sinking along the archipelago slope, with water of Atlantic origin having a temperature of +0.50°C, a resulting mixture with a temperature of +0.35°C at 400 meters would consist of nearly 94 percent Atlantic water and only about 6 percent locally formed water.

This would seem to make Giletti and Kulp's point (iv), that "a new source of the deeper water of the Arctic Ocean was found to be in the Canadian archipelago," sound a bit pretentious, especially as it is based on a single tritium measurement the results of which, as Barnes and Coachman point out, tend to support the more generally accepted theory nearly as strongly as they suggest the Giletti and Kulp conclusion.

WILLIAM G. METCALF
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We wish to thank W. G. Metcalf for his comments on our report "Tritium tracer in Arctic problems" and our subsequent exchange of letters with Barnes and Coachman. The point under discussion is our interpretation of the high value of tritium concentration found in a sample of Arctic Ocean water at a depth of 400 meters. In our explanation of this value we suggested that the supply of tritium occurred by the sinking of local surface water (normally richer in tritium) to this depth. We drew the analogy with other localities where sinking takes place as a result of freezing surface conditions. It would appear from Metcalf's calculation that only about 6 percent of the sea water in our 400-meter sample could have been derived from the surface as a result of such freezing.

In the generally accepted view of Arctic Ocean circulation the water at this depth is derived by the sinking under the arctic surface water of more highly saline water from the Atlantic. This water would then circulate cyclonically, traveling past Siberia before reaching our sample location north of Canada. If this were so, a very rapid rate of circulation would be required, and the net effect would be a generally high tritium content for all the deep water partaking of this pattern. As we pointed out in our reply to Barnes and Coachman, improbably high natural tritium production rates are required to maintain this concentration.

Metcalf suggests that the tritium data actually do "as Barnes and Coachman point out, tend to support the more generally accepted theory nearly as strongly as they suggest the Giletti and Kulp conclusion." On the contrary, there is a major contradiction between the tritium data and the expected tritium concentration. If the major cyclonic-flow pattern is excluded from this area, however, then all the data can be made to fit without the need for fresh supplies from the arctic surface. In this case, the Atlantic-derived water must flow in a fairly direct line to the sample location.

A possible solution to the problem may therefore be a more sharply defined version of the generally accepted theory. Should subsequent measurements support these original tritium observations, the theory may have to incorporate direct flow of Atlantic-derived water to the region north of Ellesmere Island. Further, if cyclonic flow exists over most of the Arctic Ocean, it must bypass the sample area.

Finally, we wish to stress the point that tritium can be used as a tracer to derive information on mixing rates in the Arctic Ocean. The present limited amount of data is as yet insufficient for drawing firm conclusions.

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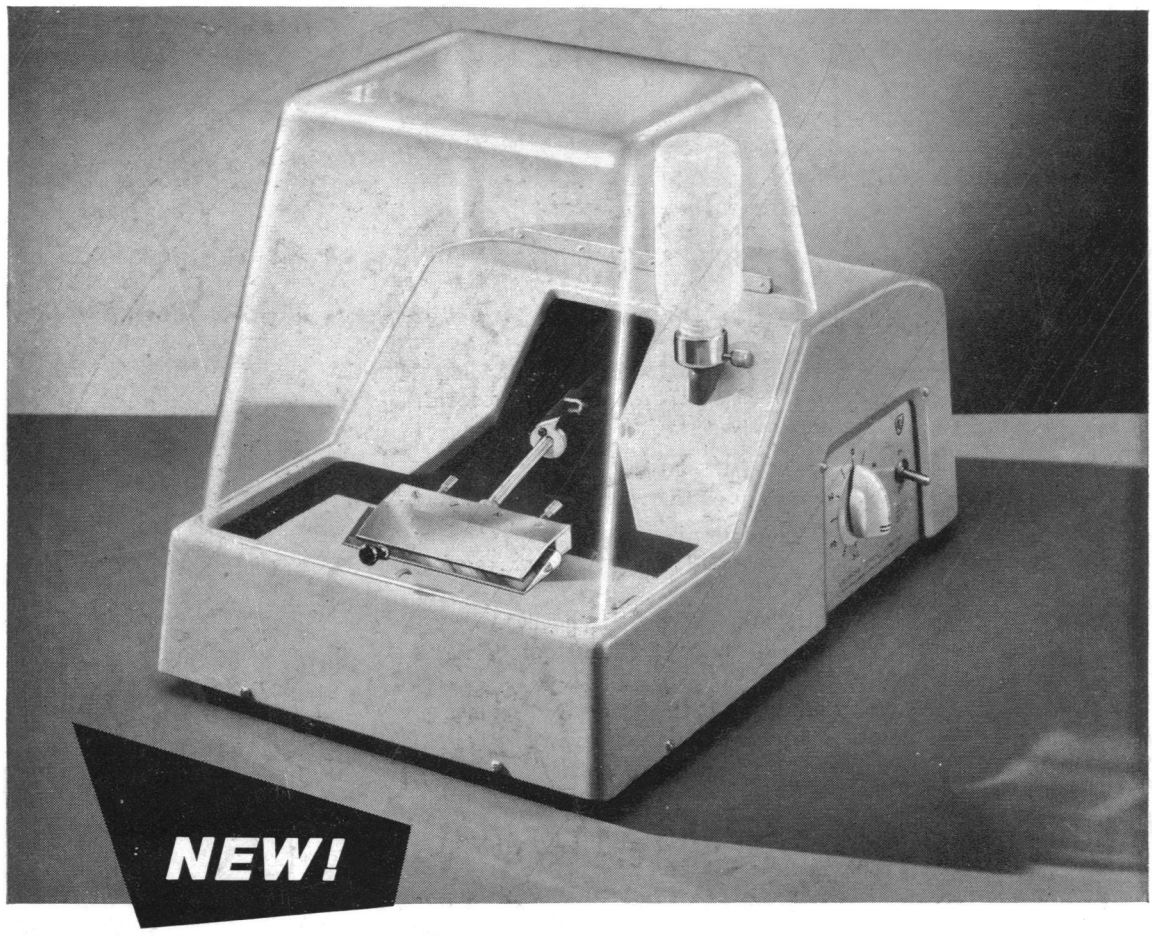
Note

This letter is the Lamont Geological Observatory Contribution No. 386.



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