mined in this manner, we have used Eq. (1) to calculate the $B(E2)$ values for all the transitions listed in Table I for which Eq. (1) holds. The resulting numbers are listed under the heading "rotational." There is striking similarity between the two sets of calculated numbers. Note that for the ^{21}Ne transition discussed above, both methods of calculation lead to a $B(E2)$ that is much smaller than the measured value reported.

All these results indicate a close relationship between the shell-model and rotational pictures of the low-lying levels in light s-d shell nuclei.

We are grateful to K. H. Bhatt for many useful discussions on the unified rotational picture of these nuclei.

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POLARIZATION-VECTOR ANALYZING POWER OF THE REACTIONS ^{9}Be$(d,p)^{10}$Be AND ^{12}C$(d,p)^{13}$C

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Measurements have been made of the vector analyzing power for polarized deuterons of 12 MeV of the reactions ^{12}C$(d,p)^{13}$C, ^{12}C$(d,p)^{13}$C* (3.09-MeV state), and ^{9}Be$(d,p)^{10}$Be. For the first of these reactions a comparison has been made with proton-polarization measurements at a nearby energy.

Recently considerable interest has been shown in the usefulness of polarization measurements in (d,p) stripping reactions.[1-3] It has been suggested[1,2] that such studies should provide a more sensitive test for j dependence than cross-section measurements[4] and that they should give added insight into the reaction mechanism.[3,5] Most polarization experiments have examined $P_p(\theta)$, the proton polarization produced in the reaction using unpolarized deuterons,[6,7] but Yule and Haeberli[8] have recently reported proton asymmetries produced using a polarized deuteron beam. Their work on medium-weight nuclei $(54 > A > 24)$ suggested that the proton-asymmetry angular distributions depended not only on l_n, the orbital angular momentum of the captured neutron, but also upon its total angular momentum j_n. The present work, which refers to light nuclei, strengthens the conclusions on j dependence and further allows a comparison to be made with a measurement of $P_p(\theta)$. This is of fundamental importance in understanding the reaction mechanism.[5]

Adopting the notation employed by Yule and Haeberli,[8] the proton asymmetry A_p produced by a deuteron beam of vector polarization p initiating a reaction of vector analyzing power $P_d(\theta)$ is

$$A_p = \tfrac{3}{2}pP_d(\theta),$$

where the polarized-beam scattering intensity is related to the unpolarized one by

$$I_{\text{pol}} = I_{\text{unpol}}(1 + A_p).$$

Yule and Haeberli[8] included a small term for tensor-polarization effects. The present work employed a 12-MeV pure vector-polarized beam from the Birmingham University radial ridge cyclotron[9]; the experimental technique has been fully described elsewhere.[10]

The vector analyzing power has been determined for the following reactions: ^{9}Be$(d,p)^{10}$Be (ground state, $l_n = 1$), ^{12}C$(d,p)^{13}$C (ground state, $l_n = 1$), and ^{12}C$(d,p)^{13}$C* (3.09-MeV state, $l_n = 0$).

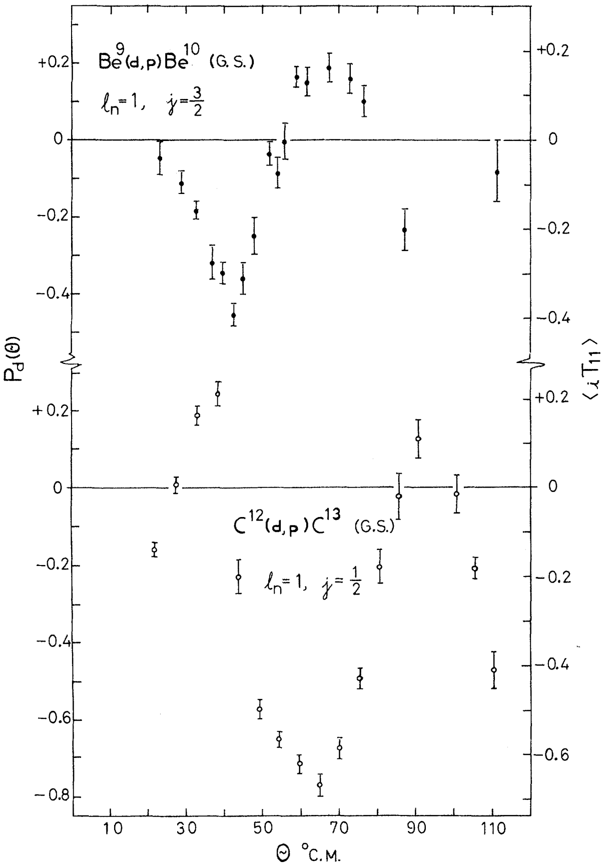

FIG. 1. Experimental angular distributions of vector analyzing power for two $l_n = 1$ reactions. $\langle it_{11}\rangle = \frac{1}{2}\sqrt{3} \times P_d(\theta)$ is shown (see Ref. 10).

