EXTRAIT DES

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THE SHELL SPECTRUM OF BD — 14° 1971 (PGC 1985) IN 1947

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Sommaire. — *Boss* 1985 *a révélé en fin* 1947, *un spectre entièrement différent de ce qui avait été observé précédemment. La région ultraviolette est caractérisée par d'intenses raies d'absorption du genre de celles que l'on observe dans les étoiles à atmosphère étendue* (*table I*). *Les raies d'émission de Fe II*, [*Fe II*] *et* [*Ni II*] *sont restées à peu près les mêmes que précédemment* (*table* 2). *Le spectre ultraviolet est comparé à ceux d'étoiles à atmosphère très étendue. L'analogie de B* 1985 *et de VV Cephei est discutée. De nouvelles observations tant photométriques que spectroscopiques sont désirables.*

The star Boss 1985 [1] has been classified as K5 + Be at Harvard and as M2ep at Mount Wilson. It is a symbiotic object consisting of an M star and a Be star. For a long time it has been known to possess [Fe II] lines [2]. The Balmer lines have a remarkable structure : an emission of appreciable width is flanked on the longward side by a narrow, deep absorption line ; this structure is superimposed over a broader line, having Stark-effect wings. The emission component of the Balmer lines is strong, all the way to H18 and may still be present in higher members. The profile of the Balmer lines is very similar to that found in VV Cephei at certain phases of the evolution of this binary. The early type component is approximately of type B3e. Because of the blending with the late type star it is difficult to identify the absorption — or weak emission lines of the B-component longward of H_ε.

B 1985 was placed on the observing program of the McDonald Observatory in 1939, on account of the symbiotic character of the object, and especially because of the presence of [Fe II]. A general description of the spectrum and discussions on new forbidden lines of [Fe II] and [Ni II] have been published recently [3].

Spectrograms have been obtained on various occasions at the McDonald Observatory since 1939. While minor variations were not excluded, no spectacular change had been observed until October 1947. At this time the star was being observed in the ultraviolet region for detection of new expected forbidden lines. The first spectrogram (October 18) revealed a very striking change in the ultraviolet region, compared with spectrograms obtained until about 1942. While previous spectrograms had mostly revealed emission lines of H, Fe II, Cr II, [Fe II] and [Ni II], the Autum 1947 material was characterized by intense absorption lines similar to those of a shell spectrum. A considerable change in spectrum had occurred, such as has been observed

Plate 2 B 1985 (Region 3300 - 3950)

