kev excited state neutron groups (curve B) as a function of angle in the center-of-mass system. Figure 2 also shows Butler's[5] theoretical curves for angular distributions resulting from a stripping process. These curves are for deuteron energies above the coulomb barrier which for oxygen is about 2.5 Mev. Hence, it is interesting to compare the shape of the experimental intensity *vs* angle curve for the 536-kev level of F^{17} with the $L_p=0$ curve of Butler. If the comparison is valid, this leads to the assignment of $S_{\frac{1}{2}}$ to the first excited state of F^{17}. Burrows, Gibson, and Rotblat[6] have bombarded O^{16} with 8-Mev deuterons, and they have interpreted the angular distribution of the protons from the 0.88-Mev level of O^{17} by means of Butler's theory. This led to their assignment of $S_{\frac{1}{2}}$ to this first excited state of O^{17}. Hence, it appears that the 0.536-Mev level of F^{17} and the 0.88-Mev level of O^{17} are the mirror levels expected from the equality of n-n and of p-p forces.

Alder and Yu[7] have assigned $D_{5/2}$ to the ground state of O^{17} on the basis of a nuclear induction experiment. By mirror nuclei arguments, the ground state of F^{17} should also be $D_{5/2}$. The shape of the experimental intensity *vs* angle curve for the ground state of F^{17}, as shown on Fig. 2, is not inconsistent with such an assignment if it is remembered that for our low deuteron energy compound nucleus formation might be expected to compete appreciably with the stripping process. Compound nucleus formation would probably tend to make the angular distribution more isotropic.

The author is extremely grateful to Professor H. T. Richards for suggesting this experiment, for his aid in the exposure of the plates, and for many helpful discussions. She also wishes to acknowledge the generous assistance of D. R. M. Williamson, and of D. J. Donahue, R. E. Benenson, and D. S. Craig in the running of the generator.

* Supported by the AEC and the Wisconsin Alumni Research Foundation.

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