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WINTER COLLEGE ON LASERS, ATOMIC AND MOLECULAR PHYSICS

(24 January - 25 March 1983)

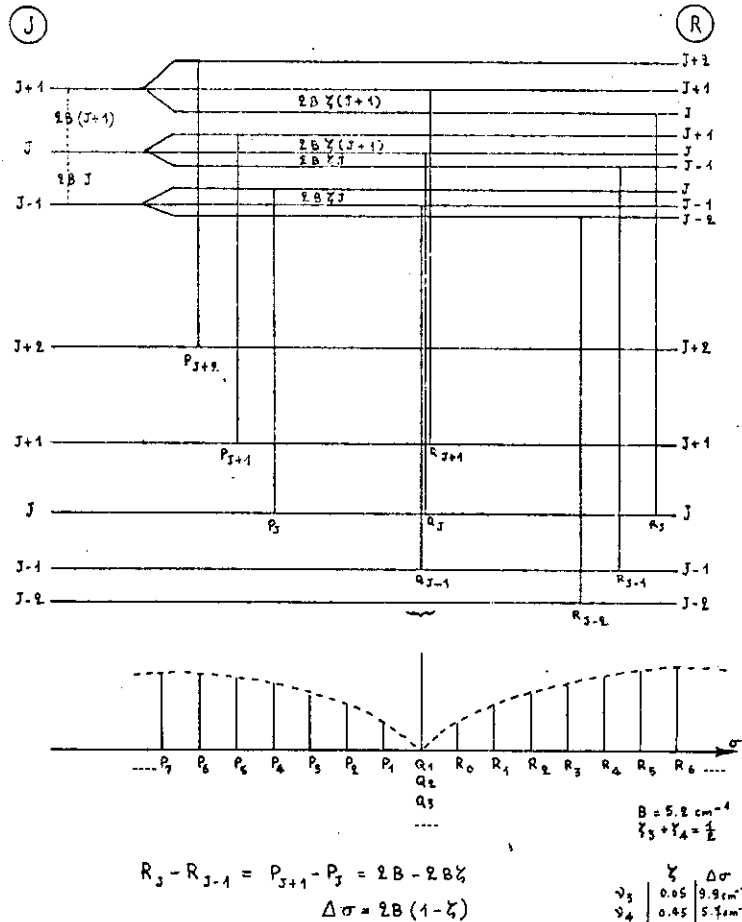
Rotation-Vibration Spectra II

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These are preliminary lecture notes, intended only for distribution to participants.
Missing or extra copies are available from Room 230.

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BANDS ν_3 AND ν_4 OF METHANE

$P | \Delta J = 1$
 $Q | \Delta J = 0$
 $R | \Delta J = +1$

2

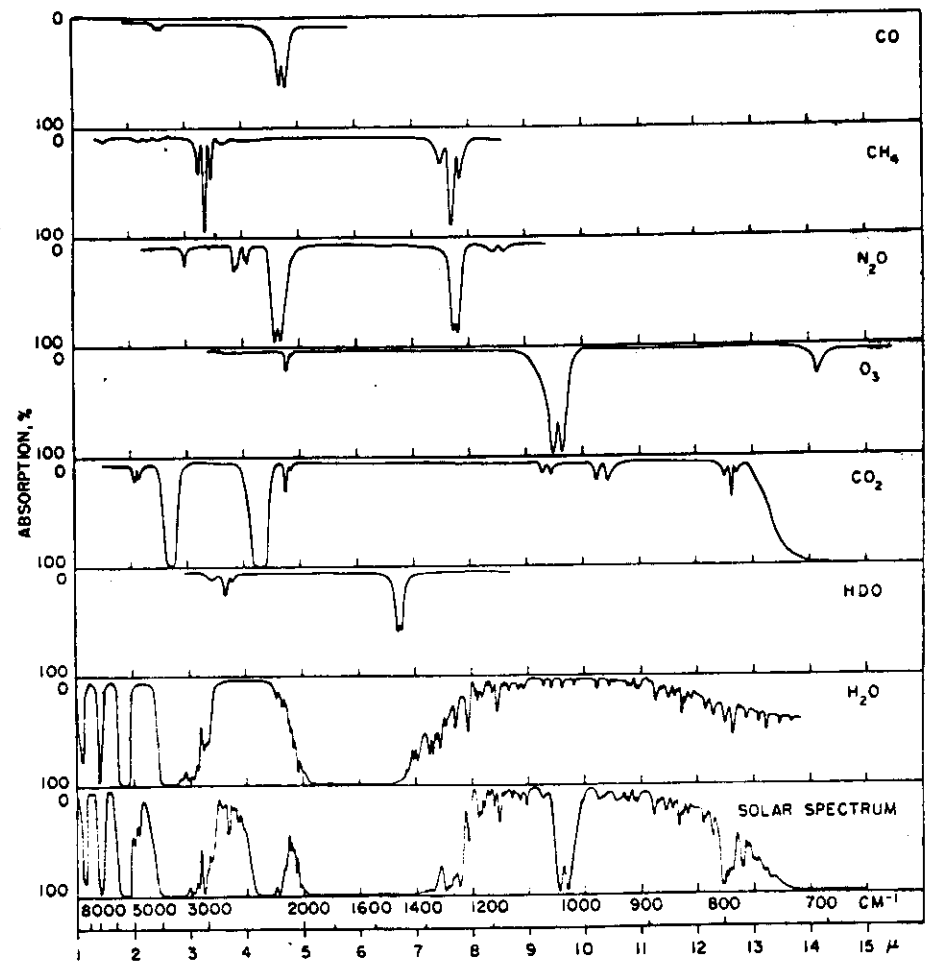


Fig. 16-1. The Near-Infrared spectra of Solar Irradiation and of CO, CH₄, N₂O, O₃, CO₂, HDO and H₂O

