# LETTERS TO THE EDITOR

*Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the eighteenth of the preceding month, for the second issue, the third of the month. Because of the late closing dates for the section no proof can be shown to authors. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.*

**Communications should not in general exceed 600 words in length.**

## Search for a Neutron-Deuteron Reaction

Attempts have been made to obtain a reaction of neutrons with deuterons but without success. The only quantitative estimate of the limit of the transmutation cross section, made on the basis of gamma-ray measurements,[1] is $3\times10^{-26}$ cm$^2$. Schiff[2] has estimated the cross section of the reaction to be $3\times10^{-27}$ cm$^2$.

Since the discovery that $H^3$ is radioactive, it seemed advisable to check the existence of the reaction by radioactive methods. An attempt was therefore made to prepare $H^3$ by the bombardment of heavy water with neutrons slowed in paraffin. In order to obtain experience in the detection of radioactive $H^3$ this isotope was prepared by the method of Alvarez.[3] It was found that the radioactive hydrogen thus produced was easily detected by the G-M counter used for the later work. In the experiment designed to produce this substance by the neutron-deuteron reaction a sample of heavy water (99.6 percent) was placed within a few inches of the beryllium target which served as the source of the neutrons. This was bombarded with deuterons in the amount of 130$\mu$ amp. hr. of deuterons accelerated to 8 Mev in a cyclotron. The water was then electrolyzed and the hydrogen passed through a palladium valve, through a liquid-air trap, and into an all-glass G-M counter arrangement. Two counter tubes had been connected and filled with equal pressures of purified hydrogen. Their backgrounds were measured and found to be comparable. The hydrogen of one was replaced by the irradiated gas, and the counting rates obtained. A tip between the counters was broken, the contents were thoroughly mixed and the counting rates were again taken. The ratios of the counting rates in the two tubes before and after mixing the gases were compared and found to agree within a small fraction of the probable error.

Measurements were also made, under identical bombarding conditions, of the activities in aluminum and silver. The $Al^{28}$ activity indicated a capture cross section of $Al^{27}$ for slow neutrons 300 times that of $D^2$. The ratio of the capture cross section of $Ag^{109}$ to $D^2$ was found to be 10,000.

Calculations were then made to limit the cross section of the reaction

$$D^2+n^1=H^3.$$

Calculation of the absolute cross section from the geometry of the experiment, assuming reasonable values for such data as were not known accurately, indicated a value of $2\times10^{-28}$ cm$^2$. A more direct evaluation may be made from the comparison with aluminum. Goldhaber[4] considers that the capture cross section of $Al^{27}$ for slow neutrons, derived from scattering data, is close to $10^{-25}$ cm$^2$. This gives a maximum value for the formation of $H^3$ of $3\times10^{-28}$ cm$^2$, in excellent agreement with the other value.

The authors wish to express their gratitude to Dr. L. Skaggs and Mrs. E. Graves for the use of scaling and counting circuits, and to the American Philosophical Society, the Research Corporation, and the Chemical Foundation for aid in the construction of the cyclotron used in obtaining the beam of deuterons.

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March 14, 1940.

[1] Kikuchi, Aoki, and Takeda, Tokyo Institute of Phys. and Chem. Research **31**, 195 (1937).
[2] L. I. Schiff, Phys. Rev. **52**, 242 (1937).
[3] L. W. Alvarez and R. Cornog, Phys. Rev. **56**, 613 (1939).
[4] Private communication.

## Photophoresis of Small Particles in a Magnetic Field

At the New York Meeting of the Physical Society on February 24 I presented some important matter which did not appear in the abstract.[1]

In a vertical magnetic field which is homogeneous, commutable and free of residual magnetism, particles move when irradiated by intense light in the direction of the magnetic lines of force as if they were single magnetic north or south poles (magneto-photophoresis). Thus intense light apparently produces single magnetic poles on every particle and between these "magnetrodes" a real visible magnetic current flows. The hypothesis of single poles gives a natural and better explanation than the old ones for the behavior of these particles and for the puzzling form of the corona of the sun (pointed out by G. E. Hale) whose lines follow exactly the magnetic lines of force and for other phenomena.

References: *Regarding the determination of the charge:* Physik. Zeits. **39**, 673 (1938) and the "Micro-Coulomb Experiment" appearing in Proc. Roy. Soc. London. *Regarding photophoresis etc.:* Physik. Zeits. **31**, 478 (1930) and **33**, 201 (1932) and Ann. de physique, Paris, April, 1940.

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[1] See abstract 38, Proceedings of the New York Meeting, Phys. Rev. **57**, 562 (1940).