The experimental results are shown in Figs. 1 and 2. The most striking feature is that the two $l_n = 1$ angular distributions are quite similar in general shape to those reported by Yule and Haeberli.[8] Furthermore, the j_n values ($\frac{3}{2}$ for ^{10}Be, $\frac{1}{2}$ for ^{13}C), although known already,[11] could easily have been found by a simple comparison of these results with those of Yule and Haeberli.[8] We conclude, therefore, that the j dependence observed for $l_n = 1$ reactions on medium-weight nuclei may be extended into the low mass region.

A recent measurement has been made at Cracow, Poland, of the proton polarization $P_p(\theta)$ produced in the ground-state reaction ^{12}C$(d,p)^{13}$C ($l_n = 1$) at 12.3 MeV.[12] The closeness of the energy to that of the present work enables a useful comparison to be made. Figure 3 shows a plot of the Cracow $P_p(\theta)$ results against the present $P_d(\theta)$ values. A linear relationship is clearly indicated having the form

$$P_p(\theta) = 0.94 P_d(\theta) + 0.10.$$

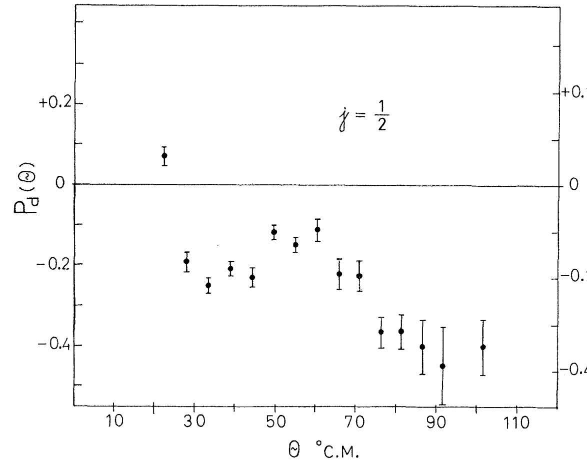

FIG. 2. Experimental angular distribution of vector analyzing power for the $l_n = 0$ reaction leading to the first excited state of ^{13}C.

A similar comparison has been reported for data at 21 and 22 MeV,[6] but with some doubt about the absolute values of $P_d(\theta)$. In the present work there is an absolute normalization uncertainty of about 10% in the determination of $P_d(\theta)$.[10]

Working on $l_n = 0$ cases, van Rij[5] has examined the consequences of either the proton or the deuteron spin-dependent distortion being dominant

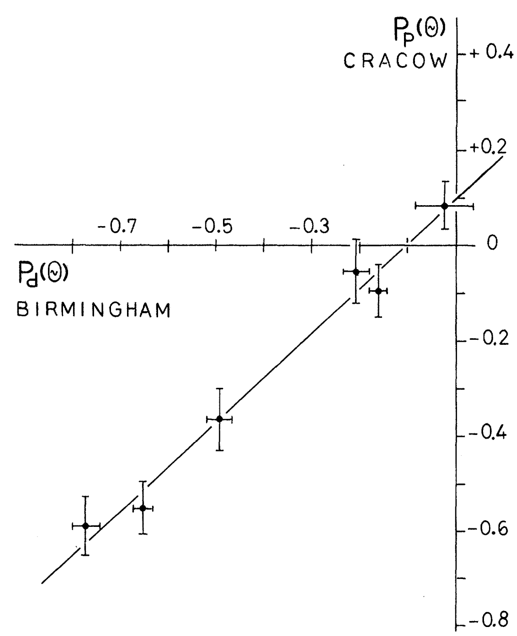

FIG. 3. A plot of proton polarization produced at 12.3 MeV (Ref. 12) versus the vector analyzing power at 11.9 MeV (present work) for the reaction ^{12}C$(d,p)^{13}$C (ground state).

in a distorted-wave Born-approximation description of stripping reactions. For the proton-dominant case a result of $P_d(\theta) = \frac{2}{3}P_p(\theta)$ was found, and for the deuteron-dominant case the result was $P_d(\theta) = P_p(\theta)$. The present work would seem to favor the latter description, provided no radical difference occurs for the predictions with $l > 0$.

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ELASTIC SCATTERING OF 600-MeV PROTONS BY ^{4}He

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The differential cross section for elastic scattering of 600-MeV protons from ^{4}He has been measured for laboratory angles between 4° and 44°. The data are analyzed in terms of the diffraction approximation of Glauber.

When high-energy particles for which the wavelength is considerably less than the internucleon spacings are used in nuclear structure studies, new information may be obtained which is not forthcoming from lower energy data. Recently at Brookhaven[1] the scattering of 1-BeV protons from ^{4}He was measured, and a diffraction pattern was observed with a pronounced minimum at a square of the momentum transfer $\Delta^2 = 0.24\ (\text{BeV}/c)^2$. Various models were applied to interpret these data. Using the strong-absorption model, the assumption of a sharp surface for the helium nucleus was required.[1] In the optical model a Saxon-Woods potential with a small diffuseness was necessary to fit the data.[2] Both assumptions are at variance with the nearly Gaussian charge distribution for ^{4}He as established from electron scattering.[3,4] Czyż and Leśniak[5] and Bassel and Wilkin[6] have pointed out that a more correct description of the scattering process is the diffraction approximation of Glauber.[7] Using a Gaussian single-particle density distribution in this approximation, the magnitude of the measured cross section as well as its basic features are well reproduced.

In spite of the success of the diffraction ap-