

New bands in the A-X system of CaF

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[PLATE-5]

The $A_1\Pi - X^2\Sigma$ system of CaF which lies in the region 6300-5830Å is reinvestigated by exciting the CaF₂ sample in a 150V d.c. carbon arc at 6-12A current. More members were observed in each of the known sequences $\Delta v = -1, 0$ and $+1$.

INTRODUCTION

The A-X system of CaF obtained in carbon arc was investigated by Datta (1921), Johnson (1929) and Harvey (1931). Mohanty & Upadhyaya (1967) performed a part of the rotational analysis of the (0,0) band and obtained the rotational constants.

A reinvestigation of the spectrum with high current arc discharges showed about twenty new bands in the known sequences $\Delta v = -1, 0$ and $+1$.

EXPERIMENTAL

The spectrum was excited by burning CaF₂ salt in a carbon arc at 150V d.c. and 6-12A current and was photographed on a 3.4 meter Jaco grating spectrograph. The $\Delta v = 0$ and -1 sequences were photographed at a dispersion of 2.4Å/mm and the $\Delta v = +1$ sequence at about 0.95Å/mm. The exposure times varied from 2 to 4 minutes on Ilford R-40 plates. Iron arc was used as standard.

DISCUSSION

All the newly observed bands are shown in figure 1 duly marked. The band head data and vibrational analysis are presented in table 1. Good agreement was found between the observed bands and the calculated ones with the existing formulae.

$^3\Pi_{3/2} - X^2\Sigma$ sub-system : In the $\Delta v = -1$ sequence, eight bands belonging to P_2 series were observed out of which none were reported by earlier workers and Q_2 series consists of four new bands. In $\Delta v = 0$ sequence, one extra band in Q_2 series and two extra bands in P_2 series were recorded. However, $\Delta v = +1$ sequence shows only Q_2 heads and appears as if it has originated at 5830Å and starts diverging towards longer wavelength side and all the band heads appear to be degraded to violet. Johnson's (1929) assignment starts from (4,3) and the head lies at 17145.6 cm⁻¹. This numbering

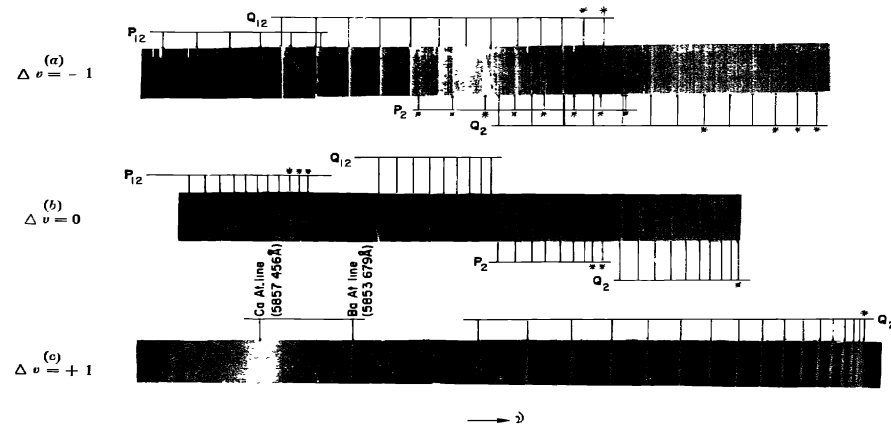


Figure 1. (a), (b), (c). Photograph showing $\Delta v = -1, 0$ and $+1$ sequences respectively of $A^2\pi - X^2\Sigma$ system of CaF. Newly observed bands are marked *

TABLE I. NEW EXPERIMENTAL DATA (IN CM^{-1}) AND VIBRATIONAL ANALYSIS

$\Delta v = -1$		$\Delta v = 0$		$\Delta v = +1$	
Q_1 Series	$v' - v''$	Q_1 Series	$v' - v''$	Q_1 Series	$v' - v''$
${}^2\Pi_{3/2} - {}^2\Sigma$ sub-system.					
16050.0	7-8	16597.9	9-9	17146.1	1-0
75.1	10-11				
82.7	11-12				
90.2	12-13				
P_1 Series		P_1 Series			
15951.6	1-2	16552.3	7-7		
63.0	2-3	55.3	8-8		
74.0	3-4				
84.6	4-5				
95.1	5-6				
16004.3	6-7				
13.0	7-8				
21.8	8-9				
${}^2\Pi_{1/2} - {}^2\Sigma$ sub-system.					
Q_{12} Series		P_{12} Series			
16008.5	11-12	16457.6	8-8		
15.9	12-13	61.3	9-9		
		64.8	10-10		

was thought to be uncertain by Harvey (1931) since this end was not properly resolved and the first few Q_2 heads were supposed to be superposed. In the present work this portion of the spectrum is clearly resolved and it shows that the bands actually start from 17146.1 cm^{-1} . So, this is taken as (1,0) band of this sequence and subsequently the band at 17145.6 cm^{-1} becomes the (2,1) band and so on upto (17,16).

${}^2\Pi_{3/2} - X {}^2\Sigma$ sub-system: The Q_{12} series in $\Delta v = -1$ sequence has two more bands and the band at 15865.6 cm^{-1} in P_{12} series is reassigned as (2,3) for consistency in the analysis. The P_{12} series in $\Delta v = 0$ sequence has three extra bands than observed by previous workers.

It has been possible to locate the new bands in the $\Delta v = 0$ sequence in the sub-systems from intensity considerations and expected positions of the band heads though they are weak and overlapped by fine structure of the preceding bands.

The red degraded bands listed in literature beyond the $\Delta v = +1$ sequence of the ${}^2\Pi_{3/2} - {}^2\Sigma$ sub-system have not been well developed on our plates. Instead of the diffuse maximum with its centre at 5853.7 \AA in the microphotometer trace given by Harvey (1931), a moderately intense sharp line at the same wavelength has been recorded on our plate 5, figure 1(c). This line is very probably due to an impurity of barium in the calcium salt.

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