③

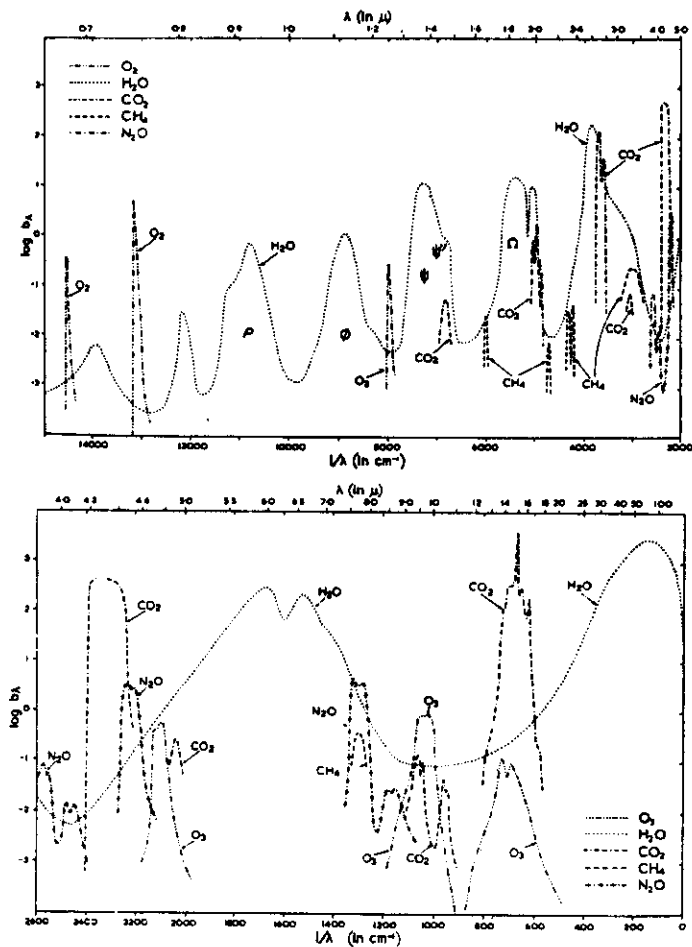
