THE SPECTRA OF TWO PECULIAR STARS MWC 17 AND CD−27°11944*

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ABSTRACT

Wave lengths and radial velocities of emission lines in the peculiar stars MWC 17 and CD−27°11944 have been tabulated. The former is interesting because it contains forbidden [*Fe* III] and [*Fe* II], which places it between RY Scuti and η Carinae. The spectrum also shows *H*, *He* I, *N* II, *N* III, *O* II, *Si* II, [*N* II], [*O* I], [*S* II], etc. CD−27°11944 is a P Cygni type star showing *H*, *He* I, *Fe* II, *Ca* II, *Na* I, *N* II, and very weak [*Fe* II]. The dilution effect is small for *He* I, while the presence of forbidden [*Fe* II] suggests great distance from the photosphere. It is probable that this apparent discrepancy is caused by stratification. There is some suspicion that both stars may possess red companions.

THE SPECTRUM OF MWC 17

The bright-line spectrum of MWC 17[1] has been observed by Merrill, Humason, and Burwell,[2] who describe it as follows: "The bright *H* lines are very intense and numerous. Other bright lines are outstanding even with low dispersion. Chief among these are *Fe* II lines (with the forbidden lines relatively strong as in η Car) and the nebular line of unknown origin λ 4658 with its companion line λ 4701."

Recent work by Edlén and Swings[3] has shown that λ 4658 and λ 4701 are forbidden lines of [*Fe* III], and the brief description by Merrill, Humason, and Burwell suggests that MWC 17 shows simultaneously strong [*Fe* II] and [*Fe* III], thus combining the essential features of η Carinae ([*Fe* II] only) and RY Scuti ([*Fe* III] only).

Four spectrograms were secured at the McDonald Observatory on August 16, 20, 23, and 24, 1940; two were taken with the quartz prisms (dispersion, 100 A/mm at λ 3933) and two with the glass prisms (dispersion, 50 A/mm at λ 3933). The spectrum has not appreciably changed since the Mount Wilson observations. The continuous spectrum is very weak except in the red, where it is strong and where it gives rise to the suspicion that a late-type component may be associated with an early-type spectrum whose maximum of intensity lies in the violet region. The presence of several strong emission lines in the red region makes it impossible to identify the hypothetical red component. The radial velocities are collected in Table 1.

Since these radial velocities are practically equal, we have adopted $V_{rad} = -35$ km/sec and have corrected the measured wave lengths accordingly. These are given in Table 2.

The Balmer lines are very strong and may be followed to H_{18}. Several *He* I lines are present. Among the permitted lines we find, in addition to strong *Fe* II, the following elements: *C* III is possibly present (λ 5696, as in RY Scuti and 9 Sagittae) but is very weak; *N* II, *N* III, and *O* II are weak; *O* III is very doubtful; *Al* II is weakly present; *Si* II: λλ 3856–3863 are present, while λλ 4128–4131 and 5041–5056 are absent, this being the same selectivity which we have previously discussed for Z Andromedae, BD+11°4673, and P Cygni;[4] *Ti* II is doubtful. The permitted lines of the following elements are absent: *Fe* III, *He* II, *C* II, *Mg* I and II, *Al* I and III, *Ca* II, and *Si* I and III.

The forbidden lines of the following elements are observed: [*N* II], [*O* I], [*S* II], [*Fe* II], and [*Fe* III], whereas [*O* II], [*O* III], and [*Ne* III] are absent.

* *Contributions from the McDonald Observatory, University of Texas*, No. 30.

[1] α (1900) 1^h41^m; δ (1900) +60°12′; 40^s following and 2′N of BD+59°318; $m_{phot} = 12.2$; No. 101 of Mount Wilson discovery lists of Be stars.

[2] *Ap. J.*, **76**, 156, 1932. [3] *Observatory*, **62**, 234, 1939. [4] *Ap. J.* in press.

