

THE ${}^5\Pi-{}^7\Sigma$ ELECTRONIC TRANSITION IN MnBr AND MnF

by P. TIRUVENGANNA RAO, *I.C.I. Research Fellow, Physics Department,
Andhra University, Waltair.*

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In a previous communication, the author 1952 has reported the analysis of the γ system of MnCl in the region λ 4800–5100 on the basis of an electronic transition ${}^5\Pi-{}^7\Sigma$. Analogous systems mentioned earlier by Mesnage (1938), Müller (1943) and Bacher (1948) in MnBr and MnF are studied by the author in detail and the results obtained are reported in the present paper.

EXPERIMENTAL.

The experimental set up is the same as the one used for manganese chloride and described previously (Author, 1949). Even in the case of manganese fluoride, a discharge tube of the same design was used to reproduce the system. The current flowing through the discharge tube is adjusted in such a way that no SiF bands were recorded on the plates. A Fuess glass instrument with an average dispersion of 30 \AA per mm. in the region studied, was used for photographing the spectra. Exposures using Ilford Selochrome plates varied from half to two minutes' duration.

PLATE.

In Plate, Fig. I, which is a reproduction of the γ system of MnBr , the bands are apparently arranged in three groups. Starting from the red end, these groups are obviously to be regarded as the $\Delta v = -1, 0$ and $+1$ sequences respectively. The $\Delta v = 0$ sequence is better developed than the remaining sequences and is therefore examined for studying the multiplet structure.

Fig. II is a reproduction of the γ system of MnF occurring in the region λ 4900–5000. The $\Delta v = -1$ and $+1$ sequences are completely absent in the system.

STRUCTURE AND ANALYSIS OF THE BANDS.

MnBr.

The possible rotational heads and the scheme of the transitions to be expected in a ${}^5\Pi-{}^7\Sigma$ electronic transition are fully described in the previous paper. With reference to the figure of transitions given there, the vibrational and rotational assignments for the γ system in MnBr are given in Table I. The intervals between the members of the $\Delta v = 0$ sequence and those of the other groups suggest that the vibrational frequencies ω'_v and ω''_v are of the order of 255 and 288 wavenumber units respectively. The bands in the $\Delta v = 0$ group whose assignments are not shown in Table I belong to forms with $\Delta K = 0, 2$ or 3 in each F level. As sufficient number of bands are not developed in each of the other groups their assignment is not shown.

TABLE I.

MnBr Bands. γ System.

Sequence.	Wave-length.	Wave-number.	I	ΔJ		
				-1	0	+1
$\Delta v = -1$	5086.9	19652.9	4			
"	5077.1	19690.8	3			
"	5069.0	19722.3	5			
"	5063.7	19742.9	1			
$\Delta v = 0$	5041.9	19828.3	2		RQ_1	R_{12}
"	5025.3	19893.8	1	RJ'_{21}	Q_2	R_{23}
"	5021.0	19910.8	7			
"	5007.9	19962.9	6	RP_{32}	RQ_3	R_{34}
"	4993.9	20018.9	10			
"	4991.0	20030.5	5	RP_{43}	RQ_4	R_{45}
"	4986.5	20048.6	6			
"	4974.2	20098.1	1	RP_{54}	RQ_5	R_{56}
$\Delta v = +1$	4930.8	20275.0	2			
"	4928.8	20283.3	3			
"	4924.5	20301.0	2			

The intervals between the R heads of the $\Delta v = 0$ sequence shown in Table II indicate that the value of the coupling constant A is approximately 68.

TABLE II.

v', v''	R_{56}	R_{45}	R_{34}	R_{23}	R_{12}
0, 0	20098.1	20030.5	19962.9	19893.8	19828.3
	67.6	67.6	69.1	65.5	

MnF.

For the γ system in MnF, the assignments for members of the $\Delta v = 0$ sequence were shown in Table III. As in MnBr, the rotational assignments are shown for the R heads only. The intervals between the R heads shown in Table IV suggest that the coupling constant A is of the order of 35.