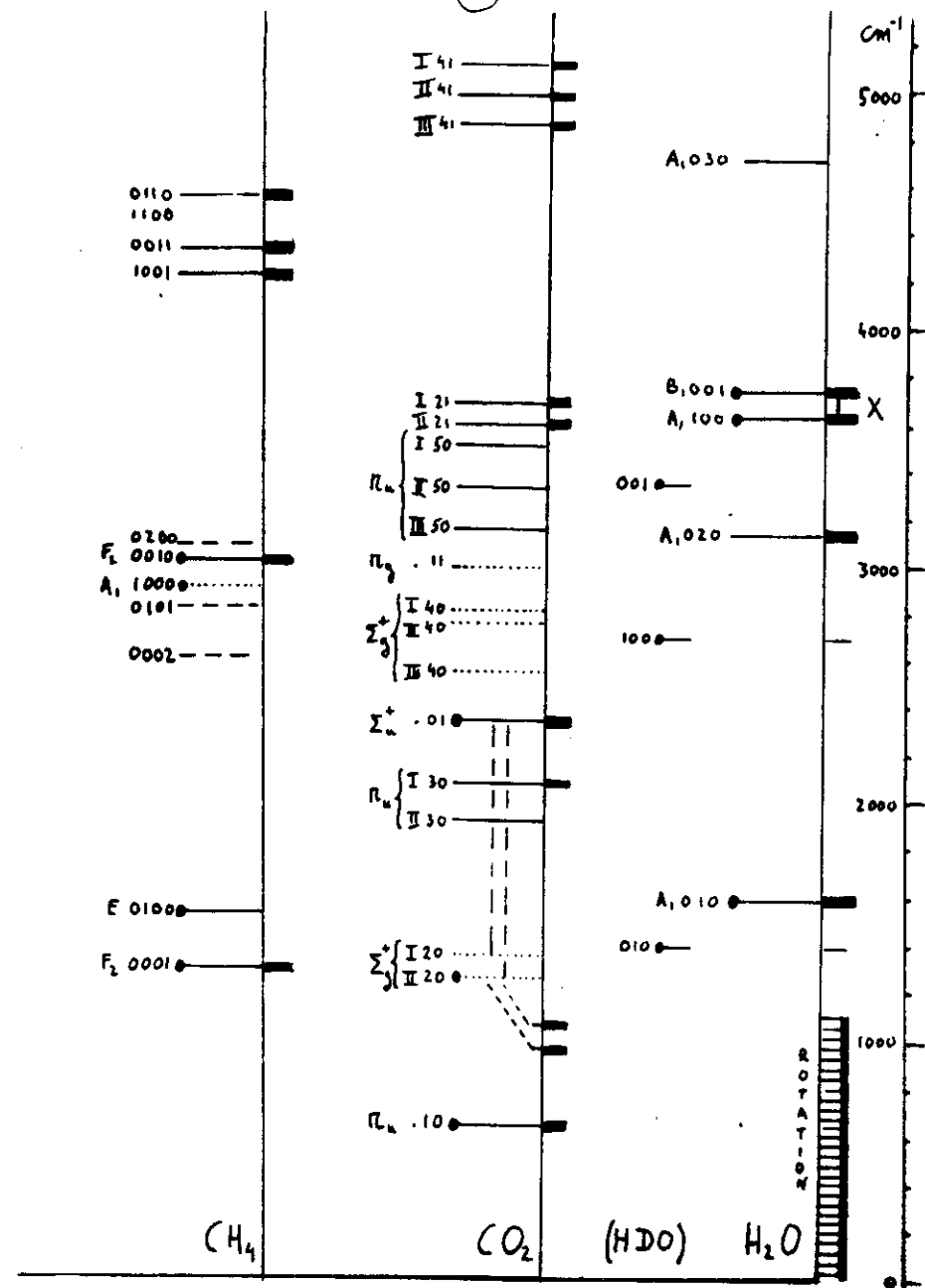
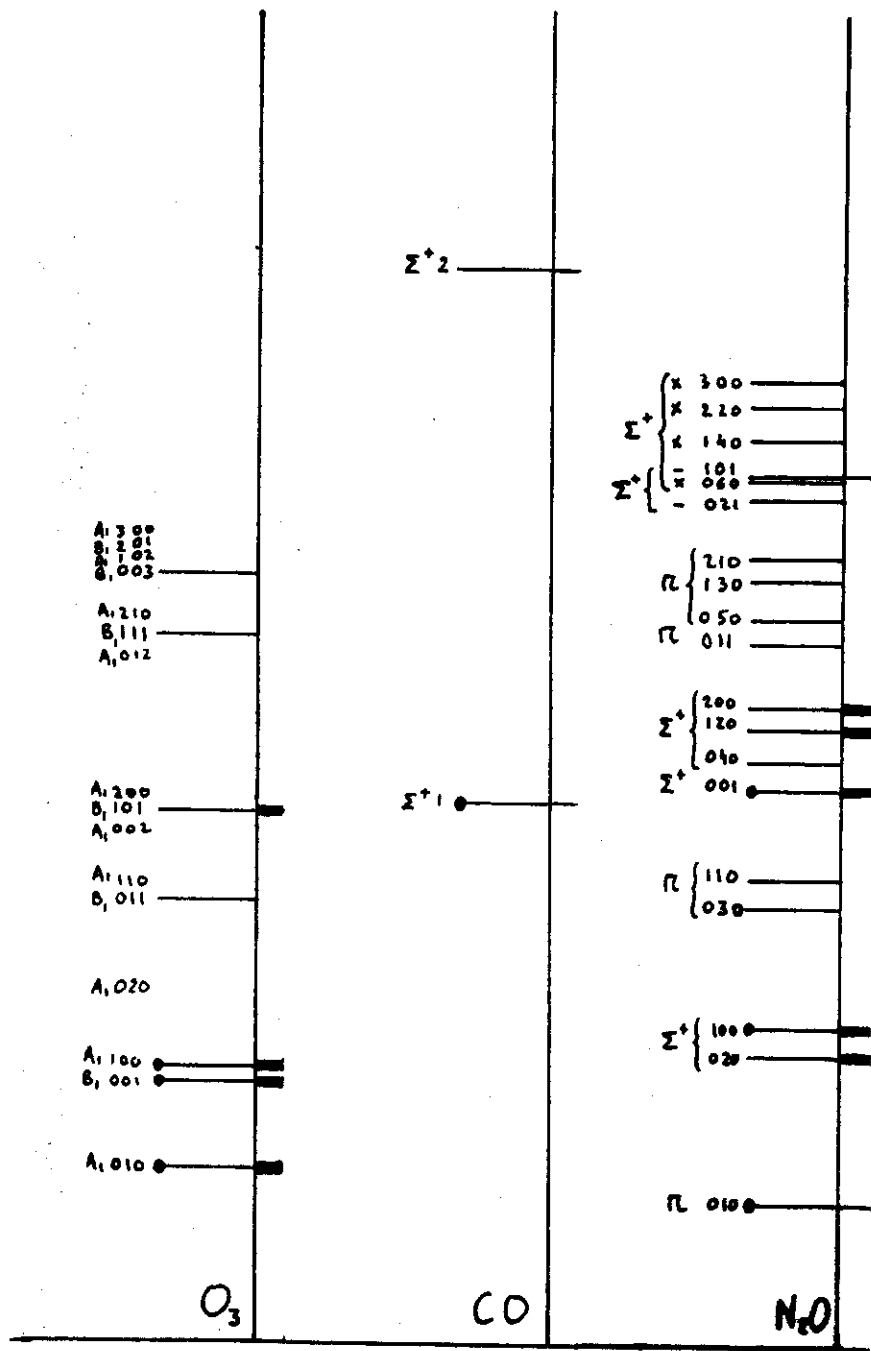


