tained using the value $\alpha=2.0\times10^{-7}$ cc/ion-sec. for neon given in reference 2. The slope of the curve yields a value, $\tau=1.75$ milliseconds for the diffusion decay time. The diffusion of the electrons takes place in a quartz cylinder with an inside radius, $R=2.22$ cm and inside height, $H=3.82$ cm. For this geometry, the characteristic diffusion length, $\Lambda$, as determined by the equation in Fig. 6 of reference 1 is equal to 0.735 cm.

The ambipolar diffusion coefficient, $D_a$, is given by Eq. (9) of reference 1.

$$D_a=\Lambda^2/\tau=309 \text{ cm}^2/\text{sec. } (p=0.356 \text{ mm Hg}).$$

Data of the type shown in Fig. 1 were taken over the pressure range 0.27 to 1.10 mm Hg. According to kinetic theory, the product $D_ap$, where $p$ is the gas pressure, should be constant at constant temperature. The experimental results are shown in Fig. 2. The value $D_ap=115\pm10$ (cm$^2$/sec.) $-$ (mm Hg) is obtained

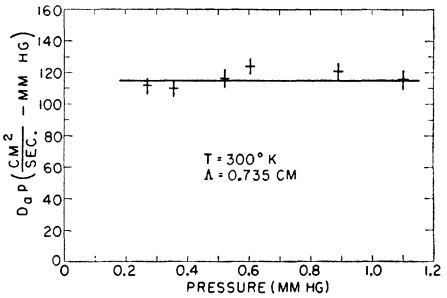


FIG. 2. Pressure dependence of the ambipolar diffusion coefficient for neon.

at $T=300$°K, which agrees with unpublished estimates obtained with the previous apparatus. With the knowledge of $D_ap$, one may calculate the positive ion mobility from Eqs. (18) and (19) of reference 1. The extrapolated value for 760 mm Hg and 20°C is 2.9 cm/sec. per volt/cm as compared to Munson and Tyndall's value[3] of 6.23. As in the analogous case of helium,[4] a possible explanation of the discrepancy is that the ions observed by Munson and Tyndall were molecular; i.e., $Ne_2^+$. Rough estimates of the rate of conversion of atomic to molecular ions by three-body collisions with normal atoms indicate that, at the pressures used in our experiment, the ions are predominantly atomic. Unfortunately, the lack of pressure data in reference 4 prevents the drawing of conclusions as to the nature of the ions observed.

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[1] M. A. Biondi and S. C. Brown, Phys. Rev. **75**, 1700 (1949).
[2] M. A. Biondi and S. C. Brown, Phys. Rev. **76**, 1697 (1949).
[3] Munson and Tyndall, Proc. Roy. Soc. **A177**, 187 (1941).
[4] M. A. Biondi and S. C. Brown, Phys. Rev. **76**, 302 (1949).

## A New Method for Measuring Film Transport in Liquid He II*

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FILM transport rates of liquid He II have heretofore been measured mainly by a visual method; i.e., by observation of the changes in height of liquid helium columns in glass vessels.[1,2] The optical technique requires the incidence of external radiation upon the helium film, and is limited to studies of transport rates over transparent dielectric surfaces.

In the present method the dielectric property of liquid helium is employed to indicate the total amount of liquid helium between the walls of a cylindrical capacitor. Variations in height of the liquid helium contained within the annular space are observed as changes in capacitance. The capacitor, serving in this way as a depth gauge, is placed within a container of the material over whose surface the transport rate is to be measured. The container and capacitor assembly is enclosed within a copper radiation shield provided with small holes to allow the passage of liquid and vapor. Electrical connections are brought down through the liquid helium bath to minimize thermal conduction to the container.

The capacitor is connected in parallel with the tuned circuit of a radiofrequency oscillator, and changes in capacitance are observed by means of frequency changes of the oscillator. The oscillator frequency has been measured by beating the signal against the output of a heterodyne frequency meter, and reading the frequency of the meter in the condition of zero beat note. An automatic frequency recording circuit has also been used. In this case, the frequency meter is not tuned during the course of a transport rate measurement. The audio beat signal is amplified and fed to a voltage divider consisting of a large resistance in series with an air core inductance. The voltage across the inductance, proportional to frequency, is rectified and fed to a recording potentiometer.

The depth gauge has been calibrated with a cathetometer in the He II region, and shows a satisfactorily linear frequency *vs.* height dependence.

As a check on the method, transport rates in glass containers have been measured in this way, and found to compare very closely with the results of Daunt and Mendelssohn.

Preliminary measurements of creep over copper indicate rates significantly higher than those over glass. Further studies over various materials are now in progress.

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[1] J. G. Daunt and K. Mendelssohn, Proc. Roy. Soc. **A170**, 423, 439 (1939).
[2] Webber, Fairbank, and Lane Phys. Rev. **76**, 609 (1949).

## A Precision Determination of the Half-Life of Radium C′

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THE widespread use of RaC′ to check the proper functioning of delayed coincidence and variable resolution coincidence equipment made a redetermination of the half-life with high accuracy desirable.

The apparatus used was a 20-channel time analyzer, originally intended for neutron time-of-flight measurements, and similar in principle to other time-of-flight spectrometers already described.[1,2] For the measurement, a gated amplifier was inserted between the time analyzer proper and the crystal oscillator which produced pulses to switch the analyzer. A $\beta$-ray pulse from a set of 6 G-M tubes in parallel will open the amplifier, which stays open for a sequence of 20 pulses. In this way each $\beta$-pulse renders all the channels in turn operative once. The six $\beta$-ray tubes surround a thin-walled proportional counter, in whose sensitive volume a small thin-walled glass capillary containing radon is mounted. A $\beta$-pulse from RaC will be registered by the G-M tubes and is followed by an $\alpha$-particle from RaC′, which is registered by the proportional counter. The time-distribution of the $\alpha$-pulses relative to the $\beta$-pulses is analyzed by the time analyzer. The $\alpha$-pulses are first fed to a special prearranging circuit where they are replaced by standard pulses derived from the oscillator. The position of these pulses has been chosen such that they always fall definitely in one channel and not on the border between two channels. These standard pulses are then fed to the time analyzer proper. With this arrangement the channels will be entirely equivalent and will not depend on varying tube characteristics