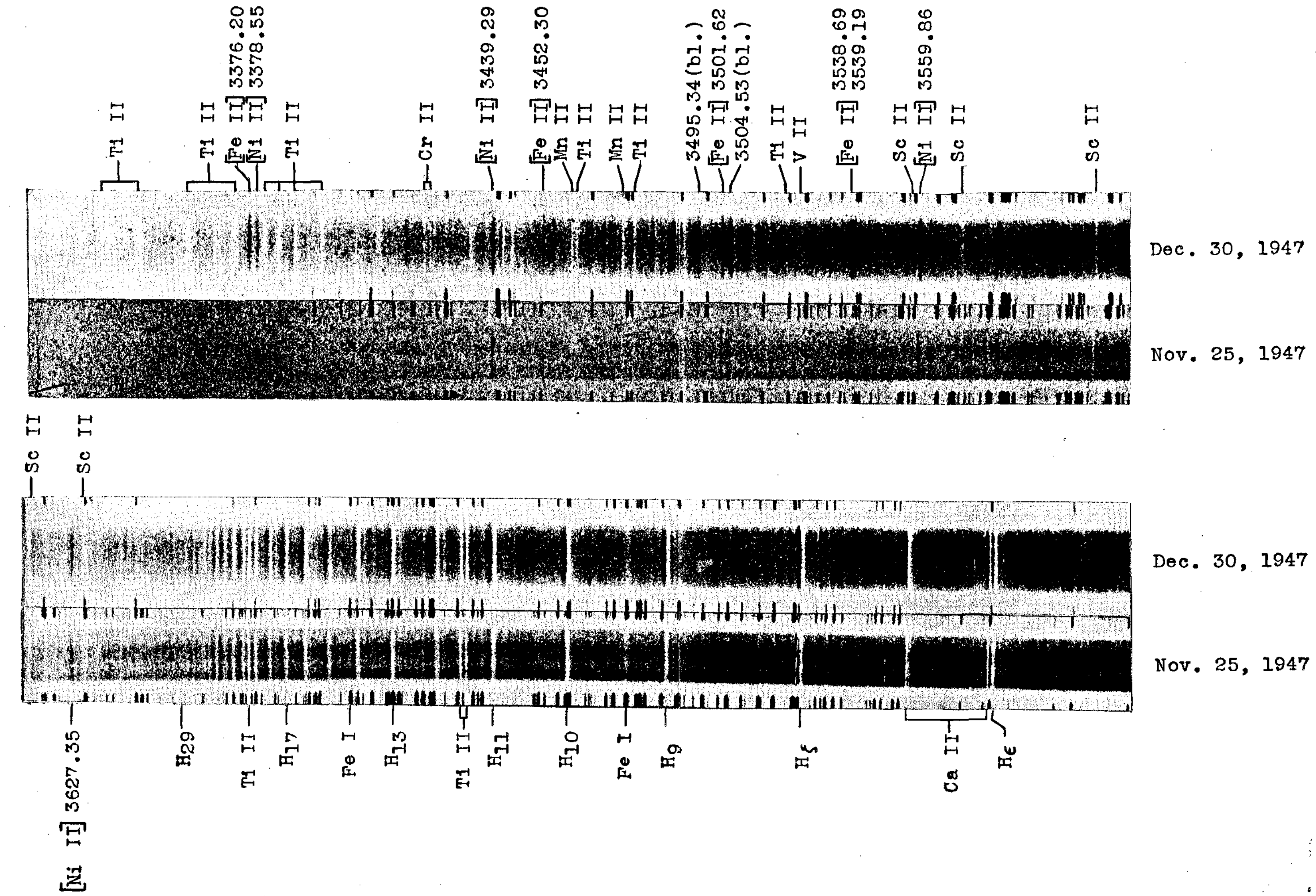


Plate 3 B 1985 (Region 3100 - 3500) (1947)

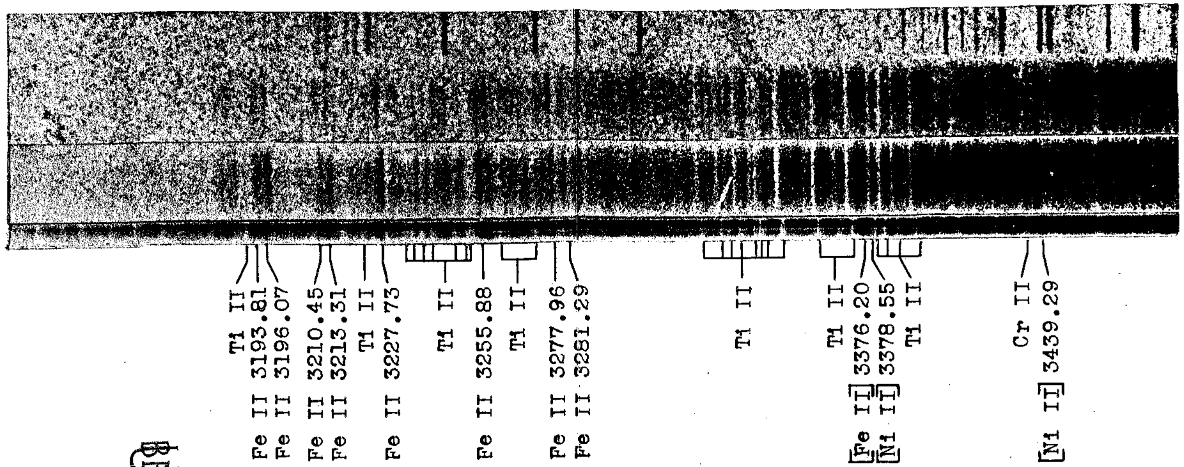
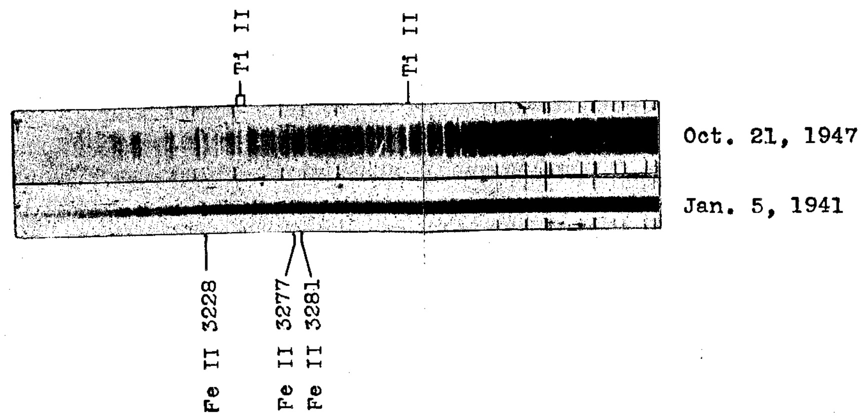


Plate 1 B 1985. Region 3100 - 3500.
Comparison between 1941 and 1947.



in various other symbiotic objects, for example Z Andromedae (outburst) or VV Cephei (eclipse). The spectrum was still suspected to be variable in the Fall of 1947 ; changes were suspected in ten day-intervals, (f. ex. between Oct. 21 and Oct. 31) during the period Oct. 18-Déc. 30 in the course of which seven spectrograms were obtained. The apparition of the shell type spectrum was announced in a private letter to Dr. Paul W. MERRILL in November 1947. In his answer of December 4, 1947, Dr MERRILL announced that the spectrum had been observed independently by Dr. R. F. SANFORD, on a Mt Wilson coudé spectrogram with dispersion 10 A /mm. Dr. SANFORD's spectrogram which covers the ultraviolet region, shows numerous Balmer lines in absorption. Essentially similar results were published by Dean B. McLAUGHLIN [4], on the basis of spectrograms covering the photographic region, to about λ 3 900. A observers noticed the striking similarity of B 1985 to VV Cephei at certain phasesl

I have no photometric data on B 1985. In the visual region the main contribution is doubtlessly that of the M-component. Hence variations in the hot component may not affect the visual magnitude appreciably. It seems very probable that the considerable spectroscopic changes observed in the ultraviolet region have been accompanied by changes in the ultraviolet brightness of the object. This is one of these typical examples where monochromatic photometry is imperative. This is of course true of many other objects (AX Persei, CI Cygni, Z Andromedae, etc...) : observations of the brightnesses in specific spectral regions characteristic of the different « components » of the object (M-companion, H_α-emission, ultraviolet emitter) would permit physical discussions which integrating photometry does not.