Figure -17-

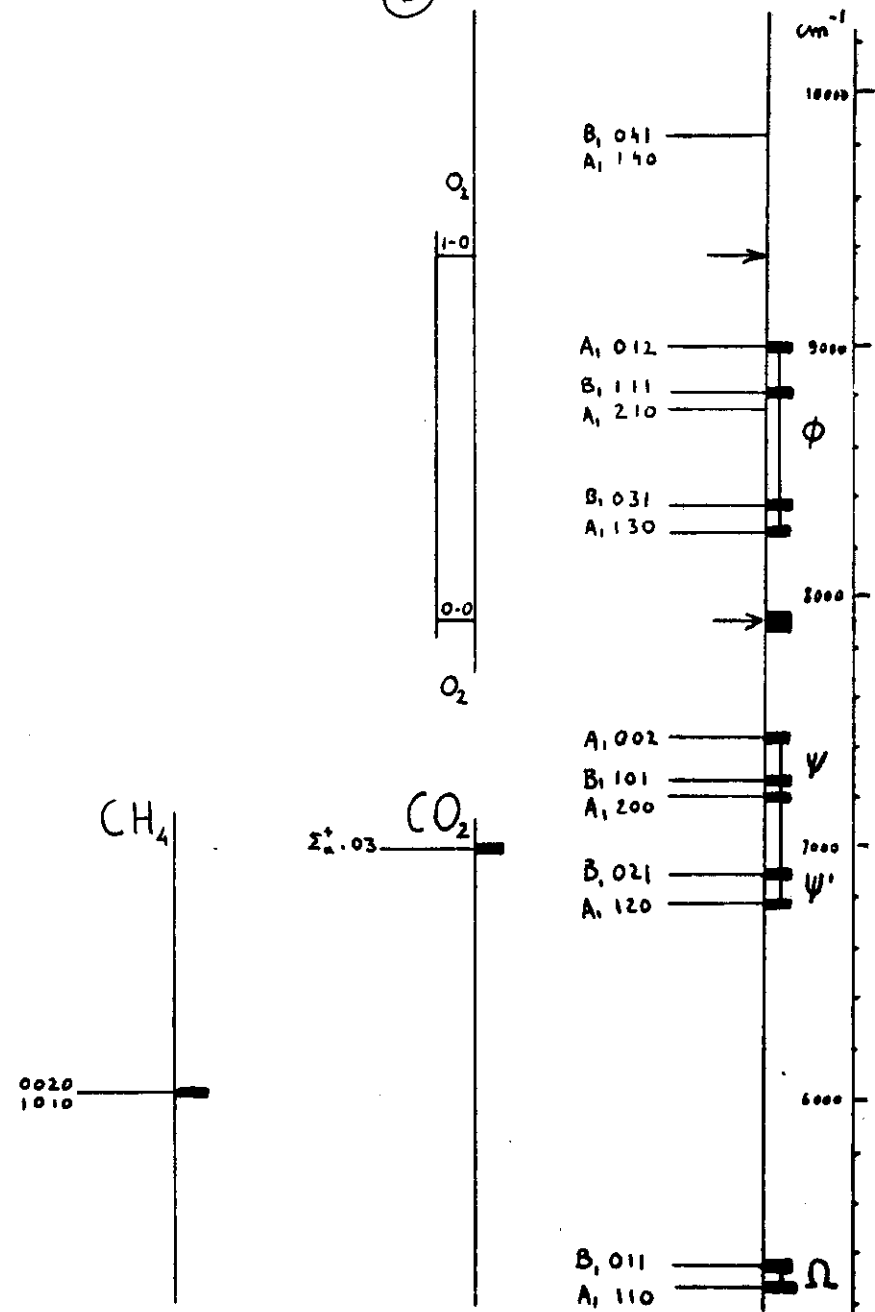
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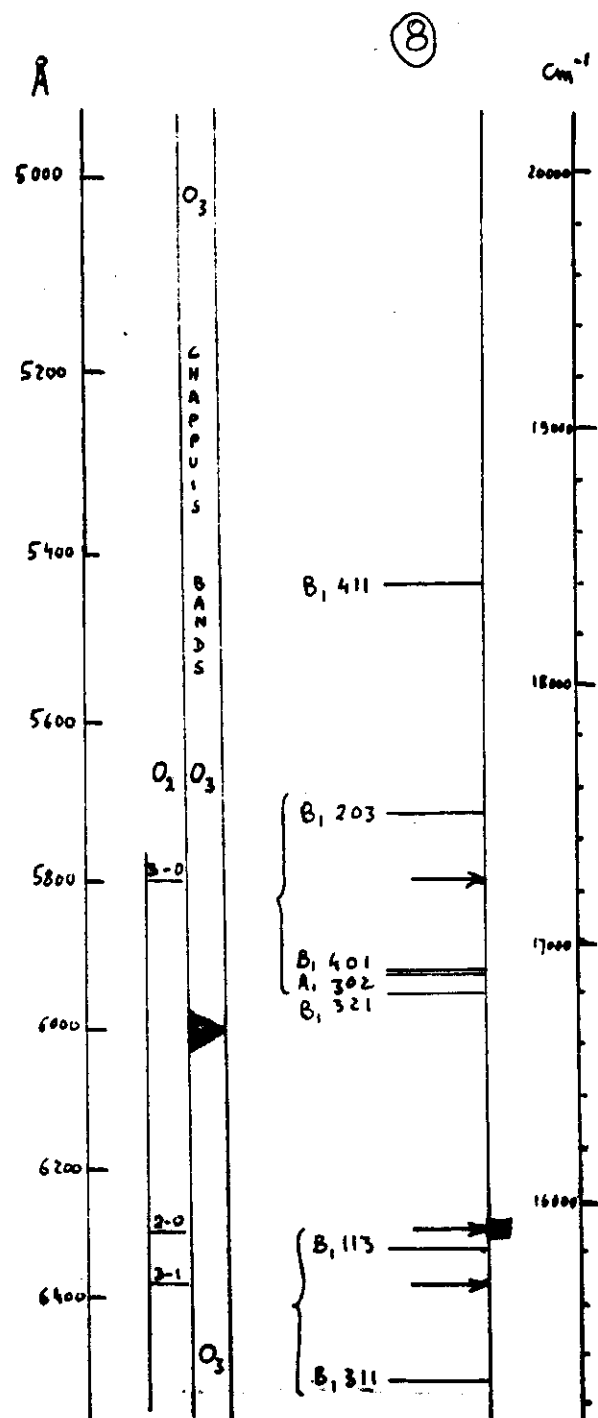
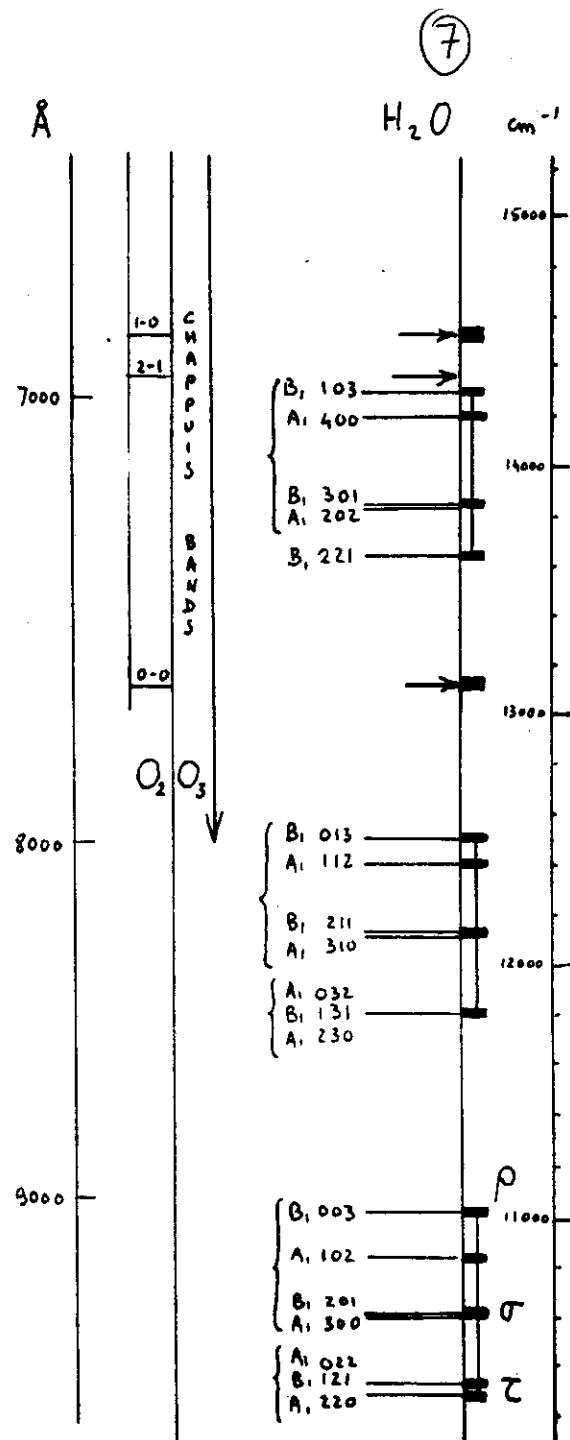


