8) Light beam non-parallelism
9) Fluctuations in line voltage
10) Drift and noise in the electronic circuit
11) Measurement of crystal dimensions

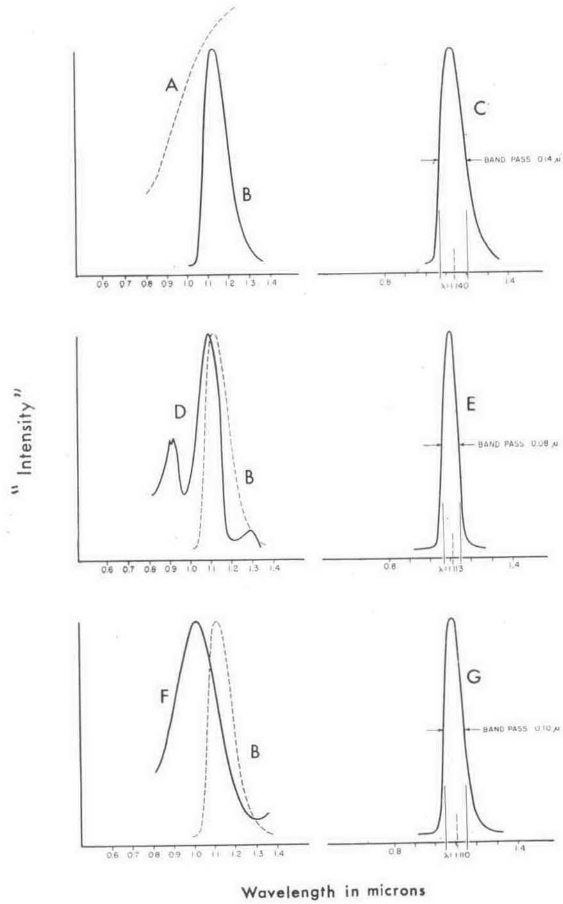

FIG. 3. Calibration curves for British World War II war surplus infrared image converter tubes, model CV-147, operated at 3000 volts A.C. with various filters. See text for details.

12) Inaccuracy in weight calibration
13) Inaccuracies in the calibration of the mechanical advantage of the lever arm
14) Frictional losses in the mechanical system
15) Personal error

The relative non-uniformity of stress distribution in this work has been found to be negligible. Values of $n\lambda/2$ intervals of stress-induced retardation for a given experiment are found to be reproducible to $\pm 1\%$. Independent experimental runs are also found to be reproducible to $\pm 1\%$. Errors in polar and crystal orientation are less than ± 15 minutes of arc, and therefore negligible. A thorough discussion on the effects of and corrections for poor stress distribution, polar misorientation and crystal misorientation in piezobirefringence investigation can be found in reference (9).

The determination of average wavelength, band pass and index of refraction of silicon are believed to be correct to $\pm 0.5\%$. The divergence of the light beam in air is less than 1 degree of arc, and therefore negligible. Measurements of crystal dimensions are correct to within ± 0.0005 cm. or approximately $\pm 0.2\%$. Weight calibration is correct to within $\pm 0.05\%$. The effect of fluctuations in line voltage was minimized by drawing all current through a Sola CVH constant voltage transformer.

All other sources of error listed above are variable and not amenable to quantitative evaluation. Their composite effect on the accuracy of the piezobirefringence constant is difficult to evaluate. However, the reported values are believed to be correct to within $\pm 2.5\%$.

Experimental Results

Values for the piezobirefringence constants of crystalline materials may be calculated on the basis of the empirical mathematical stress-optical theory developed by F. Pockels (3, 4). Pockels' theorem may be expressed as

$$q = \frac{2h\lambda}{n_0^3 T d}.$$

For silicon, q represents the piezobirefringence constants $((q_{1111}-q_{1122})$ and $2q_{1212})$; h = the amount of stress-induced retardation in units of wavelength; λ = the wavelength in air of the light expressed in centimeters; n_0 = the index of refraction for the unstressed material; T = the applied homogeneous stress expressed in dynes/cm.^{2}; d = the path length through the crystal in centimeters. The wavelength of radiation used in this work has been measured as 1.11 microns with a band pass of 0.08 micron at $\frac{1}{2}$ "intensity" (silicon+water filters).

The experimentally measured value of the piezobirefringence constant $(q_{1111}-q_{1122})$ of silicon at 26° C.$\pm 1°$ for a wavelength of 1.11 $\mu = -14.4 \times 10^{-14}$ cm.^{2}/dyne. The reported value of $(q_{1111}-q_{1122})$ has been obtained from the average of three independent determinations. The value of each determination, in turn, is obtained from the average of eight consecutive orders of $\lambda/2$ stress-induced retardation. The reproducibility between the