We have listed in tables I and II the absorption- and emission lines observed from October to December 1947. The notations are the same as usual ; an identification between parentheses is an uncertain or minor contribution. It is planned to re-discuss the object on the basis of more extensive material later on. The spectrograms were measured in the ultraviolet region only. Blending by the M-component makes measurements difficult or doubtful longward of λ 3 935. Even in the region from λ 3 750 to λ 3 935 certain absorption lines (f. ex. of Fe I) may be due mostly to the M-star. The wave lengths in Table I and II have been corrected for the velocity of the earth, but not for the radial velocity of the star. Plate 1 shows the remarkable differences between the ultraviolet spectra in 1947 and 1941. Plate 2 shows the spectrum from λ 3 300 to λ 3 950 in 1947. Attention is called to the intense [Ni II] lines which I believe, are here reproduced for the first time. The region $\lambda < 3\,500$ is shown on plate 3 . On plates 2 and 3 the emission lines are given by their wave lengths, the absorptions by the elements only. Plate 2 shows that the Balmer continuum appears with fair intensity in absorption. As appears from the plates and tables, the highest members of the Balmer series appear mainly in absorption.

TABLE I

Absorption Lines in B 1985 (October to December 1947)

I	λ	Identification Element	λ	Int.	I	λ	Identification Element	λ	Int.
1	3 115.38	Cr II	15.65	20	4	3 162.53	Ti II	62.57	35
		Cr II	15.28	12	0	3 164.40	(Cr II	63.93	10)
		(Fe II	15.49	1)			(V II	64.82	40)
1	3 117.97	Ti II	17.67	20	1	3 165.91	(V II	65.89	30)
		V II	18.38	1 000	3	3 168.48	Ti II	68.52	40
		Cr II	17.28	15	1nn	3 172.33	Cr II	72.08	40
		Cr II	18.14	10			Y II	73.07	100
2nn	3 119.33	Ti II	19.80	15	1	3 177.89	Fe II	77.53	10
		Cr II	18.65	60	3n	3 180.63	Cr II	80.73	75
		Cr II	20.37	75			Fe II	79.50	8
2nn	3 125.64	Cr II	24.98	100			Fe II	80.16	7
		V II	25.28	600			(Cr II	79.45	8)
		V II	26.21	150			(Ti II	80.22	2)
1	3 128.67	Cr II	28 70	40	1	3 182.41	Ti II	81.84	8
		Ti II	28.64	10			Ti II	82.57	6
		Ti II	27.88	10			Cr II	81.43	20
1	3 132.79	Cr II	32.06	125			(Zr II	82.86	35)
		(V II	33.33	150)	1	3 183.75	Cr II	83.32	40
2	3 136.48	Cr II	36.68	40			Cr II	84.36	15
		(Cr II	35.74	30)			Fe II	83.11	8
		(V II	36.50	160)	1	3 187.68	V II	88.52	300
0	3 138.75	(Zr II	38.66	25)			V II	87.72	200
1	3 142.61	V II	42.48	150			Fe II	86.74	11
		Cr II	42.97	8			Fe II	87.29	8
1	3 143.54	Ti II	43.76	10			Cr II	86.75	18
		(Cr II	43.68	7)	5	3 190.65	Ti II	90.87	30
2	3 147.07	Cr II	47.23	50			(V II	90.69	500)
		(Fe II	46.75	2)	1	3 191.78	(Fe II	92.06	3)
2	3 147.94	Ti II	48.03	12			(Ti II	92.26	2)
1	3 154.95	Ti II	54.19	2			(Ti I	91.99	80)
		V II	55.41	60	2	3 197.20	Cr II	97.12	75
		Fe II	54.20	12			Cr II	96.96	20
		Cr II	54.04	5			Cr II	98.00	15
1	3 156.33	Ti II	55.67	12	2n	3 202.33	Ti II	02.53	40
1	3 157.37	Ti II	57.40	2			(Cr II	01.26	25)
		Cr II	58.03	20	0	3 203.31	Cr II	03.53	15
5	3 161.23	Ti II	61.75	30			Cr II	02.52	15
		Ti II	61.20	25			(Ti II	03.43	3)

TABLE I (*suite*)