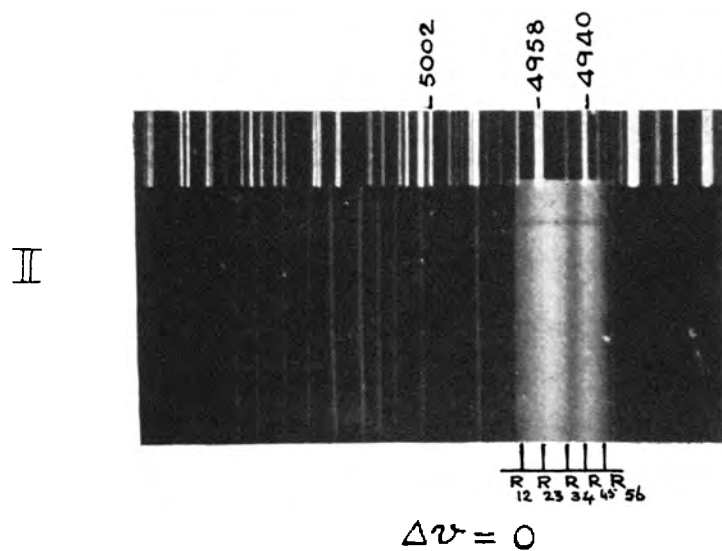
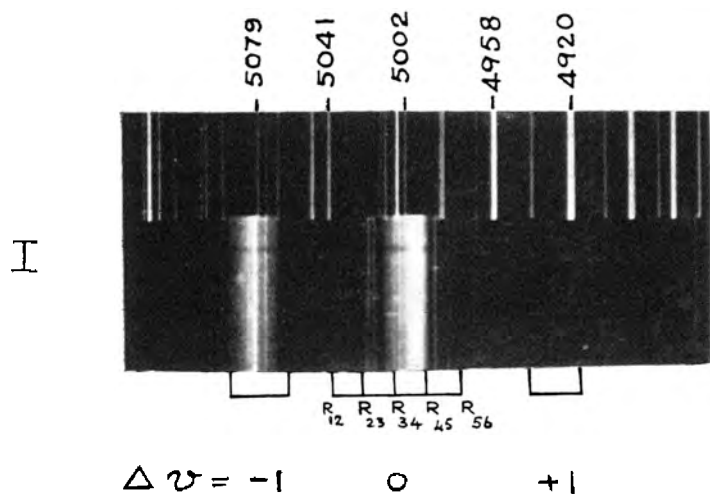


Fig. I. MnBr Bands (γ System)

Fig. II. MnF

TABLE III.
MnF Bands. γ System.

Sequence.	Wave-length. Å	Wave-number. cm. ⁻¹	I	ΔJ		
				-1	0	+1
$\Delta v = 0$	4964.4	20137.8	5		R_{Q_1}	R_{12}
"	4958.0	20163.8	8			
"	4955.7	20173.2	9	$R_{P_{21}}$	R_{Q_2}	R_{23}
"	4952.3	20187.0	10			
"	4947.3	20207.4	7	$R_{P_{32}}$	R_{Q_3}	R_{34}
"	4041.8	20229.9	3			
"	4939.2	20240.6	10	$R_{P_{43}}$	R_{Q_4}	R_{45}
"	4936.5	20251.6	9			
"	4933.2	20265.2	6			
"	4931.2	20273.4	5	$R_{P_{54}}$	R_{Q_5}	R_{56}

TABLE IV.

v', v''	R_{56}	R_{45}	R_{34}	R_{23}	R_{12}
0, 0	20273.4	20240.6	20207.4	20173.2	20137.8
	32.8	33.2	34.2	35.4	

ABSTRACT.

The emission spectra of MnBr and MnF were excited in a heavy current discharge through the vapour and photographed in the visible region using a Fuess glass spectrograph. The γ system in each of these molecules has been interpreted on the basis of a ${}^5\Pi-{}^7\Sigma$ transition, as in the case of a similar system in MnCl.

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