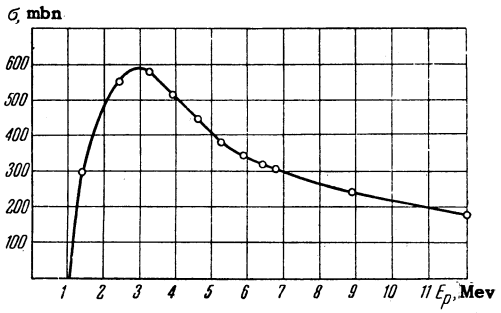

FIG. 3. Dependence of the total cross section for the reaction T (p, n) He^3 on proton energy.

α particle. The method of inverse reactions proposed by Barshall[9] was used for the measurement of the polarization. In our case, the inverse reaction is the reaction He^3 (n, p) T. A chamber filled with He^3 to a pressure of 10 atmospheres was placed at an angle θ_1 to the beam of neutrons originating from the reaction T (n, P) He^3, and the right-left asymmetry of the proton yield from the reaction He^3 (n, p) T was measured by the proportional-counter telescope[5] at an angle θ_2. In the c.m.s., a single angle $\theta_{c.m.}$ corresponds to the angles θ_1 and θ_2. The angle θ_1 was chosen from the condition of equality of the excitation energy of the intermediate nucleus He^4 in the direct and inverse reactions. This angle is uniquely determined by the energy of the reaction Q = −0.764 Mev and by the energy E_p of protons bombarding the tritium target:

$$\cos\theta_1 = (6E_p - 5.348) / \sqrt{12E_p(3E_p - 3.056)}.$$

Such a method makes it possible to measure the absolute values of the polarization without an analyzer of known properties.

Polarization measurements require a very exact geometry, since the measured azimuthal asymmetry may be due to the inequality of the right and left deviation angles with respect to the neutron beam. To check the geometry of our experimental setup, we measured the scattering of neutrons on hydrogen by means of recoil protons under the same geometrical conditions. In order to increase the angle sensitivity, the detection of recoil protons was carried out on the falling portion of the spectrum, where the counting rate decreases with the angle, both owing to the decrease in intensity and owing to the decrease in energy.

The measurements showed that, for $E_p \lesssim 10$ Mev, the asymmetry at angles corresponding to the condition of Barshall is not larger than 5%. For the angle $\theta_1 = \theta_2 = 40°$, large asymmetry has been found indicating that the neutrons are polarized.

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ISOTOPIC SHIFT OF THE CURIE POINT IN URANIUM HYDRIDE AND DEUTERIDE

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THE observed ferromagnetism of uranium hydride and deuteride[1-3] makes possible an investigation of the isotopic shift of the Curie temperature.

One possible cause of such a shift is the difference in distance between the uranium ions in these two compounds. Actually, crystallographic investigations[4] have shown that the constants a of the cubic lattices of uranium hydride and deuteride are equal to 6.6310 and 6.625 A respectively. So noticeable a distance between the lattice constants of the two compounds should undoubtedly influence the value of the volume integral with which the value of the Curie temperature is directly connected.

There exist several methods capable of deter-

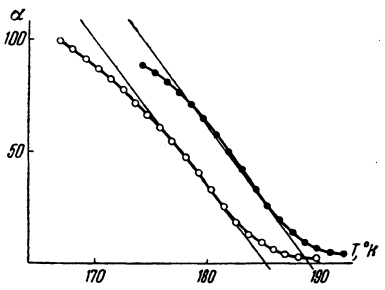
mining the Curie temperature in a ferromagnet with sufficient accuracy. In the present investigation, aiming to obtain preliminary data on the shifts of the Curie points, we investigated the temperature variation of the residual magnetism of samples of uranium hydride and deuteride. It is known that as the Curie point (close to 180° for the compounds of interest to us) is approached from the low-temperature side, the residual magnetism experiences a rapid decrease, linear over a sufficiently wide temperature interval. The intercept of the magnetization vs. temperature curve with the temperature axis can be assumed to be the Curie temperature of the specimen only in the first approximation. However, the difference in the so obtained "extrapolated" temperatures of the two specimens is apparently equal, with sufficient accuracy, to the true difference of the Curie temperatures of these specimens.

The residual magnetism of the specimens was measured with an astatic magnetometer. The temperatures of the specimens were determined in the various experiments either with a copper-constantan thermocouple, or with a platinum resistance thermometer. Approximately 20 specimens of uranium hydride and deuteride were prepared. The impurities in the initial uranium fluctuated from 0.4 to 0.12 percent. All the hydride and deuteride specimens were obtained through a direct reaction between the uranium and hydrogen or deuterium at approximately 250°C. The hydrogen and deuterium were produced by decomposition of a suitable amount of uranium hydride or deuteride at a temperature near 400°C.

In all the specimens investigated, an isotopic shift of the Curie temperature was observed in going from the hydride to the deuteride. This shift is practically independent of the purity of the initial uranium and consequently is not due to chemical impurities. Typical curves of the temperature dependence of the residual magnetism J_R of the hydride and deuteride samples are shown in the figure. It is seen from these curves that the difference in the Curie temperatures of uranium hydride and deuteride is 4°. The average error, obtained in the measurement of 10 pairs of specimens, is 0.5°. The Curie-temperature shift $\Delta\Theta$ in going from the hydride to the deuteride of uranium is thus

$$\Theta_{UH_3} - \Theta_{UD_3} = \Delta\Theta = +(4.0 \pm 0.5)^\circ K.$$

The method described is not suitable for the determination of the absolute Curie temperature. The Curie temperature obtained by the extrapolation method depends on the magnetic "prior history" of the specimen. In our experiments, residual



● – UH_3, ○ – UD_3; α – magnetometer deflection, proportional to the residual magnetism of the specimen, J_R.

magnetism was produced by slowly cooling (for one hour) the specimens, placed in a magnetic field of approximately 200 oersteds, from room temperature to that of liquid nitrogen, after which the magnetic field was turned off and the specimen remained magnetized. The value of the residual magnetism depends, naturally, on the intensity of the magnetic field in which the specimen is cooled and on the lowest cooling temperature.

The extrapolated Curie point, obtained from the residual magnetism vs. temperature curve for the given specimen, remained constant within 0.1 or 0.2° under considerable variations of the external conditions (magnetizing field and temperature).

We are planning an investigation of the absolute value of the Curie temperature of uranium hydride and deuteride.

In conclusion, we thank Academician I. K. Kikoin for suggesting the problem and for great help in the investigation.

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MAGNETOCALORIC EFFECT IN URANIUM HYDRIDE AND DEUTERIDE

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THE investigation of the magnetic properties of the ferromagnets uranium hydride and uranium deuteride is of great interest, because it discloses