I	λ	Identification Element	λ	Int.
2	3 209.10	Cr II	09.21	50
		Cr II	08.62	20
1	3 211.27	(Fe II	10.45	10)
		(Fe II	11.07	1)
4	3 216.87	Ti II	17.06	30
		Cr II	17.44	50
		Cr II	16.55	20
		V II	17.12	400
		Y II	16.70	100
3	3 218.30	Ti II	18.27	25
2nn	3 222.63	Ti II	22.84	35
		(Fe I	22.07	20)
0	3 225.53	Cr II	25.39	12
		Cr II	25.44	8
		(Ti II	24.24	35)
4	3 229.32	Ti II	29.19	40
		Ti II	29.40	35
		Ti II	28.60	30
1nn	3 230.75	Ti II	31.31	4
		Cr II	29.89	10
		Cr II	31.64	8
		(Fe II	30.50	1)
1	3 232.37	Ti II	32.28	30
		(Fe II	32.79	7)
		(Fe II	31.70	5)
		(V II	31 95	80
3	3 234.75	Ti II	34.52	75
		(Cr II	34.06	50)
4	3 236.82	Ti II	36.57	70
		Ti II	36.12	20
3	3 239.51	Ti II	39.04	60
		Ti II	39.66	30
		(Cr II	38.77	50)
3	3 242.32	Ti II	41.98	60
		(Y II	42.30	150)
1	3 243.24	(Fe II	43.72	8)
1n	3 245.80	(Cr II	45.31	5)
5	3 248.85	Ti II	48.60	50
3	3 252.30	Ti II	51.91	30
		(V II	51.87	200)
5	3 253.24	Ti II	52.91	40
4	3 254.32	Ti II	54.25	30
		(V II	54.77	300)
0	3 257.83	V II	57.89	100
		Fe II	57.89	3
1	3 260.33	(Ti II	60.26	3)
2	3 261.68	Ti II	61.60	60
1	3 264.44	Cr II	64.26	35
		(Ti II	63.69	4)
1	3 268.05	V II	67.71	1 000
		(Cr II	68.48	10)
		(Fe II	68.51	3)
3	3 272.04	Ti II	72.08	25
		Ti II	71.65	25
		V II	71 12	1 200
1	3 276.28	V II	76.12	1 500
		Fe II	76.61	5
		(Cr II	75.92	10)
0	3 277.40	Fe II	77.35	9
		Ti II	76.77	5
3	3 279.32	Ti II	78.92	35
		(Ti II	78.29	30)
		(V II	79.84	300)
		(Zr II	79.26	65)
1	3 280.92	(V II	81.12	40)
		(Ti II	79.99	4)
0	3 282.92	Ti II	82.33	25
		V II	82.53	150
0	3 285.16	Fe II	85.42	3
		V II	85.02	50
1	3 287.40	Ti II	87.66	40
0	3 288.56	Ti II	88.43	5
		Ti II	88.57	5
		Cr II	88.04	15
1	3 291.05	Cr II	91.75	40
		(Ni II	90.69	1)
		(Ni II	90.54	1)
		(V II	90.24	50)
1n	3 293.25	(V II	93.15	50)
		(Mo II	92.31	12)

TABLE I (*suite*)

I	λ	Identification Element	λ	Int.
1	3 298.50	Fe II	97.89	5
		V II	98.74	130
		(Ti II	98.21	1)
1	3 302.08	(Cr II	01.21	18)
		(Ti II	01.71	2)
		(Na I	02.34	8)
		(Na I	02.94	8)
0	3 305.08	(Fe II	04.43	1)
		(V II	04.47	40)
		(Cr II	04.73	5)
1	3 307.66	Cr II	07.04	50
		Cr II	08.15	18
		Cr II	06.95	50
1	3 309.69	(Ti II	08.81	8)
0	3 312.71	Sc II	12.74	5
		Cr II	11.93	40
		Cr II	12.18	40
		Cr II	13.08	20
		(Fe II	12.71	1)
1	3 315.47	Ti II	15.32	10
		Cr II	15.29	12
		Cr II	14.57	35
		(V II	14.86	50)
		(V II	15.18	50)
1	3 318.09	Ti II	18.02	10
0	3 321.83	Ti II	21.70	25
		(V II	21.54	150)
6	3 323.23	Ti II	22.94	75
		(Fe II	23.07	8)
1	3 325.13	Cr II	24.35	50
		(Fe II	25.01	1)
		(Fe II	24.84	1)
1	3 326.92	Ti II	26.76	20
4	3 329.64	Ti II	29.45	70
2	3 332.35	Ti II	32.11	30
4	3 335.28	Ti II	35.19	40
		(Cr II	35.28	40)
		(Cr II	35.46	30)
1	3 336.71	Cr II	36.33	40
1	3 337.57	(V II	37.84	200)
		(Ti II	37.85	2)
5	3 340.68	Ti II	40.34	35
		(Cr II	39.80	50)
9	3 342.52	Ti II	41.87	100
		(Cr II	42.51	50)
1	3 343.76	Ti II	43.77	10
1n	3 346.98	Ti II	46.72	15
		Cr II	47.84	40
		V II	45.90	70
		Ca II	46.99	10
10	3 349.31	Ti II	49.40	125
		Ti II	49.03	75
		(Ti II	48.84	10)
		(Cr II	49.34	6)
1	3 351.08	(Ni II	50.42	5)
		(Ti II	50.55	1)
		(Ti II	51.67	1)
1	3 354.11	Sc II	53.73	25
		(Cr II	53.12	20)
		(V II	53.78	30)
1	3 359.03	Cr II	58.50	75
7	3 361.73	Ti II	61.21	125
		(Cr II	61.77	30)
		(Sc II	61.93	12)
		(Sc II	61.27	10)
		(V II	61.51	60)
1	3 364.38	Cr II	63.71	12
		(Ti II	64.9	1)
1	3 366.55	Ti II	66.18	8
		(Fe II	66.96	3)
2	3 368.03	Cr II	68.05	150
2	3 368.91	Sc II	68.95	15
		(Cr II	69.05	18)
		(Cr II	68.73	10)
7	3 373.14	Ti II	72.80	100
1n	3 374.90	Ti II	74.35	8
		(Ni II	73.98	4)
1	3 377.61	Cr II	78.34	25
		Cr II	76.72	5
3	3 380.50	Ti II	80.28	30

