NEW MEASUREMENTS ON THE FOURTH POSITIVE BANDS OF CARBON MONOXIDE

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Abstract

New measurements of that part of the fourth positive band system of carbon monoxide between 2174A and 1280A have been made from plates photographed with a one-meter vacuum spectrograph. Low voltage arc excitation was used. The densities of the band edges were determined from a microphotometric trace. A few new band edges lying below the fourth positive system are reported. In general the measurements here reported are in good agreement with the wave-lengths published by Birge.

Introduction

THE fourth positive band system of carbon monoxide extending from 2800A to about 1280A has been measured in parts by a number of investigators at different times. Birge[1] describes the work previous to 1926 and analyzes data taken by Deslandres, Bair, Duncan, Lyman and Leifson. Recently Estey[2] discusses the papers on CO subsequent to 1926 and reports new measurements on that part of the fourth positive system lying between 1970A and 2800A.

In the course of some work with a vacuum spectrograph, measurements were made on the part of the fourth positive system of CO lying between 1280A and 2174A. It seems advisable to report these results at this time to give a more complete set of new measurements for this important band system.

Experimental Details

The bands were photographed with a one-meter vacuum spectrograph of the design described by Sawyer.[3] Two plates were made; one of short exposure for microphotometer records and the other of longer exposure for wave-length determinations.

A low voltage arc in CO containing a trace of hydrogen was used to excite the bands. The gas pressure was 0.5 mm of mercury, current 10 to 12 m.a. and potential difference 22 volts. An enlargement of one of the plates extending from 2090A to 1150A is shown in Fig. 1. A microphotometric trace of the same plate, made on a Moll self-recording microphotometer is shown in Fig. 2. The densities of the band edges and lines given in Table II and

[1] Birge, Phys. Rev. **28,** 1157 (1926).
[2] Estey, Phys. Rev. **35,** 305 (1930).
[3] Sawyer, J.O.S.A. **15,** 305 (1927).

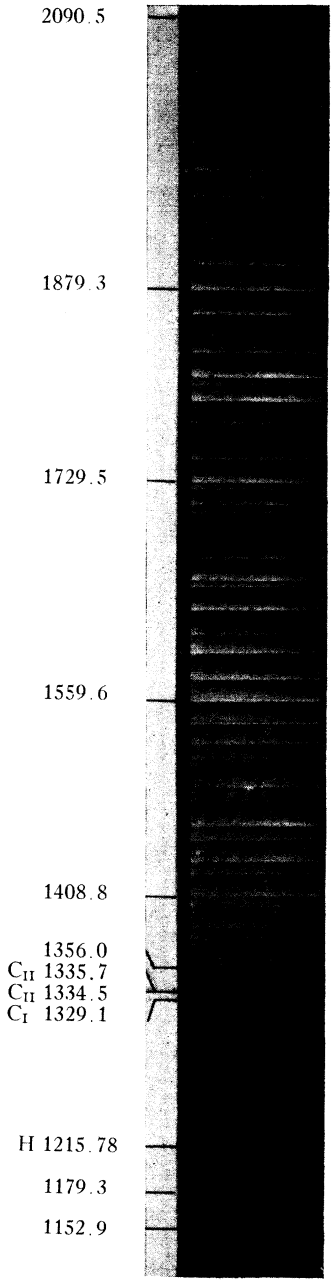


Fig. 1. The fourth positive band system of CO.

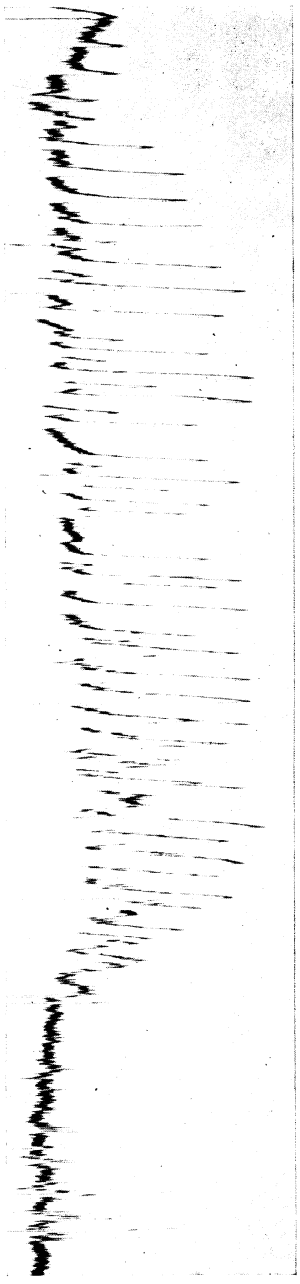


Fig. 2. A microphotometer record of part of the fourth positive band system of CO. from 2090.5A to 1280.6A. Including the hydrogen line 1215.78A, several carbon lines and bands of CO at 1179.3 and 1152.9A.

