this it is found that

$$\Delta E/I^2(I+1)^2 = 2.11 \text{ eV}.$$

The value of the parameter B is 23.7 eV, as determined from the energies of the 2+ and 4+ levels of the ground-state band in W^{184}. Here the indications are that the W^{184} deviations in the ground state from an $I(I+1)$ energy dependence are in only a small part due to coupling to the γ-vibrational band, a result in complete accord with the systematic analysis of twelve cases by Nielsen.[35]

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Bombardment of C^{12} by Li^6 Ions*

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Thin, self-supporting carbon films have been bombarded by Li^6 ions with an incident energy of 3 MeV. Relative angular distributions have been determined for alpha particles leading to the ground state of N^{14}, deuterons to the ground state of O^{16}, and protons to the second, third, and fourth excited states of O^{17}.

In this experiment, C^{12} was bombarded by 3-MeV ions of Li^6 from a Van de Graaff accelerator. The positive-Q reactions resulting from this bombardment are:

$$\begin{aligned} Li^6 + C^{12} \rightarrow\ & \alpha + N^{14} + 8.79 \text{ MeV},\\ & p + O^{17} + 7.60 \text{ MeV},\\ & d + O^{16} + 5.68 \text{ MeV},\\ & n + F^{17} + 4.05 \text{ MeV},\\ & n + p + O^{16} + 3.45 \text{ MeV}. \end{aligned}$$

A rotating solid-state detector was used to detect and identify the charged light particles produced, the energy response of the detector being calibrated with the alpha particles from ThC and ThC′. A 256-channel analyzer sorted the amplified output pulses from the detector. Relative angular distributions were measured for the alpha leading to the ground state of N^{14}, the deuteron to the ground state of O^{16}, and protons to the second, third, and fourth excited states of O^{17}.

Although light particles leading to other excited levels were identified, the angular distributions were not determined because of limitations in the resolution of the detector.

Measurements were made with Dearnaley-type[1] targets of natural carbon. The target spot was approximately 0.040 in.×0.100 in. in size, and was viewed by the detector through an acceptance angle of ±2.5°. Both a monitor detector and a Faraday cup, the latter collecting ions which passed through the target, were used to normalize the angular yield data.

Retractable foils of various thicknesses could be inserted between the detector slit and the detector proper. The charged particles were identified by noting their shift in effective energy as different absorbers of known stopping power were inserted in the beam of reaction products and by their shift in energy with angle of observation. Typical particle spectra for two different absorbers are shown in Fig. 1. Such spectra were obtained for laboratory angles from 30° to 150° in 10° intervals. The resulting angular distributions are illus-

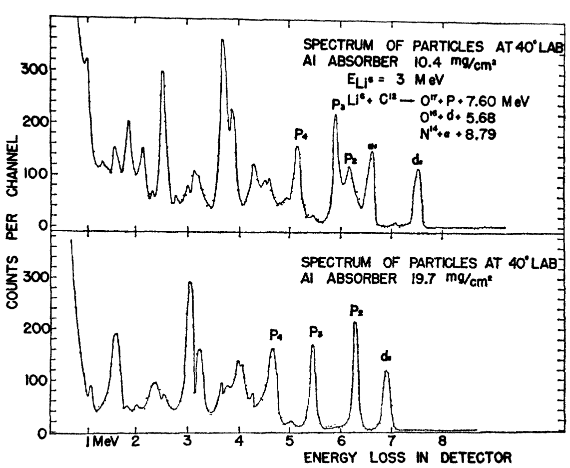

Fig. 1. Typical particle spectra.

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[1] G. Dearnaley, Rev. Sci. Instr. 31, 197 (1960).

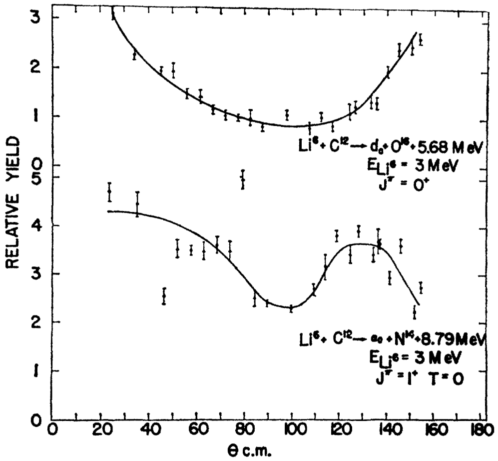

FIG. 2. Relative differential cross sections for deuterons from $C^{12}(Li^6,d)O^{16}$ leaving O^{16} in the ground state (top) and for α particles from $C^{12}(Li^6,\alpha)N^{14}$ leaving N^{14} in the ground state (bottom). The two types of data (shown as a dot and a triangle) are from two different runs under similar conditions.

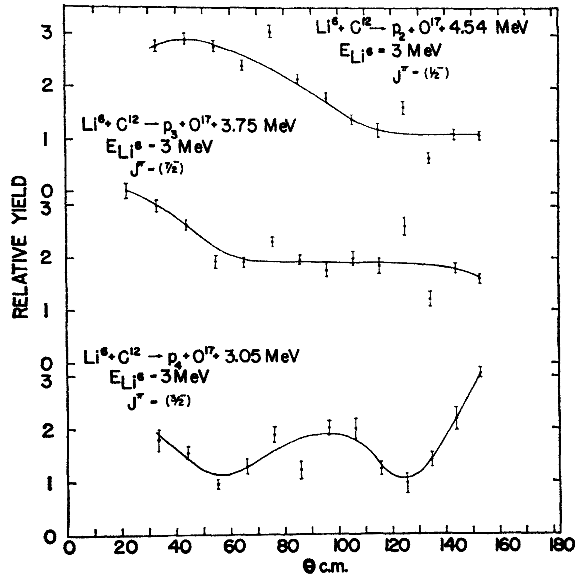

FIG. 3. Relative differential cross sections for protons from $C^{12}(Li,p)O^{17}$ leaving O^{17} in the second excited state (top), in the third excited state (middle), and in the fourth excited state (bottom).

trated in Figs. 2 and 3. In the latter figures, the error bars are statistical only. Larger errors, approaching $\pm 20\%$, arise from the subtraction of the background counts. Integrating over angle, the relative yields of the particle groups are as listed in Table I.

TABLE I. Relative integrated yields of charged particles from Li^6+C^{12} at 3 MeV.

α_0	d_0	p_2	p_3	p_4
100	41	58	61	48

The present data agree well with those taken at higher bombarding energies by Blair and Hobbie[2] and Hobbie and Forbes.[3] However, it is not clear that the Minnesota and present findings can be smoothly extrapolated to the French data[4] at 1.7 MeV.

[2] J. M. Blair and R. K. Hobbie (private communication).
[3] R. K. Hobbie and F. F. Forbes, Phys. Rev. **126**, 2137 (1962).
[4] Pham-Dinh-Lien and L. Marquez, Nucl. Phys. **33**, 202 (1962).