TABLE I (*suite*)

		Identification		
I	λ	Element	λ	Int.
		Cr II	79.82	60
		(Fe II	81.00	4)
4	3 384.13	Ti II	83.76	125
3	3 388.34	Ti II	87.83	50
		Ti II	88.75	8
0	3 391.61	Cr II	91.43	35
		Zr II	91.96	100
2	3 394.83	Ti II	94.57	40
		Cr II	94.32	35
		Cr II	95.62	20
0	3 397.56	(Ni II	97.82	1)
1	3 400.12	(Cr II	99.54	18)
		(Cr II	00.08	2)
2	3 403.39	Cr II	03.32	100
		(Ti II	02.42	8)
0	3 404.58	V II	04.43	80
2nn	3 409.10	Cr II	08.76	150
		Ni II	07.30	8
		(Ti II	09.81	4)
		(V II	08.95	15)
0n	3.413.95	(Fe II	14.14	2)
1	3 418.89	....	....	....
1	3 421.50	Cr II	21.20	75
1	3 423.29	Cr II	22.74	125
		(Co II	23.85	75)
1	3 427.02	....	....	....
0	3 428.95	(Cr II	28.94	7)
		(Al II	28.92	6)
4	3 433.81	Cr II	33.30	75
3n	3 437.53	Mn II	38.98	20
		Fe II	36.11	5
		Zr II	38.23	100
1	3 440.40	Fe I	40.61	150
		Fe I	40.99	75
2	3 442.19	Mn II	41.98	100
		(Fe II	42.24	3)
1	3 444.31	Ti II	44.31	30
		(Fe I	43.88	50)
1-0	3 446.91	Co II	46.40	100
1	3 450.44	(Cr II	50.84	3)
1	3 453.72	Ni II	54.16	5
		V II	53.09	90
1	3 457.58	Cr II	57.62	30
		V II	57.15	300
		Fe II	56.93	5
4	3 460.18	Mn II	60.31	75
3	3 461.47	Ti II	61.50	20
1-0	3 466.03	Mn II	66.34	9
		Mn II	65.04	8
		(Ni II	65.62	1)
		(V II	66.59	20)
		(Fe I	65.86	60)
		(Ti II	65.56	3)
1	3 469.66	V II	69.53	50
		V II	70.26	20
2	3 474.18	Mn II	74.04	50
		Mn II	74.12	40
2	3 477.19	Ti II	77.18	15
0	3 481.03	(Zr II	81.14	35)
1	3 483.57	Mn II	82.90	40
		Cr II	84.15	20
		Cr II	82.58	12
		Ti II	83.80	4
0	3 488.80	Mn II	88.68	40
		(Fe II	87.99	3)
2	3 490.44	Fe I	90.57	100
		Ti II	91.05	10
0	3 494.00	Fe II	93.47	10
		Fe II	94.67	5
1	3 496.60	V II	97.03	200
		Mn II	95.83	40
		Mn II	96.81	20
		Mn II	97.54	25
		Fe II	95.62	4
		Y II	96.08	80
1	3 499.18	(Fe II	99.88	4)
1	3 505.82	Ti II	04.89	80
1	3 510.86	Ti II	10.84	60
1	3 514.93	(Ni II	13.93	8)
		(Ni I	15.05	150)

TABLE I (*suite*)

