the Figure. Over the entire temperature range, the divergence does not exceed 10–15%, and may be partly due to the error attached to the exclusion of a linear term (electronic contribution to the heat capacity).

It should be noted that Eq. (1), obtained without appealing to models, but on the assumption of strong anisotropy, and yielding satisfactory agreement with experiment for graphite, cannot lay claim to a detailed agreement with experiment for lattices that are not so strongly anisotropic lattices, e.g., laminar halide salts of cadmium.[6] However, in the same way that DeBye's interpolation formula gives good agreement with experiment in the general cases up to $T \sim \theta$, while the precise cubic law ceases to be fulfilled very early, so also in the anisotropic case it may be expected that the interpolation formula obtained by the use of the limiting law of dispersion in Ref. 2 by an integration along k, not to infinity, but to the boundaries of the wave vectors, will give better agreement with experiment at low temperatures and will be applicable to a wide class of laminar structures. This is due to the relatively great stability of the integrals expressing the heat capacity under variations of the dispersion law.[7] and to the considerably greater influence of the upper limit of integration, which is taken into account by cutting off at the boundaries of the wave vectors.

It should be noted that in structures in which the layers differ (for example, in cadmium iodide, in which they are not monatomic and the surfaces of iodine ions facing one another have different positions with respect to the origin in a hexagonal system of coordinates), soft optical branches associated with weak interactions between layers may also contribute to the heat capacity.

The last remark was made by Prof. I. M. Lifshitz. We take this opportunity to thank him for his interest in this work.

*A direct numerical integration of the I. M. Lifshitz formula was performed by N. N. Lazarenko (diploma research, Kharkov State University, 1954). However, the accuracy attained therein is insufficient for comparison with experiment.

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Investigation of the Excitation Functions for the Reactions $C^{12}(p, pn)C^{11}$ $Al^{27}(p, 3pn)Na^{24}$ and $Al^{27}(p, 3p, 3n)Na^{22}$ in the 150-660 Mev Energy Range

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THE reaction $C^{12}(p,pn)C^{11}$ (1) is widely used for the measurement of proton flux. In connection with this, it is of interest to determine the value of the cross–section for this reaction for various proton energies. The excitation function of the reaction (1) was measured by Aamont and others[1] for energies from the threshold energy up to 340 mev. Comparison of the results of Ref. 1 with the data obtained by Soroko[2] (see Figure) indicate a rapid decrease of the cross–section in the 300–460 mev range. However, the measurements of the ratio of the values of the cross–section at 290 mev and 660 mev revealed[3] that, in this energy range, the value of the cross–section for the reaction (1) decreases much more slowly. The mentioned ratio was found to be

$$\sigma(670)/\sigma(290) = 0.84 \pm 0{,}03.$$

We therefore concluded it probable that a systematic error ($\sim 15\%$) in the determination of the absolute cross–section in one of the References 1,2 is the real cause of the discrepancy. Results similar to those obtained in Ref. 2 were soon obtained in new investigations[4,5] in the 410–460 mev range. Finally, the cross–sections in the 170–350 mev range were measured with great accuracy by Crandall et al,[6] (see Figure). The values found in Reference 6 are in good agreement with the data of Refs. 2-5. The cross–sections given in Ref. 1 are, evidently, systematically larger by some 15–25%.

The existence of these discrepancies led us to the investigation of the reaction (1) in the 150–660 mev range. In the course of the experiments, a graphite target was placed in the chamber of the

accelerator of the Institute for Nuclear Problems. The decrease in the proton energy was effected by means of varying the distance between the target and the center of the accelerator. The proton flux through the target was determined with an accuracy of about 2% by means of a calibrated thermal battery. The relative activity of the graphite target was measured with a group of proportional counters. The half-life was found to be 20.8 ±0.2 min. The following energy dependence of the cross-section for the reaction (1) was obtained (E_p is the proton energy in mev, $\sigma' = \sigma(E_p)/\sigma(660)$ is the relative reaction cross-section):

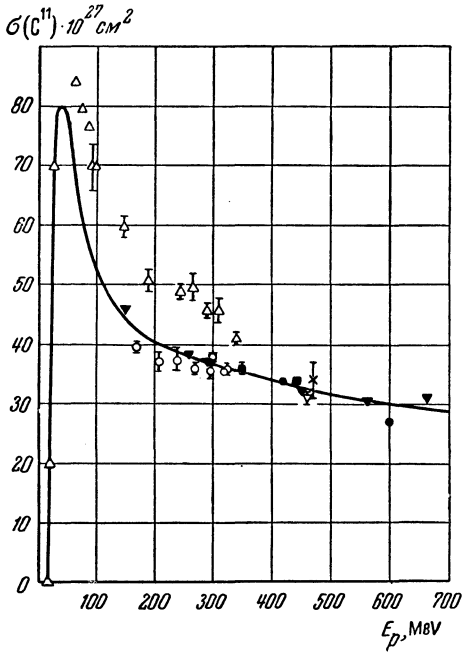
E_p:	150	260	290 [3]	350	450	560	660
$\sigma'(C^{11})$:	1.49±0.06	1.23±0.02	1.19±0.04	1.16±0.03	1.03±0.02	0.98±0.02	1.00

These results, normalized for the value of the cross-section at 350 mev[6], are shown in the Figure. The smooth curve is drawn according to the mean of the measurements of Refs. 2,4,5, and 6 and of the present work. (In the region below 150 mev, the results of the relative measurements of Ref. 1 were used). Our data are in a good agreement with those recently published.[7,8]

The excitation functions for the reactions Al^{27} $(p,3pn)$ Na^{24} (2) and Al^{27} $(p,3p3n)$ Na^{27} (3) were also measured by the same method. The results are: Al^{27} $(p,3pn)$ Na^{24} (2) and Al^{27} $(p,3p3n)$ Na^{27} (3):

E_p:	150	260	350	450	560	660
$\sigma'(Na^{24})$:	1.10 ± 0.05	1.03 ± 0.03	1.01 ± 0.02	1.02 ± 0.03	0.97 ± 0.02	1.00
$\sigma'(Na^{27})$:	1.20 ± 0.15	1.0 ± 0.1	0.96 ± 0.12	1.0 ± 0.1	1.00 ± 0.07	1.00

The energy dependence found for the reaction (2) is in an agreement with the results of reference 9.



Cross-section for the reaction C^{12} (p,pn) C^{11} for various proton energies according to the data of: △– Ref. 1, ×–Ref. 2, ■ Ref. 4, ● –Ref. 5, ○–Ref. 6, ▽–Ref. 8, ▼–the present work.

Comparison with the results for the reaction (1) shows that the ratio of the cross-section for reactions (1) and (2) decreases smoothly with increasing energy. This does not agree with the results of Ref. 10, according to which the above ratio decreases sharply in the 200–500 mev range. The latter fact leads to the conclusions[10] about the presence of a maximum for the reaction (2) at 500 mev, which is contradicted by our data.

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