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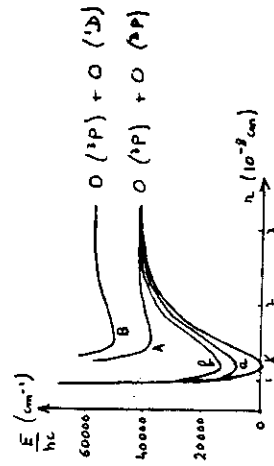
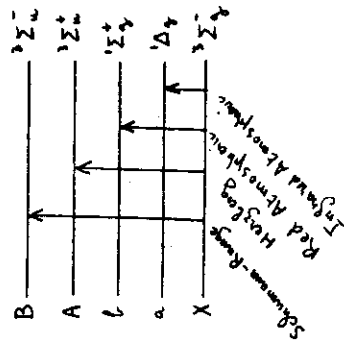


6





Electronic transitions of O_2



	Atmospheric Molecules	Rotational constants (cm^{-1})	Spacing of lines in rotational structure of rotation-vibration bands (cm^{-1})	
Diatomic	N_2	$B \approx 2.0$		(1)
	O_2	$B \approx 1.43$		(1)
	CO	$B \approx 1.92$	$2B \approx 3.8$	
Linear	CO_2	$B \approx 0.39$	$4B \approx 1.6$	(4)
	H_2O	$B \approx 0.42$	$2B \approx 0.8$	
Spherical top	CH_4	$B \approx 5.25$	$2B(1-3) \approx \begin{cases} 9.9 \text{ for } \nu_3 \\ 5.7 \text{ for } \nu_4 \end{cases}$	(3) (2)
Asymmetric tops	H_2O	$A \approx 27.8 \quad B \approx 14.6 \quad C \approx 9.3$		(4)
	O_3	$A \approx 3.50 \quad B \approx 0.44 \quad C \approx 0.39$	$2\left(\frac{B+C}{2}\right) \approx 0.8$	(5)

- (1) no rotation-vibration spectrum
- (2) one line (out of two) missing due to spin zero of nucleus ^{16}O
- (3) taking first order Coriolis interaction into account
- (4) no regularity in rotational structure
- (5) close to actually symmetric top ($B \approx C$)

See Note on "Introductory Molecular Spectroscopy"

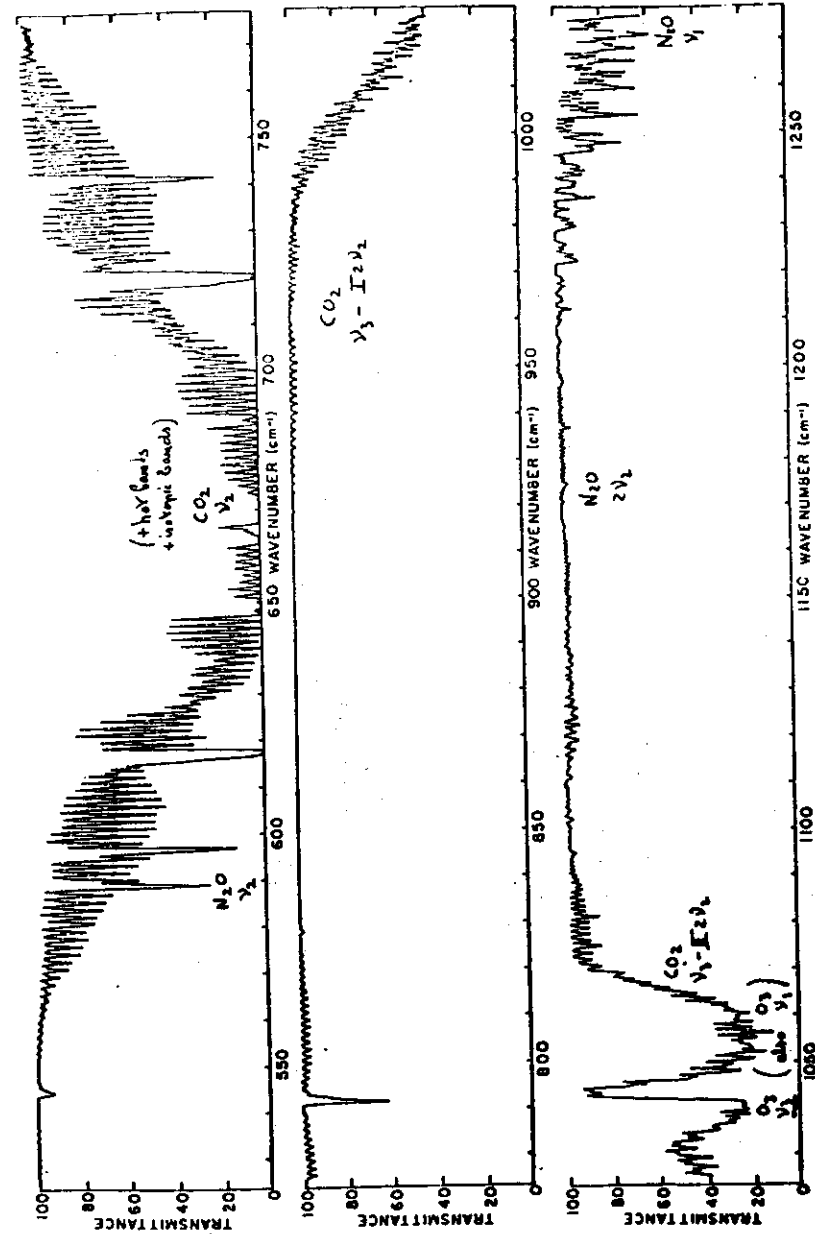


Figure 7a. Calculated spectra over much of the infrared for 40 K ft to space. Computations by Dr. T. Kyle, University of Denver.

