e observations are fitted best by a velocity. However, the situation is ated above, q_c has been determined of the observations from the linear ving the Gorter-Mellink term with rimental data and the linear theory. ints deviate from the linear theory an q_c the Gorter-Mellink term does the full mutual friction force begins ved a similar behavior and has given n to the possible existence of "sub-

for deriving critical velocities from ble to the computed curves; and it ally values of the "critical velocity" quations used in the calculation do e attempt to do this, certain qualita- experimental curves emerge rather esults permit visual recognition of a nging, from which one may infer a substantially smoother and a critical A comparison of curves a, d and the nicely.) This is to say that although f the experimental results, it fails to n the aid of reasonable arbitrary cri- lts of which are instructive and per- imentalist may readily be led astray. calculated curves in which no v_c is curves computed with and without compared; the heat current corre- tion of the curves from each other, rent"; from this a "critical velocity" esults are found in remarkably good mined from the experimental curves ver, above 1.8°K the "critical veloc- ro, in contrast to the observed values, prescription. Yet the existence of this serve as a warning to the experi- nterpreting changes in the character elation to changes in experimentally at the criterion used above essentially

requires the term $\alpha\, d^2\bar{q}^2$ occurring in (26) to be of the order of a few percent and that this criterion was in fact suggested earlier by London (*20a*). This requirement implies that $v_c d$ is a function of temperature alone. Such a variation of v_c with slit size has been found to agree with some experiments; but this condition also has only a limited range of applicability and must be considered spurious too.

V. DISCUSSION

In the preceding section we have demonstrated the rather remarkable result that a phenomenological model of the thermohydrodynamic behavior for liquid He II containing no adjustable parameters fits exceedingly well the experimental data obtained for bulk liquid as well as for liquid confined to very narrow channels, over a wide temperature range and for extreme temperature differences. It is significant that to achieve this result it has not been necessary to resort to any detailed, microscopic picture concerning the nature of turbulence in liquid He II. On the other hand we have noted several regions where nontrivial, systematic deviations occur between the measurements and the predictions of the theory. It is believed that at least some of these deviations have their origin in effects associated with the narrowness of the channel widths, and that consideration of a microscopic model is at this point required for a better understanding of the situation. In particular, some of the ideas derived from the Onsager-Feynman quantized vortex-line model appear to be pertinent and may be applied to the present results.

On the assumption that the degeneration of superfluidity in liquid He II comes about from the creation of vortex motion in the superfluid, Vinen has interpreted the mutual friction force in terms of the properties of elementary, quantized vortices. According to Vinen's (*21*) description the Gorter-Mellink coefficient $A(T)$ effectively describes the interactions between the vortex lines, moving with the superfluid, and the thermal excitations comprising the normal fluid. $A(T)$ is calculable from the kinetic model subject to several assumptions and restrictions, among which are two that are of importance when narrow slits are considered: (1) the turbulence is assumed to be homogeneous, requiring that the average distance l between vortex lines is small compared to the smallest dimensions of the slit; and (2) the effective viscous penetration depth, $1/\lambda = 2\eta_n/\rho_n(\bar{v}_n - \bar{v}_s)$, should be small compared to the slit dimensions.

The effect of these restrictions when applied to the calculations for the 3.36 μ slit is indicated in Fig. 4. Values of line spacing in turbulent flow l have been obtained according to Vinen's method from his graph of $l|\bar{v}_s - \bar{v}_n|$ vs. T (Fig. 1 of ref. *21*). It is seen that the viscous penetration depth equals the slit width at smaller relative velocities than does the average vortex line spacing, so that the restriction on the line spacing is the more stringent. Since l decreases as $\bar{q}$