I	λ	Identification Element	λ	Int.	I	λ	Identification Element	λ	Int.
1	3 520.62	Ti II	20.25	20	1	3 622.19	(V II	21.20	150)
		(V II	20.02	120)			(Co II	21.22	100)
1	3 524.49	V II	24.71	200	3n	3 625.13	Ti II	24.83	70
		(Mo II	24.65	8)			(Fe II	24.89	5)
		(Ni I	24.54	200)	1	3 626.28	....		
1	3 531.24	V II	30.76	500	3	3 628.21	(V II	27.71	60)
0	3 535.87	Sc II	35.73	10			(Y II	28.71	100)
		Ti II	35.41	40	4	3 630.99	Sc II	30.74	50
		Fe II	35.63	2	3	3 632.03	Cr II	31.49	50
0	3 541.41	V II	41.34	50			Cr II	31.72	40
1	3 546.38	V II	45.19	1 000			Fe I	31.46	125
1n	3 549.43	Y II	49.02	100	1	3 633.60	Y II	33.13	200
1	3 557.23	V II	56.80	1 500			Cr II	34.04	10
		(Fe II	57.55	2)	1	3 635.42	(Ti I	35.46	80)
		(Zr II	56.61	30)			(Mo II	35.14	20)
2	3 558.99	Sc II	58.54	20	2	3 642.96	Sc II	42.78	40
1	3 561.34	Ti II	61.57	3			(Cr II	43.22	10)
		V II	60.59	90	1	3 645.52	Sc II	45.31	30
0	3 570.14	Fe I	70.10	100			(Cr II	44.70	10)
2	3 572.45	Sc II	72.52	50	1	3 652.09	Sc II	51.80	25
		(Zr II	72.47	30)			(Cr II	51.68	12)
0	3 576.82	Sc II	76.34	35	0	3 653.93	Ti I	53.50	100
		Ni II	76.76	3	1n	3 656.00	H	blend	
2	3 581.17	Sc II	80.93	30	1	3 658.30	H_{35}	57.93	—
		Fe I	81.19	250			H_{34}	58.64	—
1n	3 585.62	Cr II	85.54	40			(Cr II	58.19	20)
		Cr II	85.31	60	1	3 660.81	H_{33}	59.42	—
		Y II	84.53	100			Ti II	59.76	60
1	3 589.77	V II	89.74	1 000	1	3 664.23	H_{29}	63.41	—
		Sc II	89.63	20	2	3 666.98	H_{27}	66.10	—
		Sc II	90.47	20	2	3 668.62	H_{26}	67.68	—
1	3 592.04	V II	92.01	800	3	3 670.42	H_{25}	69.47	—
1	3 594.12	V II	93.32	600	3	3 672.28	H_{24}	71.48	—
		Cr I	93.49	900	4	3 674.74	H_{23}	73.76	—
6	3 613.89	Sc II	13.84	60	4	3 677.43	H_{22}	76.36	—
		(Cr II	13.21	20)			Cr II	77.93	30
		(Cr II	13.26	15)			Cr II	77.69	40
2n	3 619.72	Fe I	18.77	125			Cr II	77.86	50
		V II	18.92	200	5	3 680.28	H_{21}	79.35	—
		V II	20.50	20	5	3 683.71	H_{20}	82.81	—

TABLE I (*suite*)

I	λ	Identification Element	λ	Int.
5	3 685.51	Ti II	85.19	250
5	3 687.75	H_{19}	86.83	—
1	3 689.72	....		
6	3 692.57	H_{18}	91.56	—
2n	3 694.84	(Fe I	94.01	20)
		(Fe I	95.05	8)
6	3 698.06	H_{17}	97.15	—
		(Cr II	98.00	35)
1nn	3 701.26	V II	00.34	200
		V II	00.96	30
1	3 702.69	(Mo II	02.55	8)
8	3 704.78	H_{16}	03.85	—
1	3 706.30	Ti II	06.22	20
		Ca II	06.03	10
		Fe I	05.57	100
1	3 708.04	(Fe I	07.83	20)
1	3 710.28	Y II	10.30	500
		(Fe I	09.25	75)
		(V II	09.33	40)
		(V II	11.12	50)
6	3 712.71	H_{15}	11.97	—
		(Cr II	12.97	35)
0nn	3 716.42	V II	15.48	1 200
		Cr II	15.19	20
		Cr II	15.45	20
2nn	3 720.04	Fe I	19.93	250
9	3 722.76	H_{14}	21.94	—
		(Fe I	22.56	50)
1	3 725.14	Fe II	25.30	3
1n	3 728.04	V II	27.35	1 000
		Cr II	27.37	40
		V II	28.33	200
		Fe I	27.62	50
1	3 730.76	(Zr II	31.26	25)
		(Ti I	29.81	50)
0	3 732.44	V II	32.76	800
7	3 735.20	H_{13}	34.37	—
		(Fe I	34.87	300
1	3 737.49	Fe I	37.13	150
		Ca II	36.90	12
		Cr II	37.55	10
1	3 739.65	....		
1	3 741.68	Ti II	41.63	50
0	3 744.19	(V II	43.61	40)
2	3 746.06	Fe I	45.56	100
		Fe I	45.90	40
		V II	45.81	800
		(Zr II	45.97	40)
1	3 748.31	Cr II	48.68	7
		Ti II	48.01	10
		Fe II	48.50	8
		Fe I	48.26	60
8	3 751.01	H_{12}	50.15	—
		(V II	50.88	600)
1	3 753.23	(Ti I	52.86	80)
8	3 759.45	Ti II	59.29	200
		(Fe II	59.46	6)
7	3 761.58	Ti II	61.32	200
		(Cr II	61.90	8)
		(Cr II	61.69	7)
		(Ti II	61.87	15)
1	3 764.39	Fe I	63.79	100
1	3 766.25	(Cr II	65.62	8)
		(Fe I	65.54	20)
2n	3 767.57	Fe I	67.19	80
		(Zr II	66.83	25)
		(V II	67.72	40)
10	3 771.47	H_{11}	70.63	—
		(V II	70.97	400)
1nn	3 775.20	Y II	74.33	300
		(Ti II	70.06	6)
		(Ti II	74.65	3n)
		(V II	74.68	15)
1	3 787.06	V II	87.23	150
1	3 795.56	Fe I	95.00	60
		Y II	94.37	50)
10	3 798.76	H_{10}	97.90	—
1	3 807.52	....		
0	3 813.71	Cr II	14.00	12
		Ti II	13.39	7

TABLE I (*suite et fin*)