The transition of auroral type of [*N* II], λ 5755, is strong. Because of the great intensity of $H\alpha$, it is difficult to ascertain whether the nebular transitions of [*N* II] are present, but they cannot be very strong. The simultaneous appearance of [*N* II] and [*Fe* II or III] is known in other stars, such as RY Scuti, BD+11°4673, etc.

In [*O* I] the transitions of nebular type are very strong, whereas there is only a trace of the auroral line. [*O* I] and [*Fe* II] appear also simultaneously in other stars, for example, HD 45677.

In [*S* II] the transauroral transitions are present. These behave like auroral lines with regard to electron density, and their presence, together with [*N* II] 5755, is not surprising. [*Fe* II] and [*S* II] have also been observed simultaneously in other stars, for example, η Carinae, VV Cephei, BD+11°4673, etc.

TABLE 1

RADIAL VELOCITIES OF THE EMISSION LINES IN MWC 17

Element	Lines Used	V_{rad}
		km/sec
H	All lines from H_{18} to $H\gamma$, with the exception of H_8	−28
	$H\gamma$ and $H\delta$	37
He I	λ 4471 and λ 5876	29
[*S* II]	λλ 4068–4076	43
Fe II	Ten unblended lines of laboratory intensity ⩾8	37
[*Fe* II]	Four unblended lines	−37

The [*Fe* II] lines are strong, and, as in η Carinae and BD+11°4673, they belong to the following transitions: $a^6D - a^6S$, b^4F, b^4P; $a^4F - a^4G$, b^4F, b^4P, and possibly also $a^2P - c^2D$.

The [*Fe* III] lines belong to two multiplets $^5D - {}^3F$ and $^5D - {}^3P$. The relative intensities of the seven lines observed in MWC 17 are quite similar to those in RY Scuti.[5] Table 3 gives the more important ionization and excitation potentials.

The presence of [*Fe* III] shows that an appreciable part of the iron atoms are doubly ionized and that the mean ionization must be around 16.5 v. (Table 3) or less, because [*Fe* II] is stronger than [*Fe* III] despite the greater number of lines. The absence of permitted *Fe* III lines shows that the mean ionization is much lower than 30 v. and, consequently, is too low to give rise to [*O* III] and [*Ne* III]; this also explains the relative weakness of *He* I, which is a recombination spectrum. The presence of [*N* II] and [*S* II] is quite natural, and the absence of [*O* II] (transition of nebular type) must be attributed to the high electron density prevailing in those regions where oxygen is ionized. On the other hand, the presence of nebular [*O* I] suggests that these lines are emitted in the outer regions where the ionization and the electron density are lower. Such a stratification effect is well known. For example, in IC 4997, [*O* III] shows a strong transition of auroral type, whereas [*O* I] shows only the nebular type.[4]

The ratio in intensity of the permitted and forbidden lines of *Fe* II is quite similar in η Carinae and in MWC 17. But it should be remembered that the *Fe* II lines may be due both to recombinations and to electron collisions ([N II] 5755 requires an electron energy of 4.0 v. and is strong; hence, an appreciable fraction of the electrons must have kinetic energies of around 5.6 v., which is required for *Fe* II). In any case, the intensity ratio *Fe* II/[*Fe* II] is not indicative of the excitation temperature. In *Fe* II the excited levels of metastable character are only about 2 v. lower than the ordinary excited levels

[5] *Ap. J.*, **91**, 584, 1940.

giving rise to the observed *Fe* II lines. If collisional excitation is important, the intensity ratio *Fe* II/[*Fe* II] will depend to a considerable extent upon the electron density. A

