II

AND CORRESPONDING FLUID VELOCITIES[a]

$\bar{v}^0_{n,c}$ sec^{-1})	$\bar{v}^0_{s,c}$ (cm sec^{-1})	$\bar{v}^1_{n,c}$ (cm sec^{-1})	$\bar{v}^1_{s,c}$ (cm sec^{-1})
05	2.9	14.9	2.8
41.5	3.4	15.7	3.4
23.5	4.7	15.2	4.9
15.0	6.8	12.8	7.2
5.4	7.4	5.3	8.3
2.2	6.6	2.1	6.8
83	6.7	16.8	7.3
30	6.0	14.3	6.4
11.3	5.1	8.9	5.7
6.9	9.5	6.1	10.9
4.0	12.0	3.7	15.3

lues averaged over the cross section of the
ty in the channel is then given as 3/2 times
ocity $\bar{v}_{r,c}$ may be given by $\bar{v}_{s,c} + \bar{v}_{n,c}$.
ined at T_0 and T_1, respectively.

w are associated with the superfluid
ation in superflow. This effective de-
e remaining superfluid to flow more
e result is a sort of runaway process
perfluidity through complete conver-
onclude that in small slits the critical
remains finite and that $\bar{v}_s$ increases
royed by the vortex catastrophe. It
rgument may be applied to the results
(*29*) who have observed the onset of
channels with $d < 10^{-6}$ cm to be at

USION

namical sets of equations have been
le set has yet been constructed which
or of this quantum liquid. The two-
k mutual friction term as interpreted

on the basis of the vortex line model has been shown by others to represent rather well most of the experimental observations. In the present paper these equations have been applied to the flow of He II through narrow slits and have been tested over a range of temperature and pressure gradients substantially larger than has been studied hitherto. Furthermore, a detailed study has been made of the approximations made in arriving at solutions of the equations of motion as well as of the limitations implied by the vortex line model for superfluid turbulence. Within this framework the agreement found between theory and experiment is generally quite good. In addition the Gorter-Mellink mutual friction coefficient as determined by Vinen for large channels and small temperature gradients has been found to be equally appropriate for narrow channels and large temperature gradients in those regions where the vortex line model indicates it should be valid, and not elsewhere. It would thus appear that the equations used here are applicable over an exceptionally wide range and are capable of describing a broad spectrum of flow phenomena of superfluid helium.

ACKNOWLEDGMENT

The authors wish to express their appreciation to Dr. R. B. Lazarus for helpful discussions and for indicating the variance method used to obtain approximate values of the Gorter-Mellink constant from the experimental data.

REFERENCES

1. W. E. KELLER AND E. F. HAMMEL, JR., *Ann. Phys.* (*N.Y.*) **10**, 202 (1960). (I)
2. E. F. HAMMEL, JR. AND W. E. KELLER, *Phys. Rev.* **124**, 1641 (1961). (II)
3. C. J. GORTER AND J. H. MELLINK, *Physica* **15**, 285 (1949).
4. W. F. VINEN, *Proc. Roy. Soc.* **A240**, 114 (1957).
5. L. TISZA, *Phys. Rev.* **72**, 838 (1947).
6. F. LONDON, *Phys. Rev.* **54**, 947 (1938).
7. L. LANDAU, *J. Phys. U.S.S.R.* **5**, 71 (1941); *ibid.* **11**, 91 (1947).
8. I. M. KHALATNIKOV, *J.E.T.P.* (*U.S.S.R.*) **20**, 243 (1950).
9. P. P. CRAIG AND J. R. PELLAM, *Phys. Rev.* **108**, 1109 (1957).
10. K. N. ZINOVIEVA, *J.E.T.P.* (*U.S.S.R.*) **31**, 31 (1956).
11. H. VAN DIJK AND M. DURIEUX, Helium vapor pressure scale T_{L55}. Kamerlingh Onnes Laboratory, Leiden, Holland (1955).
12. D. DE KLERK, R. P. HUDSON, AND J. R. PELLAM, *Phys. Rev.* **89**, 662 (1953); R. D. MAUER AND M. A. HERLIN, *Phys. Rev.* **76**, 948 (1949); *ibid.* **81**, 444 (1951).
13. P. J. BENDT, R. D. COWAN, AND J. L. YARNELL, *Phys. Rev.* **113**, 1386 (1959).
14. J. G. DASH AND R. D. TAYLOR, *Phys. Rev.* **105**, 7 (1957).
15. D. F. BREWER, D. O. EDWARDS, AND K. MENDELSSOHN, *Phil. Mag.* **1**, 1130 (1956).
16. J. G. DASH, *Phys. Rev.* **94**, 1091 (1954).
17. D. F. BREWER AND D. O. EDWARDS, *Phil. Mag.* **7**, 721 (1962).
18. H. C. KRAMERS, T. M. WIARDA, AND A. BROESE VAN GROENOU, *in* "Proceedings of the Seventh International Conference on Low Temperature Physics," G. M. Graham and A. C. Hollis Hallett, ed., p. 562. Univ. Toronto Press, Toronto, Canada, 1961.
19. W. F. VINEN, *in* "Progress in Low Temperature Physics," C. J. Gorter, ed., Vol. III, p. 44 ff. North Holland Publishing Co., Amsterdam, 1961.