From the values of the limiting current and that of the heat of evaporation of liquid helium, it is possible to estimate very roughly the thickness of the film. It appears to be of the order 10^{-5} cm. We obtained the same value when we determined the thickness from the value of the temperature gradient along the film, if we assume the heat conductivity of liquid helium to be 10^4 cal./gm.cm.sec., as found by Allen, Peierls and Zaki Uddin[2]; in their experiment the temperature gradient was of the same order as ours.

Kapitza recently supposed that the abnormally high thermoconductivity of helium II can be explained by the presence of strong convection currents in helium; it is evident, however, that with such extremely thin films as in our case (10^{-5} cm.) such convection currents could scarcely be formed.

At present, experiments on the direct determination of the film thickness are in preparation, and a detailed description of them will shortly be published.

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Transport Phenomena in Helium II

F. London[1] has recently proposed a new conception of helium II, according to which this liquid can be regarded as a degenerate Bose-Einstein gas, that is, as a system in which one fraction of the substance—say, n atoms per cm.^{3}—is distributed over the excited states in a way determined by the temperature, while the rest—$n_0 - n$ atoms per cm.^{3}—is 'condensed' in the lowest energy level. If T_0 denotes the temperature of degeneracy, the ratio n/n_0 is given by

$$n/n_0 = (T/T_0)^s \text{ for } T < T_0 \qquad (1)$$

For an ideal Bose-Einstein gas, according to London, $s = 3/2$, but for the real fluid one should rather insert $s = 5$ in order to fit Keesom's specific heat measurements.

The calculation of viscosity of a degenerate Bose-Einstein gas is in progress. A preliminary estimation shows that the atoms belonging to the lowest energy state do not take part in the dissipation of momentum. Thus, the viscosity of the system is entirely due to the atoms in excited states. This simple description allows us to account in a qualitative way for the well-known transport phenomena in helium II, though in the more exact treatment certain modifications have to be introduced, which are to be discussed in a detailed publication.

(1) Measurements of the damping of an oscillating cylinder will show the effect of atoms in excited states only. To a first approximation the viscosity, measured in this way, should be the same as the viscosity of helium gas at the same temperature. The value of the viscosity coefficient of helium gas at $T \sim T_0$ is $\mu \sim 10^{-5}$ c.g.s. units[6], while measurements in helium II just below the λ-point[2] give $\mu = 3 \times 10^{-5}$. Parallel measurements of the viscosity of helium II and helium gas in the corresponding range of temperature would provide us with an indication as to what extent the simple picture adopted here has to be refined.

(2) It is, however, not the viscosity coefficient μ which determines the flow velocity of helium II moving under the influence of a pressure gradient through a capillary. In this case, the fraction of substance consisting of atoms in the lowest energy state will perform—like a 'superfluid' liquid of viscosity $\mu \sim 0$—some sort of turbulent motion the flow velocity of which does not depend on the bore of the capillary. In addition, the atoms in excited states, behaving like a gas of pressure $\sim nkT$, will diffuse in a similar way to, say, molecules in a solution under the influence of a gradient of osmotic pressure. Thus, the total flow represents a rather complex combination of both these effects. It will largely depend on the ratio $(n_0 - n)/n$ and, therefore, on T, in agreement with experiment[3]. According to this interpretation, a temperature gradient should arise during the flow of helium II through a thin capillary.

(3) The so-called fountain phenomenon[4] of helium II is an inverse process to (2). If one maintains a temperature difference between the ends of a capillary, a gradient of density of excited atoms, n, and, thus, of pressure is produced. In consequence, (*a*) the excited atoms will diffuse towards the colder end, and (*b*) the super-fluid fraction of the liquid moves in the opposite direction. In the case of a wide tube, these currents must be equal and no resulting flow will be observed. If, however, the capillary is sufficiently narrow, the rate of the process (*a*) becomes reduced and the temperature gradient causes a surplus convection current opposite to heat flow. This picture can account for the great values of the heating current required to maintain a temperature difference at the ends of the capillary[5]. Simultaneous measurements of the heating current and the total convection of substance could provide us with information about the relative magnitude of the processes (*a*) and (*b*).

A detailed discussion of the problem will be given in the *Journal de Physique*. I am greatly indebted to Dr. F. London for the opportunity of seeing his paper before publication.

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A Simple Inexpensive Ultracentrifuge

In designing quantitative ultracentrifuges costing only a few pounds and available for measurements of sedimentation velocity and of sedimentation equilibrium, it is clearly best to adopt the simple modification of the air-driven spinning top of Henriot and Hugenard, in which the essential part of the system is immobilized by mechanical baffles[1]. This dispenses entirely with an optical system and depends upon direct analysis of the liquid after ultracentrifuging, using any suitable chemical, physical or biological method. Such opaque ultracentrifuges possess the further advantage over any transparent ultracentrifuge that the whole of the column of liquid from its upper surface outwards and from the very beginning of the sedimentation is available, without distortion, for exact measurement.