TABLE 2

EMISSION LINES IN MWC 17

λ	Int.	Identification: Elem.	Identification: λ	Identification: Int.
3691.58	0	H_{18}	3691.56	2
3696.90	0	H_{17}	3697.15	3
3703.56	0	H_{16}	3703.85	4
3712.81	1	H_{15}	3711.98	5
3722.03	1	H_{14}	3721.95	6
3734.35	1	H_{13}	3734.37	8
3749.91	1	H_{12}	3750.15	10
3761.22	0	{ *Ti* II	3761.22	300
		Ti II	3759.30	400
		Fe II	3759.46	6
		(*O* III	3759.87	9)*
3770.75	1	H_{11}	3770.63	15
3798.79	1–2	H_{10}	3797.90	20
3835.13	2	H_9	3835.39	40
3856.38	1	*Si* II	3856.09	8
3861.98	0	*Si* II	3862.51	7
3888.72	3	{ H_8	3889.05	60
		He I	3888.65	1000
3960.25	1	(*O* III	3961.59	8)
3970.41	3	$H\epsilon$	3970.07	80
4068.50	3	{ [*S* II]	4068.62	....
		(*C* III	4067.87	9)
		(*C* III	4068.97	10)
		(*C* III	4070.30	10)
4076.14	1	{ [*S* II]	4076.22	....
		O II	4075.87	800
4101.71	4	$H\delta$	4101.73	100
4173.7	2	*Fe* II	4173.45	8
4178.8	2	{ *Fe* II	4178.85	8
		[*Fe* II]	4177.21	....
4186.3	0	{ *C* III	4187.05	10
		O II	4185.45	150
4191.5	0	*O* II	4189.79	500
4201.2†	1	(*N* III	4200.02	6)
4232.8	1–2	*Fe* II	4233.17	11
4243.5	2	[*Fe* II]	4243.98	....
4277.5	1	[*Fe* II]	4276.84	....
4287.25	3	[*Fe* II]	4287.41	....
4295.7	0	{ *Fe* II	4296.57	6
		(*Ti* II	4294.12	80)
4303.1	1	*Fe* II	4303.17	8
4340.42	6	$H\gamma$	4340.46	200
4352.1	1	*Fe* II	4351.77	9
4359.19	3	[*Fe* II]	4359.34	....
4372.7	1	{ [*Fe* II]	4372.44	....
		(*Fe* III	4372.40	20)
4385.3	1n	{ *Fe* II	4385.38	7
		He I	4387.93	30
		[*Fe* II]	4382.76	....
4413.36	2	{ [*Fe* II]	4413.78	....
		(*O* II	4414.89	300)
4416.58	3	{ [*Fe* II]	4416.28	....
		Fe II	4416.82	7
4433.4	1–2	{ [*Fe* II]	4432.45	....
		N II	4432.71	30
4448.2‡	1–2	*N* II	4447.03	300