Table III were obtained from this trace by use of the relation,[4] density $=\log d/(d-h)$, where d is the total galvanometer deflection in the absence of a line and h is the height of the peak on the trace corresponding to a band edge or line.

The carbon line 2479.29 was used as a standard for the measurements of the bands from 2173.8A to 1595.8A. The hydrogen line 1215.78A was used as a standard for the measurements from the lower wave-length end of the plate up to 1611.5A. The measurements from the two standard lines overlapped for several bands near 1600A. The two measurements obtained in this way for the same edges checked within 0.2A.

The grating constant varied somewhat over the region photographed. The best values for it were previously determined experimentally by Dr. J. E. Mack. Table I gives these values for the regions over which they may be applied.

TABLE I.

Grating constant Angstroms/mm	Wave-length range
17.49	2332.2A−1970.0A
17.47	1970.0A−1729.5A
17.46	1729.5A−1597.4A
17.44	1597.4A−1025.7A

RESULTS

The measurements on the band edges, their densities as obtained from the microphotometer record, and their identification as assigned by Birge[1] are given in Table II. Some of the weaker band edges could not be measured on the plate but they appear on the photometer record in Fig. 2. A few new unidentified bands which apparently belong to the fourth positive system of CO are included in Table II.

TABLE II.

λ(IA)	ν (cm^{-1})	Density $\times 10^1$	n'	n''
2173.8	46002.8		5	13
2150.9	46492.8		4	12
2138.1	46770.9		7	14
2129.1	46968.9		3	11
2107.9	47439.7		2	10
2090.5	47835.0	0.5	5	12
2068.3	48348.7	0.7	4	11
2046.9	48854.4	0.5	3	10
2042.9	48949.5	0.3		
2034.9	49142.2	0.7	6	12
2026.3	49351.3	1.4	2	9
2012.4	49691.2	0.7	5	11
2006.4	49839.8	0.4	1	8
1990.8	50230.3	1.6	4	10

[4] Hughes and Lowe, Phys. Rev. **21**, 292 (1923).

TABLE II (*continued*).

λ(IA)	ν(cm^{-1})	Density $\times 10^{1}$	$n'n$	n''
1970.0	50761.7	2.8	3	9
1950.0	51281.5	2.6	2	8
1930.6	51797.1	3.0	1	7
1918.0	52129.5	1.4	4	9
1912.8	52279.9	0.5	0	6
1897.8	52692.0	4.0	3	8
1879.2	53214.4	6.1	2	7
1859.3	53782.5	4.8	1	6
1850.1	54050.8	0.3	4	8
1841.3	54309.8	1.3	0	5
1829.9	54646.9	4.0	3	7
1827.6	54715.7	0.8	6	9
1810.8	55223.0	7.6	2	6
1804.9	55404.7	1.9	5	8
1792.4	55790.8	7.5	1	5
1784.9	56026.8	1.3	4	7
1772.9	56403.8	3.4	0	4
1747.1	57238.7	3.8	2	5
1743.5	57356.2	0.7	5	7
1729.5	57820.8	6.1	1	4
1723.7	58013.4	2.2	4	6
1712.2	58403.4	3.9	0	3
1704.8	58658.9	3.1	3	5
1684.9	59350.0	0.4	5	6
1669.7	59891.7	3.9	1	3
1647.8	60687.3	4.0	3	4
1629.6	61366.3	6.9		
1611.5	62055.9	3.1	4	4
1597.4	62603.7	6.9	0	1
1595.8	62665.3	1.6	6	5
1576.8	63421.6	7.1	2	2
1559.6	64120.6	7.0	4	3
1545.3	64712.8	3.5	0	0
1542.4	64835.7	6.9	3	2
1525.7	65542.0	5.3	2	1
1515.7	65977.9	2.5	7	4
1510.4	66206.3	1.8	4	2
1492.6	66997.2	6.0	3	1
1480.2	67556.6	1.5	5	2
1463.4	68333.3	9.0	4	1
1452.2	68859.6	4.9	6	2
1435.3	69671.4	6.4	5	1
1425.8	70136.5	4.7	7	2
1408.8	70981.4	4.8	6	1
1401.0	71378.1	2.5	8	2
1384.0	72256.9	2.7	7	1
1378.0	72566.8	1.5	9	2
1373.7	72796.1	0.9	11	3
1363.3	73350.4	1.1		
1356.0	73746.3	0.4	10	2
1316.0	75986.7	0.3		
1299.3	76965.7	0.2		
1280.5	78091.4	0.2		

