THE SPECTRUM OF 25 ORIONIS, 1933–1939

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ABSTRACT

During 1933–1938 the hydrogen lines showed equal emission components and no variations in velocity. Throughout this interval the emission lines steadily increased in width. In 1938–1939 the violet component became stronger than the red, velocities increased, and emission widths diminished.

A previously reported[1] investigation of the spectrum of 25 Orionis[2] indicated that from 1915 to 1933 there had been cyclic variations, with decreasing period and amplitude, in the velocities of the central absorption and emission lines of hydrogen and in the ratio of the red and violet components of the emission lines. Further estimates

JD	Velocity (Km/Sec)				Emission Ratio, log V/R		Width of Emission Lines in Angstroms		Velocity Represented by Edges of Emission Lines (Km/Sec)				Number of Plates
	Central Absorption		Emission						$H\beta$		$H\gamma$		
	$H\beta$	$H\gamma$	$H\beta$	$H\gamma$	$H\beta$	$H\gamma$	$H\beta$	$H\gamma$	Red	Violet	Red	Violet	
2427412...	+27	+29	+29	+25	−0.02	−0.02	5.7	5.5	+205	−146	+214	−164	6
7789...	26	23	24	23	− .06	− .04	6.3	5.7	216	170	223	174	7
8188...	20	24	17	25	− .01	+ .01	6.4	6.6	217	179	251	220	9
8557...	22	26	28	15	− .04	− .01	6.6	7.4	233	188	270	240	5
8923...	51	16	44	26	+ .02	.00	8.3	7.6	307	202	289	236	3
9243...	+50	+45	+49	+33	+0.11	+0.15	7.6	6.2	+280	−187	+264	−164	3

by McLaughlin[3] of the emission ratio, V/R, during 1933–1937 indicated that the conspicuous changes in the relative intensity of the emission components had ceased and that the red and violet components of the emission lines had been practically equal throughout this later interval.

The data for the present study have been obtained from 33 one-prism spectrograms taken at the University of Michigan Observatory between 1933 and 1939 (JD 7345–9339). Velocities were de-

[1] *Ap. J.*, **84**, 180, 1936.

[2] HD 35439; BD+1°1005; α $5^h19^m.6$; δ +1°45′ (1900); visual magnitude, 4.73; spectral class, B3p.

[3] *Ap. J.*, **85**, 185, 1937.

termined from the central absorption lines and from the means of the outer edges of the two emission components for both $H\beta$ and $H\gamma$. Measures were also made of the velocities represented by the outer edges of the emission lines, total widths of the emission lines, and the ratio of the intensity of the red and violet emission components. Normal places formed from the individual plate measures are given in the accompanying table, and the results are shown graphically by the black dots in the right-hand portion of Figure 1.

The curves of the diagram indicate that for the 2000-day interval, JD 7000–9000, when the emission components were practically equal, there were no marked changes in the average values of either the absorption or the emission velocities. The measures of individual spectrograms showed the same wide scatter about the average values that had been found during the period of cyclic variations.[4] The spectrograms for the winter of 1938–1939 gave the first evidence of a real change in the ratio of the emission components. The violet component became stronger than the red; and on the last spectrogram secured, it is estimated as one and one-half times more intense than the red component. It is possible that the "resumption of variation in the spectrum of 25 Orionis" suggested by McLaughlin[5] is taking place. This view is further indicated by the accompanying increase in both the absorption and emission velocities from an average value of about +24 km/sec to almost double that figure for JD 9243.

During the interval of constant velocities and equal emission components the $H\beta$ and $H\gamma$ emission lines continually increased in width to maximum breadths of 8.3 A and 7.6 A, respectively, for JD 8923, the date which just precedes the suggested resumption of variations in velocity and emission ratio. The emission widths at this time were considerably greater than at any previous time for which the star had been studied, and this excessive width could not have been caused by a mere spreading of the photographic image, because there was no conspicuous increase in the emission intensity. Throughout the times of cyclic variation there had been maxima of emission width at both maximum and minimum velocity (data for JD 5400 not comparable).[6] The velocities represented by the sepa-

[4] *Ibid.*, **84**, 184, 1936. [5] *Ibid.*, **85**, 193, 1937. [6] *Ibid.*, **84**, 187, 1936.

rate edges of these lines (see the last four curves of Figure 1) indicate that this was caused by the flaring-out of the weaker of the two emission components. However, the maximum in emission width at JD 8923 resulted from a simultaneous spreading-outward of *both* of the emission components. As the violet component became stronger and the velocities increased in value at JD 9243, the emission became narrower.

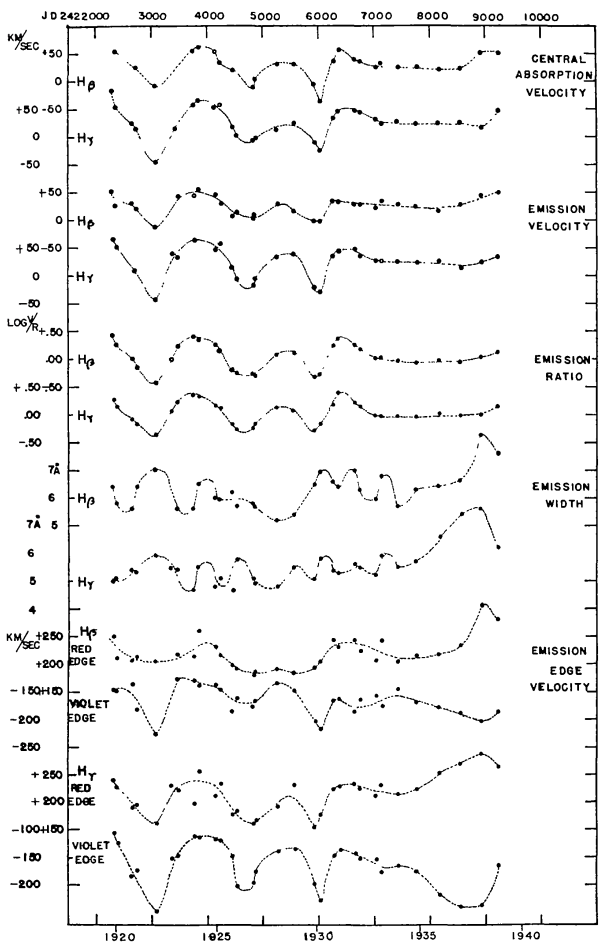

FIG. 1

It is difficult to suggest a physical interpretation for the phenomena. They do not seem to fit into the model previously described for 25 Orionis.[7] It is interesting to note, however, that immediately preceding the commencement of variations in velocity and emission ratio in γ Cassiopeiae,[8] about JD 7000, there was a corresponding conspicuous increase in the width of the emission lines, followed by a sudden decrease.

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[7] *Ibid.*, p. 200.

[8] *Ibid.*, **83**, 499, 1936.