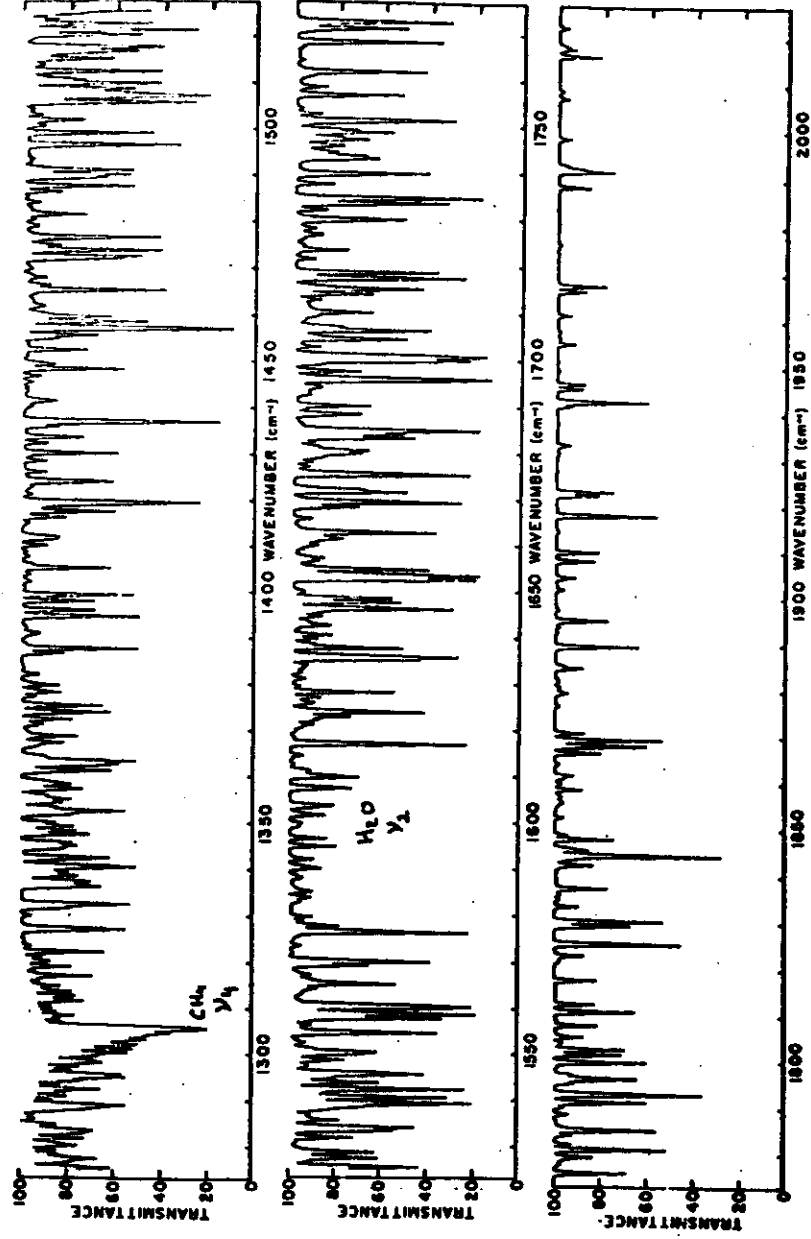


Figure 7b.

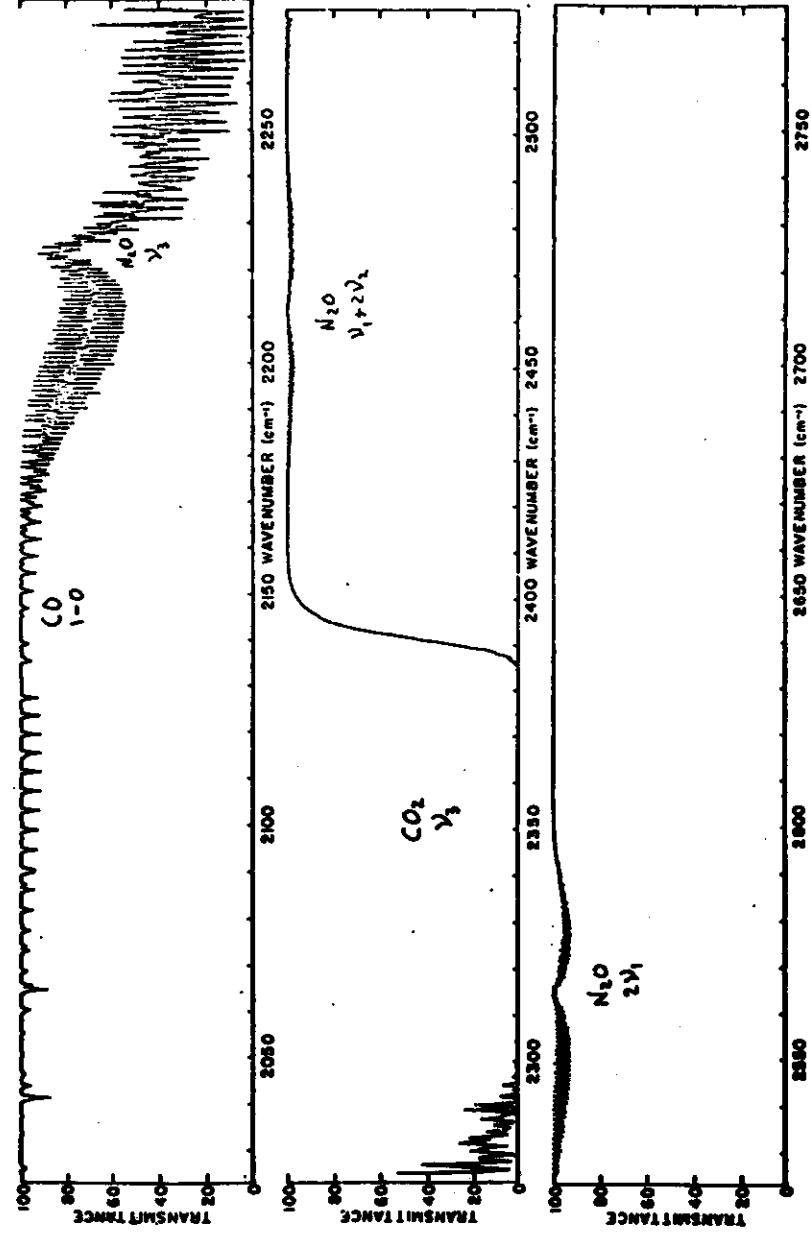


Figure 7c.

