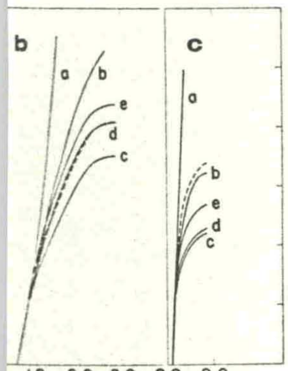

curves with calculations based on several
—T_0 = 1.2°K; b—T_0 = 1.7°K; c—T_0 =
rves b—m = 3, $\mathbf{v}_c$ = 0, A = 50 cm-sec/
; curves d—m = 3, $\mathbf{v}_c$ = 0, A as given by
h (16), A as given by Vinen; ----experi-

es where the "best" theory deviates

gated in the present work and com-
ned heat flows are shown in Fig. 1,
' (width = 3.36 μ, breadth = 1 cm,
experimental curves are obtained by
with the He bath at some fixed refer-
uccessive increments of power $\dot{Q}$ to
g at each step the equilibrium tem-
. A heat flow curve is obtained then
with $\dot{Q}$. Considering first the results
T_1 > 1.7°K the experimental points
he linear theory (curve a) and that
ribe the observed effects. The Gorter-
d in a variety of forms in attempts to
simplest and often used form takes
onstant with temperature), although
icated that a better fit might be ob-
represent such calculations: curve b
igh; and curve c with m = 4 is uni-
have suggested that A might be tem-
dependent. The first precise measure-

ments yielding values of A vs T are those of Vinen (4). The parameter A was found to be a function of temperature and independent of channel size for the large channels used (smallest dimensions of the order of a millimeter). No velocity dependence was found. The heat flow measurements indicated that m should be exactly 3, whereas the effect of $\mathbf{v}_c$ was found for Vinen's system to be unimportant in the equations. In Fig. 1a curve d, obtained using Vinen's values for $A(T)$, $m = 3$ and $\mathbf{v}_c = 0$, shows quantitative agreement with the experimental data. Calculations using (26) and (27) with $\mathbf{v}_c \neq 0$ have been made according to a model in which $\mathbf{v}_c$ is determined at each position z along the slit by a local superfluid critical velocity $\mathbf{v}_{s,c}$ at the wall. By virtue of the equality of $\mathbf{v}_s - \mathbf{v}_n$ and $\bar{\mathbf{v}}_s - \bar{\mathbf{v}}_n$ (Eq. (19)) we have $(\mathbf{v}_{s,c})_{\text{wall}} = \bar{\mathbf{v}}_s - \bar{\mathbf{v}}_n = \mathbf{q}_c/\rho_s sT$. Thus the same relation between $\mathbf{q}_c$ and the critical velocity obtains for a critical superfluid velocity at the wall as for a situation in which the critical velocity occurs in $\bar{\mathbf{v}}_s - \bar{\mathbf{v}}_n$. We have performed calulations for a variation in superfluid velocity with slit width and temperature suggested by Dash (16): $\mathbf{v}_c = 0.09\ (\rho_s\, d/\rho)^{-1/2}$ cm/sec when d is given in cm. Curve e in Fig. 1a represents these calculations, which are seen to lie significantly higher than the experimental results.

Figures 1b and 1c show the same comparisons as discussed above for T_0 = 1.7°K and 2.1°K respectively. At the former temperature the graph shows again that curve d best represents the experiments, whereas at 2.1°K none of the theories appears adequate. Possible reasons for deviations at temperatures near the λ-point will be discussed later.

Another useful way of testing the various models used in the calculations is to compare their abilities to predict the limiting heat flows at the λ-point. Figure 2 illustrates the ratio of calculated to observed asymptotic heat currents for the various theories for the 3.36 μ slit. Here again it is demonstrated that Vinen's $A(T)$ with no critical velocity provides the best agreement, except for T_0 near T_λ. Since each point on each curve is determined by an entire integration it is not possible to see from this graph alone how agreement might be improved. However, it may be shown that no single value of A can adequately describe the flow for all values of T_0 near the λ-point. Equivalently, this means that in this temperature range A depends upon the heat current present, and that A must be considered to become at high temperatures a function of velocity as well as temperature.

It would be desirable to be able to determine independently and directly from the experimental data the values $A(T)$ which best fit the measurements over the entire range. Unfortunately the results of I and II are not well suited for this purpose, primarily because at the lower temperatures the effect of the Gorter-Mellink term is not large, (i.e., $\alpha\, d^2\bar{\mathbf{q}}^2 < 1$, hence $\bar{\mathbf{q}}$ is not very sensitive to the precise value of A); and at temperatures near the λ point where it is large A is likely to be velocity dependent, as discussed above. However, it is possible