Letters to the Editor

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Notes on points in some of this week's letters appear on p. 838.

Correspondents are invited to attach similar summaries to their communications.

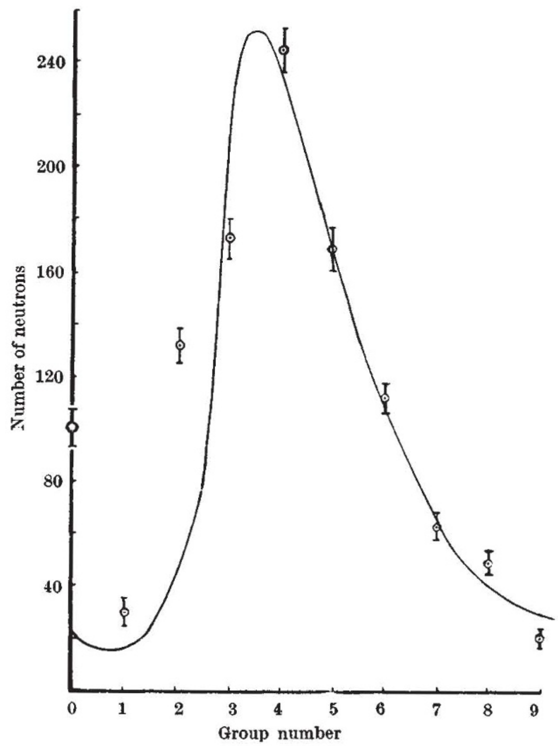
Velocity Distribution of Thermal Neutrons

We have been developing during the past year an apparatus to make possible the study of neutrons of known energies within the thermal region. In principle, the apparatus consists of a device for producing a burst of neutrons lasting about 0·5 millisecond at intervals of 5 milliseconds. The source is surrounded by paraffin to slow the neutrons down to thermal energies, and these neutrons are then detected by a boron tri-fluoride chamber 5·4 metres away. The electrical pulses from the chamber are amplified and fed to a cathode ray oscillograph. Time signals are also received by the same amplifier and oscillograph whenever the bursts of neutrons occur. Since the neutrons take an appreciable time to cross the 5·4 metres between source and detector, a pulse from the chamber will be recorded later than the time signal corresponding to the burst which produced the neutron, and the distance between the two is inversely proportional to the velocity of the neutron. The traces on the oscillograph screen are photographed on a rapidly moving film, and the distances between the time marks and the pulses measured after development. From an analysis of these measured distances the velocity distribution of the neutrons can be inferred.

The source is a tube of the Oliphant type yielding deuterons, which strike a target of heavy ice. The discharge producing the ions has a voltage of about 20 kv. and is made intermittent by means of a beam of light interrupted by a tuning fork. This light falls on a photo-electric cell the current from which is amplified until it can control the 20 kv. discharge. To accelerate the ions we use a field of between 200 and 250 kv.

The accompanying graph shows the distribution, between ten sub-divisions of the period, of 1,556 neutrons, the faster neutrons appearing to the left. We have calculated the distribution to be expected if Maxwell's distribution law held for the neutrons, taking a temperature of 15° C., and assuming that the efficiency of the boron counter is inversely proportional to the velocity of the neutrons; it is shown on the figure by the curve. A correction, of the order of 20 per cent, has been made to the observed counts to allow for neutrons which did not follow the direct path between source and detector. This was done by making an experiment with a thick boron absorber in the direct path of the beam, and subtracting the result after correcting for the relative strengths of the neutron source under the two conditions.

The curve is adjusted to fit the experimental count for the middle division, and shows reasonably good agreement for the slower neutrons. At the zero of the time-scale appears a group of fast neutrons which have not been slowed down by the paraffin to thermal energies. The discrepancy at divisions 2 and 3 may be due either to a peculiarity in the absorption of boron affecting the efficiency of the chamber at these velocities, or to the hydrogen in the paraffin not being free. This may delay the achievement of equipartition of energy, and affect some velocities more than others. We hope to examine the first suggestion by measuring the absorption of the neutrons of different energies by a boron screen.



⊙, Experimental observations; vertical lines indicate standard deviations.

It will be seen that our apparatus constitutes a 'velocity spectrometer' for slow neutrons. A suggestion for constructing such an apparatus has been put forward recently by Milatz and Horst[1], and Alvarez[2] has described an apparatus which bears the same relation to ours that a monochromator does to a spectrometer, but we believe that the results reported here are the first to be recorded by the method.

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Oct. 10.

[1] Milatz and Horst, *Physica*, **5**, 796 (Aug. 1938).

[2] Alvarez, *Bull. Amer. Phys. Soc.*, **13**, 6 (1938).