change of $(5.699 \pm 0.003) \times 10^{-6}$. Pressures in the optical cell and in the helium bath were determined with Wallace and Tiernan absolute and differential mercury manometers and Wallace and Tiernan precision dial manometers.

The interferometer was modified so that the interference fringes could be watched visually and recorded photoelectrically at the same time. The normal viewing telescope of the Jamin interferometer was altered as follows. A cylindrical lens was used for the eyepiece lens of the Jamin telescope to give magnification perpendicular to the fringe pattern only. Then a Bausch and Lomb eyepiece camera viewing head was attached to the telescope, and a 1P21 photomultiplier tube mounted in a lighttight box behind a slit in the focal plane of the camera. The camera viewing head contains a beam splitter which sends about 10% of the light to the viewing eyepiece while 90% falls on the photomultiplier slit. This slit allows light from about a quarter of one fringe to fall on the photomultiplier tube. The photomultiplier output was recorded on a 10-mv Varian G10 recorder with a 1-second full-scale balancing time. The noise level and drift of the over-all system rarely exceeded about 0.1 of a fringe, corresponding to $5.7 \times 10^{-7}$ in refractive index.

Temperatures inside the copper-walled optical cell were taken to be equal to the bath temperatures just outside the cell. These temperatures were determined from the pressure at the surface of the bath (on the 1958 scale of temperatures, $T_{58}$) (Brickwedde *et al.* 1960) plus a hydrostatic correction due to the depth of liquid over the cell. A separate experiment with a vapor pressure thermometer outside the cell showed that this procedure correctly accounts for the increase of bath temperature with bath depth to within about $10^{-4}$° K, in this metal cryostat. Temperatures outside the cell were monitored with a carbon resistance thermometer also. In fact, the temperatures inside the cell may have been higher than the temperatures outside the cell. Using the optical cell itself as a vapor pressure thermometer led to the conclusion that when the cell was only partially filled at the SVP, the surface of the liquid in the cell may have been hotter than the bath temperatures outside by up to 4 mdeg at 5.0°, 8 mdeg at 4.5°, 13 mdeg at 4.0°, 20 mdeg at 3.5°, 23 medg at 3.0°, 20 mdeg at 2.5°, 8 mdeg at 2.2°, and 1 mdeg below the λ-temperature. These apparent differences may be due to a thin layer of warmer liquid at the upper surface of the liquid helium I, when the cell is only partially filled. Such a layer would vanish below the λ-point and at higher pressures. As we could not increase these apparent differences reproducibly by increasing the radiant heat input to the cell, we did *not* apply a correction for this possible systematic error in temperature. When isotherms were performed, the temperatures were stabilized by controlling the pumping speed to the bath with a Greiner Manostat No. 8, and (or) by manual settings of two Edwards type LB1A needle valves, as well as by varying the power input supplied to the bottom of the bath by an electric heater. This procedure prevented the temperature of the cell from drifting more than ±0.5 mdeg during any run.

## 3. ANALYSIS

The refractive index, $n$, of liquid helium or helium vapor is related to the density, $\rho$, by the Lorenz–Lorentz law,