λ	Int.	Identification: Elem.	Identification: λ	Identification: Int.
4452.4‡	0–1	{ [*Fe* II]	4452.11	....
		Fe II	4451.54	4
4457.4‡	1	[*Fe* II]	4457.95	....
4471.56	1–2	*He* I	4471.48	100
4487.9‡	1	{ [*Fe* II]	4488.75	....
		Fe II	4489.18	4
4492.2‡	1	{ [*Fe* II]	4492.64	....
		Fe II	4491.40	5
4516.33	1	*Fe* II	4515.34	7
4521.52	1	{ *Fe* II	4522.63	9
		Fe II	4520.22	7
4549.62	1	{ *Fe* II	4549.47	10
		Ti II	4549.63	200
4555.24	1	*Fe* II	4555.89	8
4583.37	2	*Fe* II	4583.84	11
4629.03	2	{ *Fe* II	4629.34	7
		N II	4630.55	300
4634.74	1	{ *N* III	4634.16	9
		(*Fe* II	4635.33	5)
4641.43	1–2	{ *N* III	4640 64	10
		([*Fe* II]	4639.68	.....)
4657.36‡	2	[*Fe* III]	4658.18	....
4663.0‡	1	*Al* II	4663.05	11
4701.8	1–2	[*Fe* III]	4701.54	....
4732.1	1	{ [*Fe* III]	4733.82	....
		[*Fe* II]	4728.07	....
4755.4	1	[*Fe* III]	4754.87	....
4769.0	0	[*Fe* III]	4769.34	....
4813.9	1	[*Fe* II]	4814.55	....
4861.6	8	$H\beta$	4861.33	500
4923.4	1	*Fe* II	4923.93	12
4958 3	0–1	[*Fe* II]	4958.22	....
5010.1	1	[*Fe* III]	5010.86	....
5018.8	1–2	*Fe* II	5018.43	12
5050	1n	{ (*He* I	5047.74	15)
		[*Fe* II]	5048.2§	....
5157.9	1	[*Fe* II]	5158.02	....
5169.4	1–2	*Fe* II	5169.05	12
5197	0	*Fe* II	5197.57	6
5235	1	*Fe* II	5234.62	7
5270.3	2	[*Fe* III]	5270.30	....
5275.0	1	{ *Fe* II	5275.99	7
		[*Fe* II]	5273.39	....
5316.8	1	*Fe* II	5316.61	8
5337	1	....	....	....
5363	0	*Fe* II	5362.86	5
5434	1	[*Fe* II]	5433.15	....
5577‖	0	[*O* I]	5577.3	....
5698‖	0	(*C* III	5695.8	5)
5754.4	4	[*N* II]	5755.0	....
5875.8	3	*He* I	5875.62	1000
6299.1	6	[*O* I]	6300.2	....
6314	3	([*S* III]	6310.2	....
6346‖	2	*Si* II	6347.01	50
6364.1	3	[*O* I]	6363.9	....
6385	2	....	....	....
6563	25	$H\alpha$	6562.82	2000

* Identifications in parentheses are uncertain or constitute minor contributors.

† Also present in η Carinae. ‡ Separation difficult. § Transition $a^2P_{1\frac{1}{2}} - c^2D_{2\frac{1}{2}}$. ‖ Line uncertain.

more reliable criterion of excitation is the intensity ratio [*Fe* II]/[*Fe* III], although even here the electron density may play a role if the collisional processes have very different probabilities for Fe^+ and Fe^{++}, but this is probably not the case. In order of decreasing excitation, we then have[6] RY Scuti ([*Fe* III] strong, [*Fe* II] absent); MWC 17 (both [*Fe* III] and [*Fe* II] present); η Carinae ([*Fe* II] strong, [*Fe* III] absent).

This agrees with the other observed features. In RY Scuti, *He* II is fairly strong, whereas in MWC 17 it is absent and *He* I is present, while in η Carinae *He* I is absent. Other evidence is provided by the presence of weak [*O* III] and *C* III and the absence of [*O* I] in RY Scuti and the weakness of [*S* II] in η Carinae.

THE SPECTRUM OF CD$-27°11944$

The object CD$-27°11944$[7] was included in our program of peculiar bright-line stars because of its well-marked P Cygni characteristics, its broad lines, and its decidedly red color. A description of the spectrum has been published by Merrill,[8] who has identified

TABLE 3

IONIZATION AND EXCITATION POTENTIALS OF ABUNDANT ATOMS

Element	Ionization Potential I	Ionization Potential II	Ionization Potential III	Element	Excitation Potential
H	13.53	....	....	*H*	12 –13.5
He	24.46	54.14	....	*He* I	23 –24
N	14.48	29.47	....	[*N* II]	4.0
O	13.55	34.93	....	[*S* II]	3.0
Ne	21.47	40.9	....	[*Fe* II]	$\leqslant$ 3.2
S	10.3	23.3	....	[*Fe* III]	$\leqslant$ 2.7
Fe	7.83	16.5	30.48	*Fe* II	5.2– 5.6
				Fe III	$>$11

the bright and dark lines of *H*, *He* I, and *Fe* II. He had noticed the P Cygni characteristics and had found that the emission lines have a small, positive displacement, whereas the absorption components give large, negative velocities. No actual radial velocities were given. The continuous spectrum, although strong at $H\beta$, did not extend beyond $H\gamma$ on Merrill's spectrograms, and the drop in the spectral intensity-curve was found to be much more rapid than for a normal B-type star.