I	λ	Identification Element	λ	Int.	I	λ	Identification Element	λ	Int.
		Ti II	14.58	4	1	3 883.28	Mn II	83.28	3
		Fe II	14.12	4			(Ti I	82.89	20)
0	3 816.57	Fe I	15.84	100	3	3 886.66	Fe I	86.28	40
2nn	3 820.78	Fe I	20.43	250			La II	86.37	150
1	3 824.49	Fe I	24.44	50	10	3 890.01	H_8	89.05	—
		(Fe II	24.91	4)	3	3 895.85	Fe I	95.66	25
1	3 826.28	Fe I	25.88	200			V II	96.15	60
		(V II	26.97	30)			Ti I	95.24	30
1	3 828.15	Fe I	27.82	75	0	3 898.76	V II	99.14	200
0	3 830.56	(Mg I	29.35	40)	4	3 900.52	Ti II	00.55	70
2	3 832.92	Mg I	32.30	80			(Fe I	99.71	30)
		Y II	32.89	100			(Al II	00.68	10)
10	3 836.38	H_9	35.39	—	2	3 903.24	V II	03.27	250
1	3 838.70	Mg I	38.29	100	2	3 906.83	(Fe II	06.04	5)
1	3 841.21	Fe I	41.05	80			(Cr II	05.64	25)
		Fe I	40.44	80			(Si I	05.53	100)
1	3 850.98	(Fe I	49.97	40)	3	3 913.47	Ti II	13.46	60
1	3 856.85	Si II	56.02	8	1	3 916.70	V II	16.42	200
		Fe I	56.37	50			(La II	16.05	300)
1nn	3 859.74	Fe I	59.91	300	2	3 921.13	(La II	21.54	200)
0	3 863.66	Si II	62.59	6			(Ti I	21.42	30)
		V II	63.81	60			(Fe I	20.26	20)
		(Fe II	63.95	1)	1	3 923.31	Fe I	22.91	25
		(Fe II	63.41	1)	2nn	3 928.44	V II	29.73	50
1n	3 873.04	Fe I	72.50	60			Fe I	27.92	30
1	3 878.84	Fe I	78.57	100			Ti I	29.87	40
		Fe I	78.02	60	8	3 933.91 }			
		V II	78.71	300	5	3 934.72 }	Ca II	33.66	400.

The values obtained for the radial velocities are given in Table III. The large negative velocity of the emission components of the Balmer lines stands in contrast with the large positive velocity of the absorption components. The difference in radial velocity between the emission and absorption components is very similar to that found by STRUVE in the case of VV Cephei [5] where it amounts to 109 km/sec. The other elements, whether in emission or in absorption, reveal velocities intermediate between the values found for the Balmer components.

Examination of tables I and II reveals several interesting features. It should be borne in mind that the laboratory intensities have only a limited meaning : actually

TABLE II

Emission Lines in B 1985 (October to December 1947).

I	λ	Identification: Element	λ	Int.
1	3 114.18	Fe II	14.29	7
1	3 183.27	Fe II	83.11	8
1	3 193.02	Fe II	92.92	9
1	3 194.08	Fe II	93.81	11
4	3 196.14	Fe II	96.07	10
2	3 210.60	Fe II	10.45	10
5	3 213.46	Fe II	13.31	13
3	3 216.07	([Cr II]	16.32	...)
10	3 228.15	Fe II	27.73	13
1	3 231.56	Fe II	31.70	5
3	3 233.77	(Cr II	34.06	50)
		(Ti II	34.52	75)
1	3 238.39	[Cr II]	39.07	...
		Cr II	38.77	50
		Ti II	39.04	60
3	3 256.63	Fe II	55.88	8
		[Fe II]	56.31	...
		[Fe II]	56.73	...
1	3 274.25	[V II]	73.98	...
		[Fe II]	75.02	...
		(Ni II	74.90	3)
6	3 277.96	Fe II	77.35	9
		[Fe II]	77.12	...
1-0	3 281.72	Fe II	81.29	7
		[V II]	81.59	...
1	3 282.56	....		
4	3 376.40	[Fe II]	76.20	...
3	3 378.42	[Ni II]	78.55	...
6	3 439.22	[Ni II]	39.29	...
2	3 452.25	[Fe II]	52.30	...
3	3 495.34	Fe II	94.67	5
		Mn II	95.83	40
		Cr II	95.37	25
3	3 502.01	[Fe II]	01.62	...
		[Fe II]	02.0	...
		Co II	01.73	200
2	3 504.53	[Fe II]	04.02	...
		[Fe II]	04.51	...
		Fe II	03.47	2
		Ti II	04.89	80
0	3 535.66	Fe II	35.63	2
		[Fe II]	36.25	...
		Ti II	35.41	40
4	3 539.42	[Fe II]	39.19	...
		[Fe II]	38.69	...
4	3 559.59	[Ni II]	59.86	...
5	3 627.42	[Ni II]	27.35	...
2	3 711.49	H_{15}	11.97	...
3	3 721.43	H_{14}	21.94	...
3	3 733.78	H_{13}	34.37	...
4	3 769.72	H_{11}	70.63	...
7	3 797.06	H_{10}	97.90	...
2	3 806.51	[Fe II]	06.3	...
7	3 834.56	H_9	35.39	...
3	3 837.66	Mg I	38.29	100
8	3 888.27	H_8	89.05.	

the metallic absorption lines (f. ex. of Ti II and Cr II) are sensitive to the excitation potential, the low level lines being enhanced, compared with laboratory intensities. It is only by careful consideration of the excitation potentials and of the relative intensities within multiplets that proper identifications may be made. I have tried to be rather conservative in the tables.

