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.

The Viscosity of Liquid Helium II

As is well known, the properties of liquid helium undergo a rapid change near 2.19°K, the so-called "lambda point." Below this temperature the liquid is ordinarily referred to as helium II. Recently Kapitza[1] has reached the conclusion that the viscosity of liquid helium II must be less than 10^{-9} poise and Allen and Misener[2] similarly have concluded that their experiments place the possible upper limit as 4×10^{-9} poise.

However, in connection with another experiment it has been pointed out by Kurti, Rollin and Simon[3] that rather phenomenal surface films of liquid helium II spread over surfaces brought into contact with it. Their experiments show that the films can climb for a considerable distance above the surface of the liquid. This deduction is supported by observations of Kamerlingh Onnes[4] and more recently by experiments of Daunt and Mendelssohn[5] which show that a body of liquid helium II rapidly comes to a common level in two vessels in contact with it. In our own experiments we have, on numerous occasions, obtained results that are in agreement with the above explanation. Thus it seems rather obvious that the conclusions as to the limiting value of viscosity, referred to above, are not valid because of the fact that under the conditions of the experiment most of the liquid helium would be transferred over the outer surface of the apparatus instead of through the small capillaries as supposed. Nevertheless it is known that the viscosity of liquid helium decreases rapidly with decreasing temperature near the "lambda point" since Wilhelm, Misener and Clark[6] and Burton[7] have shown, by measurements with an oscillating cylinder, that it changes from 2.7×10^{-4} poise at 24°K to 3.3×10^{-5} poise at 2.2°K.

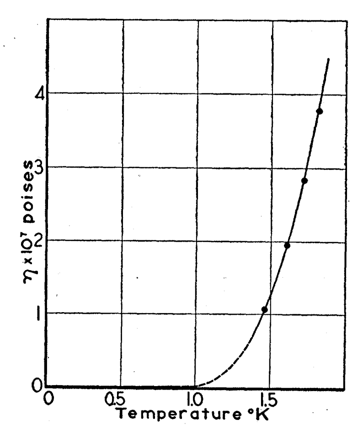

FIG. 1. The viscosity of liquid helium II measured by flow through a 10^{-4} cm channel.

We have measured the flow of liquid helium II through a small capillary into an enclosed space so that there was no possibility of transfer outside the capillary by a surface film. The capillary was calibrated in terms of the viscosity of helium gas at 4.225°K. The viscosity of the gas at this temperature was taken as 1.267×10^{-5} poise from the work of van Itterbeek and Keesom.[8] The more important results are given in Table I and are shown graphically in Fig. 1.

TABLE I. *The viscosity of liquid helium from the flow through a 10^{-4} cm channel.*

T°K	1.468	1.610	1.725	1.823
$\eta\times10^7$ poises	1.1	2.0	2.8	3.8

The values given in Table I are based on a preliminary calculation. Final corrections may increase the values at 1.823 and 1.725°K by small amounts.

The capillary channel which approximated the parallel plate type was obtained by casting a cylinder of solder in a glass tube and taking advantage of differential temperature contraction. The Reynolds number at the lowest temperature was $R=2\bar{v}\rho h/\eta=179$, where $\bar{v}$ represents the average velocity, ρ the density and h equals one-half the plate separation. Davies and White[9] have shown that R for the upper limit of laminar flow between parallel plates is 890. The plate separation was about 1×10^{-4} cm which is about the same as that used by Kapitza and considerably smaller than the capillaries used by Allen and Misener.

From Fig. 1 it appears that the viscosity of liquid helium II drops to a very low value near 1°K and will presumably vanish at the absolute zero of temperature.

A detailed account of the experiments will be published in the near future, probably in the *Journal of the American Chemical Society.*

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