Four spectrograms were secured at the McDonald Observatory in July and August, 1940, with dispersions from 40 A/mm to 100 A/mm at λ 3933. On our low-dispersion ultraviolet spectrogram the continuous spectrum may be observed as far as λ 3700, and the Balmer series extends to H_{15}. The red region of the continuous spectrum is unusually strong. Except for a strong, bright $H\alpha$ line, the region above λ 5900 shows only absorption features which certainly do not belong to an early-type star.

The strongest feature is a fairly broad band at about λ 6280. This wave length is suspiciously close to that of the strong telluric line O_2 6278.101 of Rowland intensity 4, which on our plates is probably blended with several other telluric lines of intensity 2 or 3. The same feature is present in many of our spectrograms, and it is clear that the low altitude of the star resulted in an unusually long path through the earth's atmosphere. It is probable that several other absorption features are also of telluric origin. There may be left a few faint absorption lines or bands, such as $\lambda\lambda$ 6310, 6330, and 6345, for which no satisfactory identification has been found.

A comparison with typical M-type stars such as β Pegasi and *o* Ceti shows that the

[6] In this sequence the spectrum of DO Aquilae 1925 discussed by Vorontsov-Velyaminov (*Ap. J.*, **92**, 283, 1940) would be placed between RY Scu and MWC 17.

[7] α (1900) $17^h41^m.9$, δ (1900) $-27°59'$; mag. 9.0.

[8] *Ap. J.*, **61**, 418, 1925.

strong TiO bands are certainly absent. Neither is there any similarity with the N stars 19 Piscium, BD+34°4500, and S Cephei, or with the S star HD 172804. There is some similarity, however, with the Ro star BD−10°5057. This may be purely fortuitous, but the features at λλ 6310, 6330, and 6345 agree reasonably well. There are, however, several features which are present in only one of the two objects.

TABLE 4

LINES IN THE P CYGNI TYPE COMPONENT OF CD−27°11944

λ	Int.	Identification		
		Elem.	λ	Int.
3708.04	1A	H_{15}	3711.98	5
3717.46	1A	H_{14}	3721.95	6
3728.68	1A	H_{13}	3734.37	8
3745.01	2A }	H_{12}	3750.15	10
3750.77	1E }			
3765.68	2A }	H_{11}	3770.63	15
3770.55	2E }			
3794.33	2A }	H_{10}	3797.90	20
3797.79	2E }			
3831.33	2A }	H_9	3835.39	40
3835.86	2–3E }			
3885.27	2–3A }	H_8	3889.05	60
3889.36	4E }	*He* I	3888.65	1000
3929.15	1A }	*Ca* II	3933.67	600
3934.37	0E }			
3965.42	4A }	$H\epsilon$	3970.07	80
3970.23	4E }			
3991.74	0A }	*N* II	3995.00	300
3995.53	0E }			
4021.12	1A }	*He* I	4026.19	70
4026.44	2E }			
4096.84	5A }	$H\delta$	4101.73	100
4101.52	5E }			
4171.6	0A }	*Fe* II	4178.85	8
4177.66	2E }			
4228.19	0A }	*Fe* II	4233.17	11
4232.70	2E }			
4243.67	0E	{[*Fe* II]	4243.98	....
		{*N* II	4241.80	100
4287.49	0E	[*Fe* II]	4287.4	....
4336.30	5A }	$H\gamma$	4340.46	200
4341.05	5E* }			
4355.29	2En	{*Fe* II	4351.77	9
		{[*Fe* II]	4359.34	....
4391.86	1–2En	{*He* I	4387.93	30
		{*Ti* II	4395.04	150
4416.01	1–2En	{[*Fe* II]	4416.28	....
		{*Fe* II	4416.82	7

