$$\frac{\sigma_{\text{strip}}}{2\pi R} = \frac{\alpha}{2(1+\alpha a)} \tag{1}$$
$$\times\left[\frac{\cos^2\delta}{4\alpha^2}(1+2\alpha a)+\frac{a^2\cos^2\delta}{\pi+2\delta}(1+2\alpha a)+\frac{a^2}{4}\right],$$

$$\frac{\sigma_{\text{diffr}}}{2\pi R} = \frac{1}{8\alpha}\left(\frac{4}{3}\ln 2-\frac{1}{3}\right)-\frac{a}{2}\left(\frac{3}{4}-\ln 2\right)$$

$$(\text{for } \alpha a \ll 1). \tag{2}$$

(the exact formula for σ_{diffr} is very cumbersome and for the values of a given in the table yields the same numerical results). In these formulas, δ is determined from the equation

$$\left(\frac{\pi}{2}+\delta\right)\text{tg}\,\delta = \alpha a.$$

The case $a=0$ corresponds to the usual formula

$$\sigma_{\text{strip}} = \pi R R_d/2 = 0.54\cdot 10^{-13}\, 2\pi R \text{ cm},^2$$

$$\sigma_{\text{diffr}} = \pi R R_d/2\left(\frac{4}{3}\ln 2-\frac{1}{3}\right) = 0.59\,\sigma_{\text{strip}}$$

From the above, numerical computation yields:

$a\cdot 10^{13}$ cm:	0	1	2,82
$(\sigma_{\text{strip}}/2\pi R)\,10^{13}$ cm:	0,54	0,69	0,87
$(\sigma_{\text{diffr}}/2\pi R)\,10^{13}$ cm:	0,32	0,31	0 30

It can be seen that the diffraction scattering cross section is insensitive to the choice of the force radius, while the stripping cross-section is rather strongly dependent on it (for the limiting reasonable choice

$$a = 2.82\cdot 10^{-13} \text{ cm},$$

the result differs by a factor of ~ 1.6). It is possible that this fact can explain the marked discrepancy with the experimentally found cross-section[8] which is larger almost by a factor of three than the one resulting from the equation

$$\sigma_{\text{strip}} = \pi R R_d/2$$

(the effect of the diffraction disintegration is, evidently, contributing essentially to this difference).

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34

Angular Distribution of the Products of the S^{32} (d,p) S^{33} Reaction

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THE reactions of the (d,p) type have already been well studied for many light isotopes. For the majority of the nuclei investigated, however, the experiments were carried out for a single value of the incident particle energy. It is of considerable value, in the interest of a more accurate theory of the stripping reaction, to investigate the shape of the angular distribution of the products of such reactions for different energies of incident deuterons. We therefore measured the angular distribution of protons produced in the S^{32} (d,p) S^{33} reaction for 1.8 mev and 3.8 mev deuterons. This reaction was studied earlier by Holt and Marsham[1] for 8.18 mev protons.

The deuterons accelerated in a 72 cm cyclotron bombarded a target of sulphur ($\sim 1\ \mu$ thick) coated on painter's gold. The protons produced in the reaction were registered by nuclear emulsions of the type Ia–2 (100μ thick) placed around the target at the distance of 10 cm.

The angular distribution was measured for two groups of protons, p_0 and p_1, corresponding to the production of the final nucleus in the ground and the first excited states, respectively. The experimental results obtained by us are shown in Figs. 1 and 2, where θ is the angle in the center of mass system and $N(\theta)$ is the number of protons emitted at the angle θ; the dashed lines separate the isotropic part of the angular distribution. The theoretical curves, calculated according to the formula of Bhatia et al.[2] for $R = 6.6\cdot 10^{-13}$ cm.

(for this value Holt and Marsham obtained a good agreement with the theory) are shown as well, assuming that in the ground state formation, the neutron is captured with the orbital moment l=2, and in the formation of the first excited state-with the orbital moment l=0.

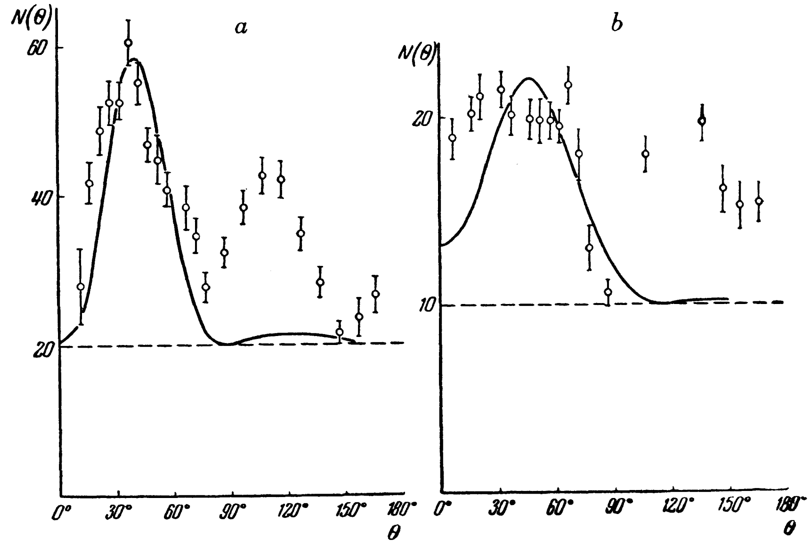

FIG. 1. Angular distributions of the p_0 proton group. Deuteron energy: *a*—3.8 mev; *b*—1.8 mev. The statistical errors are shown. Continuous curves correspond to l=2.