In Table III are given the wave-lengths of the C_I and hydrogen lines which were used as standards to measure the band edges. A few other C_I and C_{II} lines which were used to check the measurements are also given in this table. Measurements of four strong unidentified band edges below the fourth positive system are included. Three of these band edges may be seen

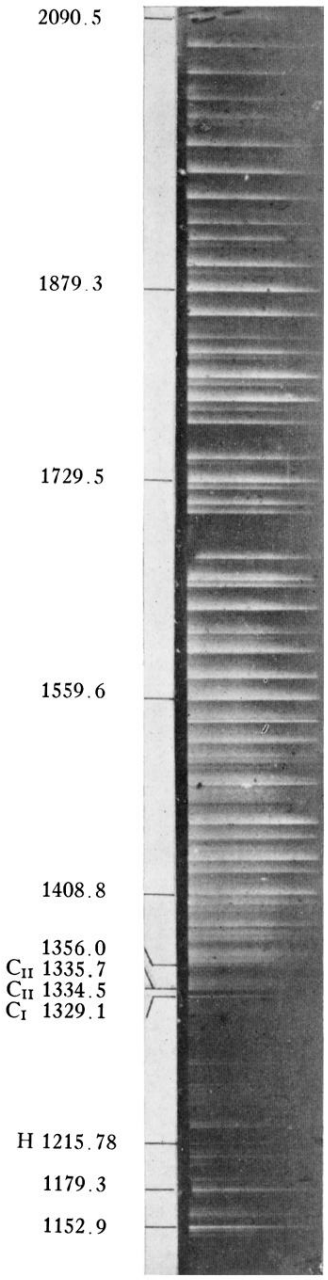
on the microphotometric trace, one just to the left of the hydrogen line. The other two at the right of this line are marked. The fourth one at 1025.7A is not shown on the trace. This was the shortest wave-length edge observed.

TABLE III.

λ (IA)	ν (cm^{-1})	Density $\times 10^{1}$	Remarks
1335.7	74866.8	0.3	C_{II} line
1334.53	74932.2	0.2	" "
1037.02	96430.1		" "
1329.1	75238.9	1.0	C_{I} line
2479.29	40334.1		" "
1215.78	82254.5	1.6	Hydrogen
1228.2	81422.6	0.7	
1179.3	84793.9	2.8	band
1152.9	86733.3	3.3	edges
1025.7	97496.3		

These edges probably belong to the absorption systems of Hopfield and Birge,[5] corresponding to transitions from excited states, above those giving rise to the fourth positive system and the normal state.

[5] Hopfield and Birge, Phys. Rev. **29**, 922 (1927).



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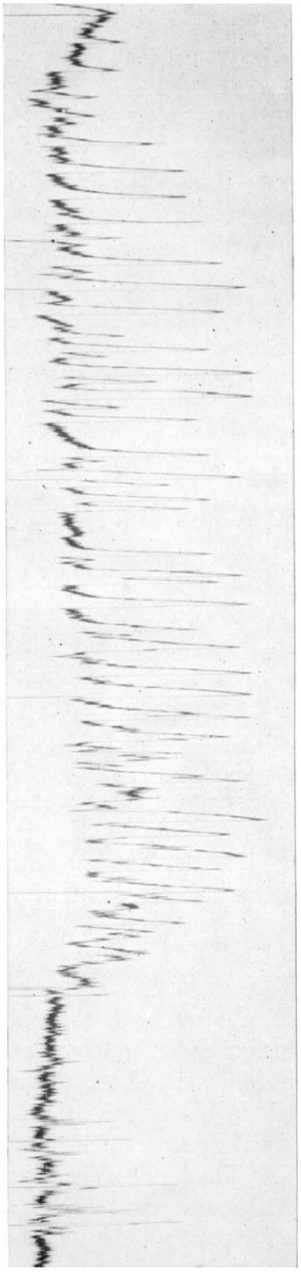

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