The Balmer series may be seen to very high members ; measures could in fact be carried to H29. The intensities are not perfectly normal : plate 2 shows, for example, that the profile of H 12 differs from that of H11 and H13. We probably have to deal

TABLE III

Radial velocities in B 1985

EMISSION LINES			ABSORPTION LINES		
Element	Mean V_{rad}	Number of lines	Element	Mean V_{rad}	Number of lines
H	— 55.9	7 (1)	H	+ 68.4	8 (2)
				+ 72.3	19 (3)
Fe II	+ 13.5	4	Ti II	+ 15.7	30
[Ni II]	— 7.7	3	Cr II	+ 22.1	11
			Fe II	+ 10.0	2
			Fe I	+ 21.8	7
			Mg I	+ 32.0	1
			Ca II	+ 49.9	2
			Sc II	+ 13.6	8
			Mc II	+ 13.0	2
			V II	+ 13.2	6 (4)

(1) From H8 to H15, H12 excluded.
(2) From H8 to H15, H12 included.
(3) From H8 to H27.
(4) Excluding λ 3 545 ; the mean velocity is + 25.8 if we accept the identification of λ 3 545.

with a reabsorption similar to that observed in the Balmer series of VV Cephei [5]. We hope to be able to discuss this point later on. No evidence is found for the presence of the light elements (He I, C II, N II, O II). Mg II, Al II and Ca I are doubtful. The neutral metals Sc I, V I, Cr I and Mn I are absent. The Fe I- and Ti I lines longward of λ 3 750 may belong to the late type component.

Compared with the shell of Pleione [6] in 1942-1943, or with the supergiant atmosphere of *l* Puppis [7], the shell of B 1985 exhibits stronger Ti II (of low excitation potential) and Sc II, and much weaker Cr II and Fe II in absorption. Actually the situation with regard to Fe II-absorption is rather confuse. There is a fairly strong emission of the Fe II multiplets of low excitation potential, and there is hardly any absorption for E. P. lower than 3.7v. (lower state). Even for E. P. higher than 3.7 v., there is little Fe II-absorption. For example, no line of the b^4D — y^4F^0 multiplet (E. P. 3.89-7.67 v. ; region λ 3 237-λ 3 259) is observed in absorption, although the laboratory intensities of certain components are high.

Comparison of the absorption lines of Ti II, Sc II, Cr II, Mn II, Ni II, V II, Fe II in B 1985 and in other stars with tenuous atmospheres like α Cygni, *l* Puppis, ε Aurigae, Pleione and 14 Comae reveals that the intensities in B 1985 are rather anomalous. A wide diversity of values is observed for the absolute intensities of the lines of individual elements or for the relative intensities of pairs of elements. For certain elements the absorbing atmosphere is similar to that of an A-supergiant, like α Cygni or l Puppis. For others we have something analogous to an early shell (Pleione) or a late one (14 Comae). All metallic lines are definitely weaker than in the F-supergiant ε Aurigae.

It is obviously with the eclipsing binary VV Cephei [8] that B 1985 may most profitably be compared. In either case the Balmer lines have the appearance of reversed P Cygni lines ; strong emission lines of Fe II, [Fe II], [Ni II] and [S II] are found. Both objects are of the symbiotic type, combining an M-component and a Be-star. However the red component of VV Cep is variable while that of B 1985 does not seem to vary. The ultraviolet spectrum of VV Cep outside an eclipse, as described by Struve and Swings is richer in permitted emission lines than B 1985 at any time of observation ; this is especially conspicuous in the case of Mn II and Cr II which are much stronger in emission in VV Cep than in B 1985 at any time of observation. Both B 1985 and VV Cep reveal a shell-type spectrum which appears most clearly in the ultraviolet. In 1939-1940, only the emission lines were conspicuous in B 1985 while the absorptions were characteristic in the Fall of 1947 [9]. The spectral variations in B 1985 may be related to the general geometrical picture of the double system, as are the variations in VV Cephei : most absorption-lines and some of the emissions may disappear or be reduced at times by eclipses while other emission features, especially those of Fe II, [Fe II] and [Ni II] may remain unaltered. These latter feature would arise in a very extensive nebulosity enveloping the system.

It appears premature to draw definite conclusions regarding the structure of the B 1985 system, although a picture similar to that of VV Ceph appears attractive. B 1985 may become as important as VV Cep and ζ Aurigae are, for the study of stellar atmospheres. However a considerable amount of observational work is still desirable. It should include photometric determinations in the ultraviolet and visual regions, thus separating the M-and B-components. Spectroscopic observations, including radial velocity determinations over a long period are also desirable. Only then will it be possible to discuss this remarkable object, and to interpret the physical, geometrical and dynamical problems involved. In such an interpretation the results obtained recently by Struve on the basis of his extensive spectroscopic investigations of eclipsing binaries will doubtlessly prove most useful.

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