It can be seen that the theoretical curves correctly describe the position of the primary maximum (the small angle maximum) in the distribution of the p_1 protons (Fig.2). In the angular distribution of the p_0 group, the maximum obtained is somewhat wider than the theoretically predicted and is shifted towards smaller angles. This widening and shift of the peak is considerably more pronounced for the 1.8 mev protons than for the 3.8 mev protons. A characteristic feature of the resultant distribution is the presence of relatively large secondary maxima—at about 115° for the p_0 group and 60° for the p_1 group which increase with decreasing energy of incident deuterons. (There are no indications of a secondary peak in the Holt—Marsham distribution; for the case of the non—excited nucleus these authors report the distribution only up to 60 °.) In the angular distribution of the p_1 group, a marked increase for angles close to 180° is also noted.

In order to explain the singularities of the experimental angular distributions obtained by us, it is necessary to take the Coulomb interaction into account, since the effective Coulomb barrier of the S^{32} nucleus for deuterons is equal to 5.1 mev. This, however, shifts the primary maximum towards larger angles and does not bring about the appearance of marked secondary peaks, as shown by several authors.[3–6] Evidently, a more correct picture could be obtained taking into account not only the Coulomb interaction but the nuclear interaction of the emitted proton with the residual nucleus as well, since it follows from the calculations of Tobocman and Kalos[6] (see also Ref. 7) that the latter interaction should cause the shift of the principal peak towards smaller angles and its narrowing as well as the appearance of secondary maxima of considerable magnitude.

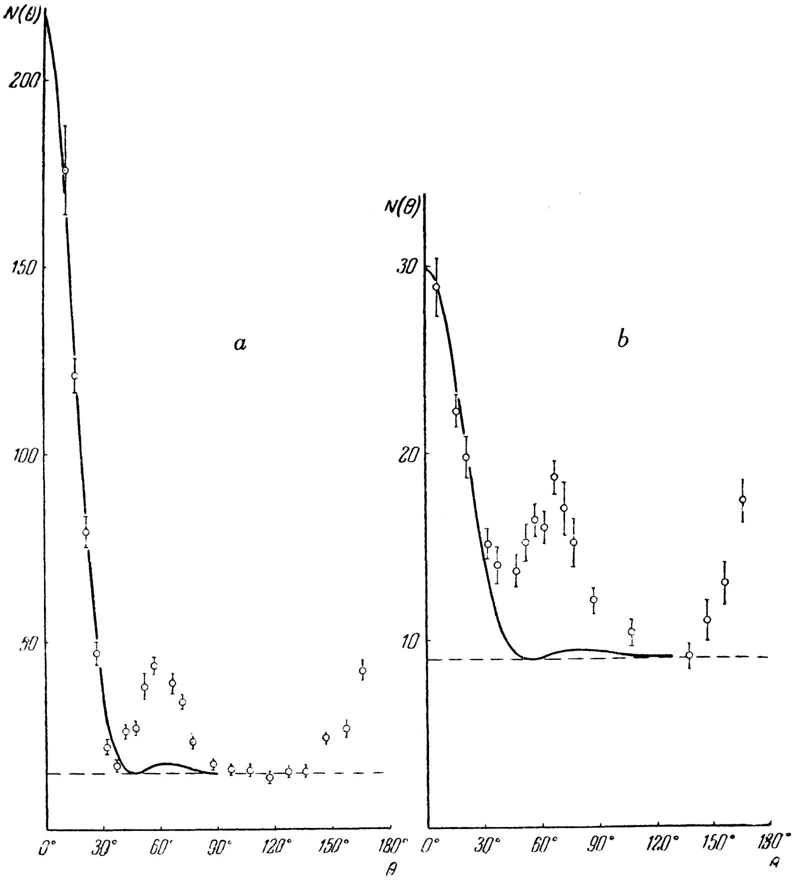

FIG. 2. Angular distributions of the p_1 proton group. Deuteron energy: a—3.8 mev; b—1.8 mev. Continuous curves correspond to $l = 0$. The scale of the ordinate axis of Figs. 1a and 2a is identical, the same is true for Figs. 1b and 2b.

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35

On a Method of Direct Computation of the Nucleon–Nucleon Interaction on the Basis of Experimental Values for the Levels of Light Nuclei

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A METHOD is given below for the study of the nucleon–nucleon interaction in nuclei based on the following assumptions: A) the forces in nucleus act between pairs of nucleons; B) the mean velocity of a nucleon in the nucleus is of the order of 0.1 c or less. Besides these assumptions which are essential for the application of the method, we assume the isotopic invariance of the proper nuclear interaction and neglect the difference in the masses of the proton and the neutron.

The wave function of the nucleus with mass number A is expanded in terms of the products A of single particle eigenfunctions of nucleons in a three–dimensional oscillator well. In this oscillator representation, Schrödinger equations are written down for different nuclei, in which the