these two bands are in fact pressure sensitive – the same quantity of gas (in meter-atmospheres) gives smaller equivalent widths at lower pressures. The slope of the lines, shows, however, that the bands are neither on the 'straight-line' or 'square-root' portions of the curve of growth, but instead in the transition region.

As Owen and Kuiper (1964) pointed out, the amount of gas required in the laboratory simulation of the Martian atmosphere is given by

$$w \frac{T_{\mathrm{lab}}}{273} \eta$$

where w is the CO_2 abundance (in meter-atmospheres) in the Martian atmosphere as determined by other spectroscopic investigations, and η is the effective airmass in the Martian atmosphere. Using the table of Owen and Kuiper (1964, p. 132) we find $\eta = 2.21$. If we adopt 75 m-atm as the Martian CO_2 abundance (Kaplan and Gray-Young, 1969), then the amount of gas required in the laboratory becomes 179 m-atm. In the range of pressures appropriate for the Martian surface (say 4 mm Hg), 179 m-atm CO_2 requires a path length of some 34 km. This was not possible in the LPL White cell, so observations were made at three different quantities of gas (four, in the case of the 103 band) and several different pressures. Then, as Owen and Kuiper found necessary, the curves were extrapolated to larger quantities of gas, as shown by the dashed lines in Figure 2. The 023 band was also observed at 13 m-atm but the data are not included in Figure 2 because of their inferior quality. They do not bear directly on the extrapolation to large quantities of gas.

Because of the gentle slope of the 175 m-atm line in Figure 2, it can be seen that the greatest source of error is the uncertainty in measurement of the equivalent width of the CO_2 band in the Mars spectrum. The error in extrapolation of the laboratory data to 175 m-atm is less significant. The horizontal line representing the equivalent width of the band in the Mars spectrum intersects the 175 m-atm line at a pressure value of 2 mm Hg (2.66 mb). Because the mean pressure along the absorbing path in the atmosphere of Mars is one-half the surface pressure (Curtis-Godson approximation), we double this value to give the *Martian surface pressure of* $5.3^{+2.2}_{-2.6}$ mb.

3. Elevation Differences

In 1965, when it became known from analysis of Mariner IV occultation data that the scale height in the lower Martian atmosphere was 9 km $\pm$ 1 km (Kliore *et al.*, 1965), speculation about elevation differences on Mars took on a new dimension. It was evident that differences in elevation of the order of a few kilometers should be detectable by the difference in atmospheric CO_2 absorption that would occur above regions of relatively different altitude.

No reliable spectroscopic results were reported from the 1967 apparition of Mars, but radar ranging data with high spatial resolution on the planet were obtained (Pettengill *et al.*, 1969) and interpreted (Binder, 1969) to show that the dark areas are uniformly lower in elevation that the bright areas. Further analysis of the radar shows that the correlation of topography with dark and bright areas is not direct. The first spectroscopic results were obtained at the 1969 apparition of Mars and reported in a preliminary form by Hunten and Belton (1969). They verified the lack of direct correlation between elevation and surface albedo, and reported a total range of altitude of more than 20 km.

In order to compare Martian atmospheric CO_2 absorption over the bright and dark areas of the planet, a 5-channel, simultaneously recording spectrometer was used with a multi-element PbS detector on the 125-cm reflector in the Crimea. The dispersion of the spectrometer and the spacing interval of the PbS detector elements were such that the two strong bands of CO_2 at 1.5753 and 1.6057 μ (6347.8 and 6227.9 cm^{-1}) fell on elements 2 and 4 of the five-element detector array. Elements, 1, 3, and 5 covered the regions outside and between the two strong bands, thus providing a measure of the intensity of the continuum. The normal entrance slit of the spectrometer was replaced by a plastic plate in which several tiny holes had been drilled and the front surface of which had been aluminized for high reflectivity. This made it possible for the observer to continuously monitor the image of Mars with the spectrometer guide microscope during the integrations. A diaphragm of diameter 3 sec of arc

Fig. 3. Photograph of Mars showing the regions observed for comparison of CO_2 band strengths and the derivation of elevation difference. Photograph by John Fountain, June 18, 1969, 01 05 UT, Cerro Tololo 60-inch reflector, Kodak High Speed Infrared film with filter transmitted 6600–8700 Å. Composite of four images. Central meridian longitude 61.24°.