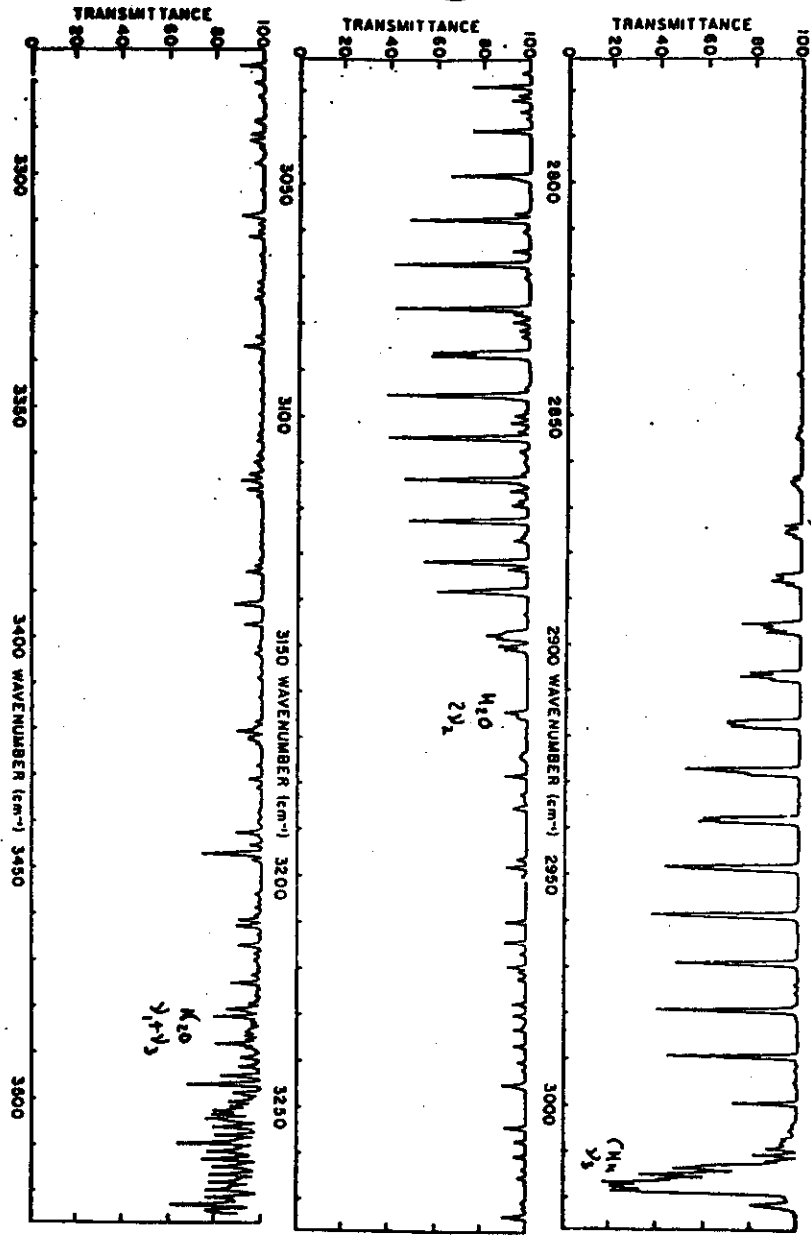


Figure 7d.

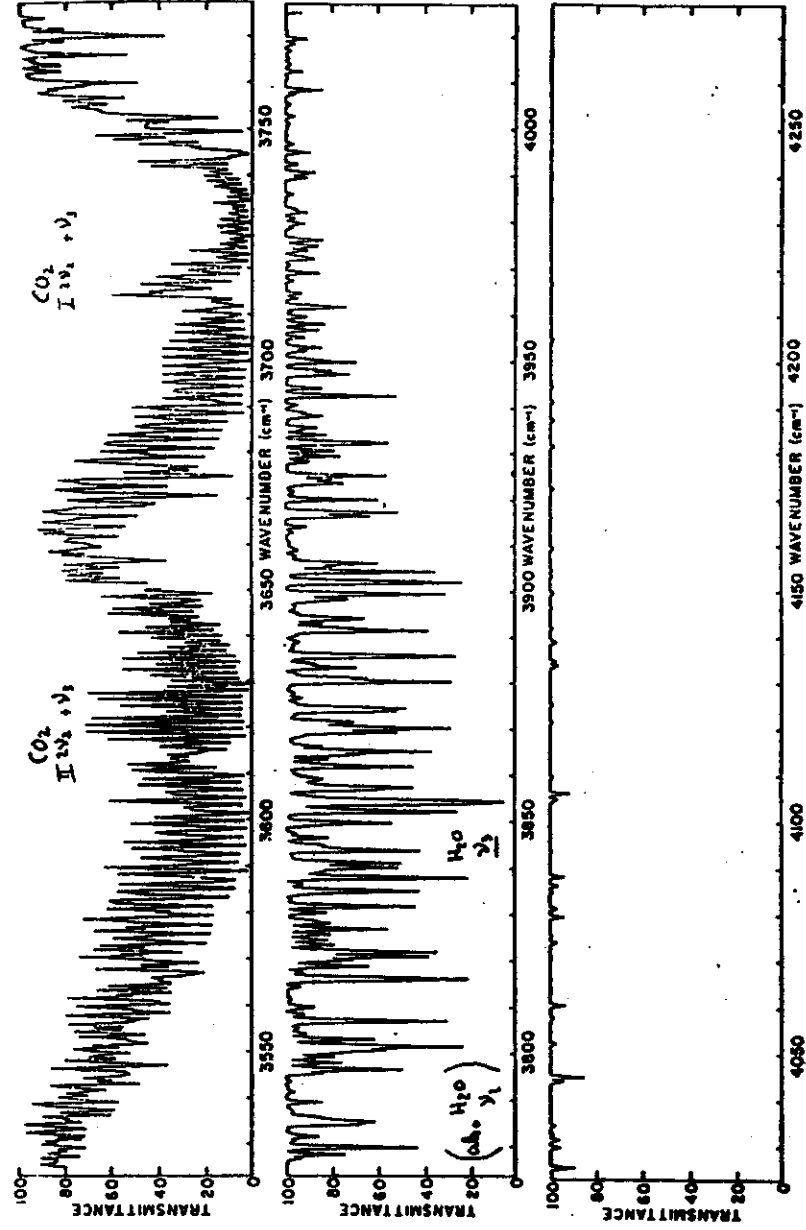


Figure 7e.