λ	Int.	Identification		
		Elem.	λ	Int.
4453.52	0Enn	{[*Fe* II]	4452.11	....
		{[*Fe* II]	4457.95	....
4466.42	2A }	*He* I	4471.48	100
4471.59	3E }			
4517.12	1A }	*Fe* II	4522.63	9
4523.11	2E }			
4554.44	2En	{*Fe* II	4549.47	10
		{*Fe* II	4555.89	8
		{*Si* III	4552.65	9
4583.87	2E	*Fe* II	4583.84	11
4632.64	2En	{*Fe* II	4629.34	7
		{*Fe* II	4635.33	5
4707.27	1A }	*He* I	4713.14	40
4714.02	2E }			
4816.68	1En	[*Fe* II]	4814.55	....
4855.48	5A† }	$H\beta$	4861.33	500
4861.58	7E‡ }			
4918.30	2A }	{*He* I	4921.93	50
4924.67	3E }	{*Fe* II	4923.93	12
5011.19	3A }	{*Fe* II	5018.43	12
5018.59	3E }	{*He* I	5015.67	100
5161.55	2A }	*Fe* II	5169.05	12
5169.36	2E }			
5197.58	0E	*Fe* II	5197.57	6
5235.8	0E	*Fe* II	5234.62	7
5275.4	1E	{*Fe* II	5275.99	7
		{[*Fe* II]	5273.39	....
5307.91	1A }	*Fe* II	5316.61	8
5316.87	2E }			
5335.6	1E	[*Fe* II]	5333.66	....
5660.15	2A }	*N* II	5666.64	300
5666.59	1E }			
5672.57	2A }	*N* II	5679.56	500
5680.2	1E }			
5867.41	2As }	*He* I	5875.62	1000
5876.05	6E§ }			
5886.01	4A‖ }	{*Na* I	5889.95	9000
5896.62	3E¶ }	{*Na* I	5895.92	5000
6563	10E	$H\alpha$	6562.82	2000
6666	3A }	*He* I	6678.15	100
6678	3E }			

* Extends from λ 4337.58 to λ 4344.56.
† Extends from λ 4853.25 to λ 4857.91.
‡ Extends from λ 4857.91 to λ 4866.40.
§ Extends from λ 5871.20 to λ 5879.56.
‖ Extends from λ 5879.56 to λ 5889.99.
¶ Extends from λ 5889.99 to λ 5904.31.

The question whether there is a red companion and whether CD−27°11944 belongs to the same group of binaries as RW Hya, Z And, T CrB, R Aqr, AX Per, CI Cyg, etc., which we have recently discussed,[9] must remain open for the present.

[9] *Ap. J.*, **91**, 546, 1940; *Proc. Nat. Acad. Sci.*, **26**, 458, 1940; also Swings, Elvey, and Struve, *Pub. A.S.P.*, **52**, 199, 1940.

Table 4 gives the wave lengths corrected to the sun. Besides the elements observed by Merrill, lines of the P Cygni type are also observed for *Ca* II, *Na* I, and *N* II; weak [*Fe* II] lines are present. The mean radial velocities are shown in Table 5.

The ejection velocity is about 350 km/sec. This may be compared with the values obtained for other stars: about 120 km/sec in P Cygni; 125 km/sec in BD+11°4673; 180 km/sec in BD+47°3487; 250 km/sec in 9 Sagittae, and 300 km/sec in BD+35°3930 N. In other words, the ejection is more violent than in P Cygni but is comparable to that in some Oe stars and in novae. Z CMa is also similar as far as the velocity of ejection is concerned. It is often assumed that the lines in P Cygni stars are narrower than in novae and in Wolf-Rayet stars; but CD−27°11944 shows that P Cygni emission lines may sometimes extend over 600 or 700 km/sec. We know, on the other hand, that there are Wolf-Rayet stars whose lines are not broader than this. For example, in BD+30°3639 (Campbell's object) the lines of *Si* IV, *C* III, and *O* III have widths smaller than 700 km/sec;[10] in the nucleus of HD 167362 the typical Wolf-Rayet lines due to *He* II, *C* III, C IV, and *O* III are still narrower, the ejection velocity of *C* III being only 186 km/sec.[11] This applies also to certain slow novae or nova-like objects. The nucleus of IC 4997 has also comparatively sharp lines, although the identified atoms are exactly the same as those ordinarily found in Wolf-Rayet stars.[12]

