Two New Bands of CO_2 in the Photographic Infrared

Recently in this journal Adel and Slipher[1] have announced the observation of one of the Venus CO_2 bands in absorption in the laboratory with a path-length of 45 m and a pressure of 42 atmos. It is the rotation-vibration-band $5\nu_3$ according to Dennison's nomenclature. With the aid of the new Agfa infrared plates we have photographed *two new CO_2 bands* at 1.2031μ and 1.2178μ using only a path-length of 4 m and a pressure of 1 to 10 atmos. At 1 atmos. pressure the fine structure of the bands is clearly to be seen on our plates, but too faint to measure. With increasing pressure the lines broaden very much so that at 10 atmos. pressure, when the intensity of absorption is fairly strong, the fine structure is not any more resolved and so cannot be measured. At this high pressure there appears, however, a comparatively sharp edge at the high frequency side of the band. This evidently corresponds to the head of the band, the convergence in the line series, being caused by the difference in the moments of inertia in the upper and lower states. The wave-lengths given above refer to these band heads.

Adel and Dennison[2] have calculated a formula representing all the observed infrared CO_2 bands known at that time. They have *predicted* the position of certain other bands, among others the pair of bands $3\nu_3+(\nu_1;\ 2\nu_2)$ at 8291 cm^{-1} and 8188 cm^{-1}. The wave-lengths of the observed heads correspond to 8309 and 8209 cm^{-1}. There can therefore be no question that the new bands are $3\nu_3+(\nu_1;\ 2\nu_2)$, the difference of the observed and calculated frequencies mainly arising from the fact, that not zero lines but band heads were measured. The distance of the head from the zero line can approximately be calculated from rough B values which can be interpolated from the data given by Adel and Dennison.[3] We obtain $\nu_{\text{head}}-\nu_0{}^+=16$ cm^{-1}, so that the frequencies of the zero lines of the observed bands become 8293 and 8193 cm^{-1}. This agrees satisfactorily with the values predicted by Adel and Dennison.

It is interesting to stress that the bands $5\nu_3+(\nu_1;\ 2\nu_2)$ occurring in the spectrum of the planet Venus but *not* observed by Adel and Slipher in the laboratory are at least 400 times less intense than the pair $3\nu_3+(\nu_1;\ 2\nu_2)$ found by us.

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[1] A. Adel and V. M. Slipher, Phys. Rev. **46**, 240 (1934).
[2] A. Adel and D. M. Dennison, Phys. Rev. **43**, 716 (1933).
[3] A. Adel and D. M. Dennison, Phys. Rev. **44**, 99 (1933).