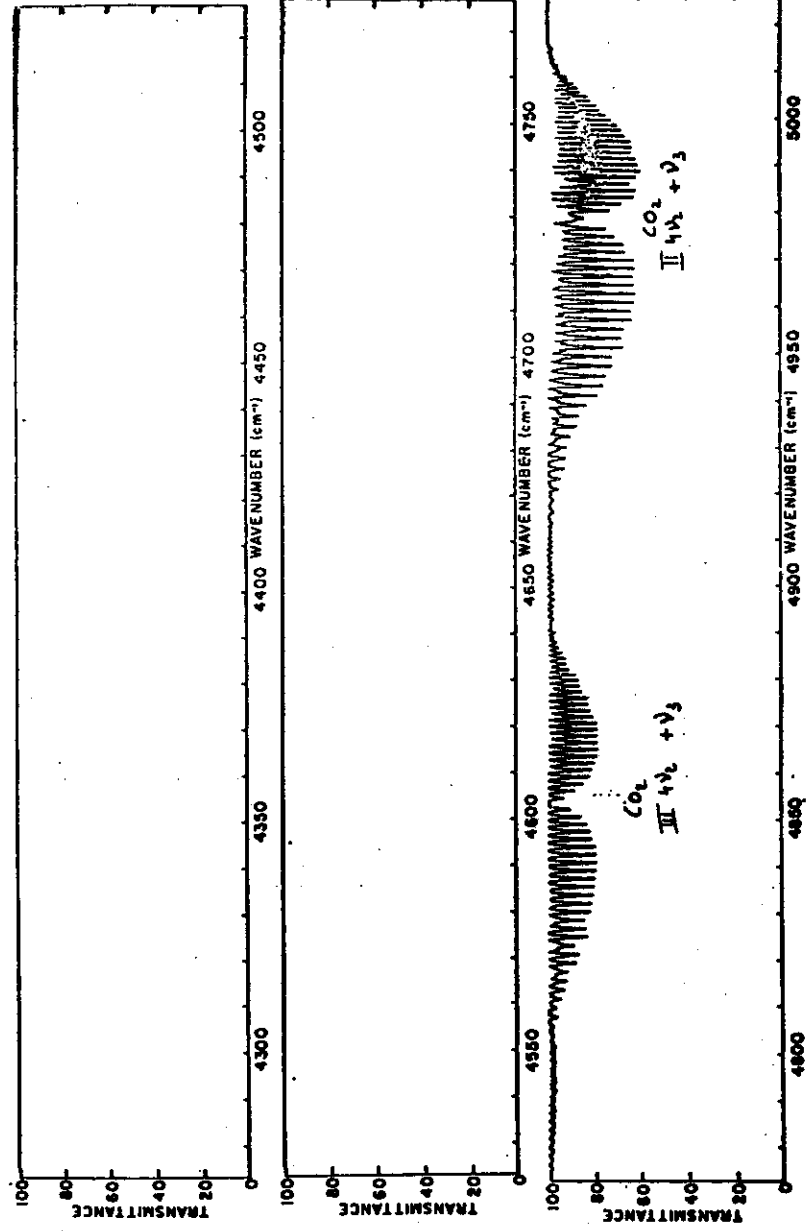


Figure 7f.

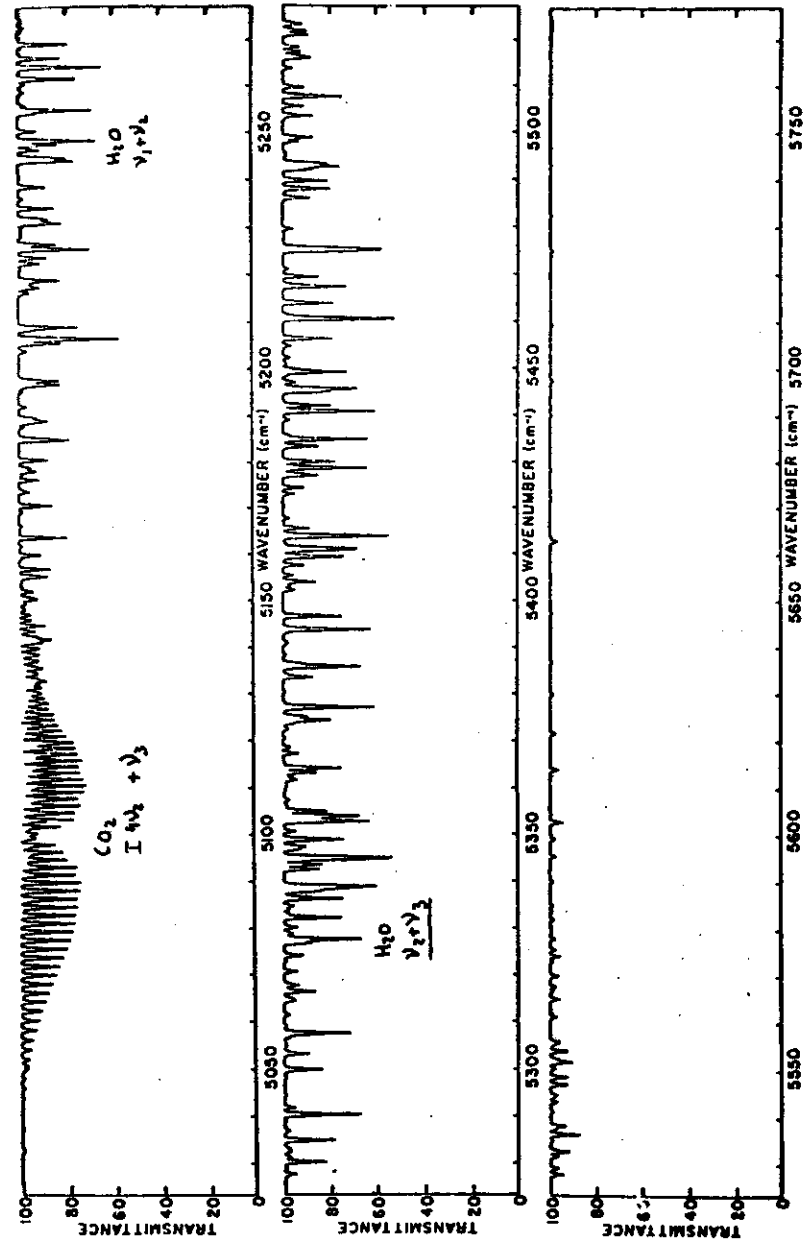


Figure 7g.