TABLE 5

RADIAL VELOCITIES IN CD−27°11944

Element	Absorption Component	Emission Component	Lines Used
	km/sec	km/sec	
H	−337	+23	From H_{15} to $H\beta$; weight 5 to $H\gamma$ and 3 to $H\beta$
He I	−373	+20	λλ 4026, 4471 (weight 3), 4713, 5876 (weight 2)
N II	−320	+22	λλ 3995, 5666, 5680
Ca II	−346	+52	K
Fe II	....	+17	λλ 4522, 4584, 5169, 5316

The presence of *Ca* II and *Na* I in emission is interesting. For *Ca* II the velocity of ejection may be determined, and, within the errors of measurement, it is practically the same as the value obtained from hydrogen or from other abundant elements. Thus, *Ca* II is presumably ejected and excited together with hydrogen and helium and does not originate in a region of the late-type atmosphere excited by the hot companion. In the P Cygni star Z CMa, *Ca* II is also present in emission and absorption, but *Na* I is only an absorption line.

CD−27°11944 belongs to that group of P Cygni type stars in which only the expanding shell is observed and not the exciting star. If we assume that the width of the absorption components of the Balmer lines is mainly due to the range in the radial component of the ejection velocity, it is found immediately that the hydrogen absorbing layer of CD−27°11944 lies very close to the effective photosphere. Other stars like 17 Leporis, BD+47°3487, HD 190073, 9 Sagittae, and BD+35°3930 N show conspicuously the spectrum of the stellar reversing layer (especially the Balmer lines broadened by rotation and Stark effect). In these cases the continuous absorption in the expanding shell is too small to produce an effective photosphere in the ejected layers.

[10] *Proc. Nat. Acad. Sci.*, **26**, 548, 1940.

[11] *Ibid.*, **26**, 454, 1940.

[12] Except that carbon and nitrogen are both present (in press).

The faintness of [*Fe* II] indicates that the main part of the ejected matter is close to the photosphere; the [*Fe* II] lines must be excited principally in the outer regions. That the dilution of the photospheric radiation must be small is also apparent from the intensity of the *He* I absorption lines starting from ordinary excited levels (for example, λ 4471 and λ 4026); the *He* I lines starting from metastable levels are not appreciably favored.

Whereas the *He* I lines of −27°11944 suffer practically no dilution effect, showing that the absorbing *He* I atoms are close to the photosphere, the weak [*Fe* II] lines must be excited in the outer regions. This kind of stratification is similar to that observed in other P Cygni or Wolf-Rayet stars. For example, in the P Cygni star BD+11°4673, we observe bright lines of silicon in four successive stages of ionization—*Si* I to *Si* IV. In Wolf-Rayet stars bands due to atoms of different ionization potentials have different ejection velocities and widths and the same star may show *He* I (I.P. 24 v.) and *N* V (97 v.).[13]

In the family of P Cygni objects, CD−27°11944 should be placed among the stars of average excitation. In P Cygni, permitted *Fe* III is very conspicuous, whereas permitted *Fe* II is absent. In others, such as RY Scuti or novae at a certain stage (for example, DO Aquilae 1925, in August, 1926[14]), forbidden [*Fe* III] is the conspicuous feature. In some stars, such as Z CMa, −27°11944, and in novae at a certain stage, *Fe* II is conspicuous, while [*Fe* II] is very weak and *He* I is still strong. In still others, like η Carinae, [*Fe* II] is strong, and *He* I is absent.

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[13] C. S. Beals, *J.R.A.S. Canada*, **34**, 169, 1940.

[14] Vorontsov-Velyaminov, *loc. cit.*