SPECTROGRAPHIC OBSERVATIONS OF PECULIAR STARS. III*

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ABSTRACT

This paper describes recent changes in the spectra of AX Per, Z And, AG Peg, and R Aqr. There is also a description of recent spectrograms of the unusually red bright-line star MWC 349.

Our understanding of the physical, dynamical, and geometrical conditions prevailing in peculiar objects which combine bright lines of high excitation and late-type spectra will eventually be based on the spectroscopic variations in these stars. CI Cygni is the only complex object known which shows forbidden lines of high excitation which do not seem to have varied appreciably in recent years, although the late-type companion is variable. As far as the bright lines of high excitation are concerned, our spectrograms of CI Cygni since September, 1939, do not differ from the ones taken by Merrill in 1931 and 1932.[1] The present paper is concerned with the description and discussion of recent spectral changes in AX Persei, Z Andromedae, AG Pegasi, and R Aquarii. It also provides some additional information on the peculiar bright-line star MWC 349.

AX Persei.—This object, which in 1939 was similar to CI Cygni to such an extent that one could hardly distinguish their spectra, has suffered conspicuous variations. The 1939 spectrum corresponded to a much higher ionization than that of 1931–1932, when it was described by Merrill.[1] But on our spectrograms of January, 1941, the forbidden lines of [*Fe* VII], which were extremely intense in 1939,[2] had disappeared, and other changes had also occurred.[3] Now our spectrograms of August 2 and 8, 1941, have reversed the situation, the star having recovered a bright-line spectrum very similar to that of September, 1939. [*Fe* VII], practically absent in January, 1941, had recovered in August, 1941, its intensity of 1939. A comparison of line intensities in the region λλ 3869–6560 on January 5, 1941, and August 8, 1941, is given in Table 1; intermediate intensities are observed on a spectrogram secured on May 30, 1941. It is apparent that the general trend after January, 1941, has been toward an increase in excitation, which had reached a minimum around January, 1941. This increase is evidenced by the following changes in the intensities relative to *He* II and *H:* (*a*) the large increase of [*Fe* VII] and [*Ne* V]; and (*b*) the decrease in intensity of *He* I, *N* III, *C* III, [*O* III], and [*Ne* III]. It should be noticed that the *He* I triplets have been reduced less than the singlets (compare, for example, λ 4388 and λ 4471).

Z Andromedae.—After its 1939 outburst to a mean maximum magnitude of 7.9, Z Andromedae declined to a mean minimum brightness of 9.6 in 1940 and then increased again in 1941, reaching magnitude 8.7 in August, 1941.[4] We noticed this recent outburst at the 82-inch telescope on July 25 and August 6. Our spectrograms reveal very striking changes in this binary since August, 1940, and even since January 5, 1941.

With regard to line intensities and structures, the evolution of the emission lines may be summarized as follows: (*a*) Increases in the following intensity ratios: *Fe* II/*N* III, *C* III, *C* IV; *O* III fl./[*Ne* V]; *He* I/[*Ne* III]; *Fe* II/*He* I; *Fe* II/[*O* III]; *Si* II/Continuum; *Mg* II/Continuum. (*b*) No variation in the structure of the "nuclear" features in the region λλ 4632–4658, but a general weakening, compared to *Fe* II. (*c*) A general intensity decrease of the forbidden lines [*O* III], [*Ne* III], [*Ne* V]. (*d*) A slight decrease in

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[1] *Ap. J.*, **77**, 44, 1933. [2] *Ap. J.*, **91**, 607, 1940. [3] *Ibid.*, **94**, 298, 1941.

[4] *Harvard Announcement Card*, Nos. 595 and 598; Leon Campbell, *Pop. Astr.*, **49**, 446, 1941.

the ratio of the auroral to the nebular transitions of [*O* III] since 1940 (no appreciable change since January, 1941). (*e*) A very strong Balmer continuum in emission.

The measured lines are shown in Table 2; the wave lengths have been corrected to the sun but have not been corrected for the motion of the star. For the identifications extensive use was made of our new table of wave lengths in α Cygni.[5] In the region between the Balmer limit and λ 3445, the very strong continuous hydrogen emission is interrupted only by the absorption lines 2p $^3P^\circ$ — 8, 9, 10d ^3D of *He* I (λλ 3634, 3587, and 3554); no trace is observed of *He* I 3613, which means that the dilution effect is not important. This latter result is in agreement with the observations of a violet absorption component of the lines 2p $^3P^\circ$ — 5, 6, 7 d ^3D. *He* I 3634 cuts deeply into the Balmer continuum. The continuous spacings between the higher members of the Balmer

TABLE 1

COMPARISON OF THE LINE INTENSITIES IN AX PERSEI ON JANUARY 5, 1941, AND AUGUST 8, 1941

Element and λ	Intensities: January 5 1941	Intensities: August 8 1941	Element and λ	Intensities: January 5 1941	Intensities: August 8 1941
3869 [*Ne* III]	4	2	4641 *N* III	4–5	1
3889 H_8 + *He* I	2	5	4646 *C* III	3 }	1–0
3967 [*Ne* III]	2	1	4649 *C* III	3n }	
*H*ε	3	4	4686 *He* II	10	8
4009 *He* I	1	abs.	4713 *He* I	2	1
4026 *He* I	2	1	*H*β	10	15
4097 *N* III	4	1–0	4922 *He* I	2–3	1
*H*δ	3	4	N_2 [*O* III]	2	0
4144 *He* I	2–3	1	N_1 [*O* III]	4	1–2
4200 *N* III + *He* II	1n	0	5016 *He* I	1	1
*H*γ	7	8	5158 [*Fe* VII]	abs.	1–2
4351 *Fe* II	abs.	0–1	5275 [*Fe* VII]	abs.	1–0
4363 [*O* III]	5	2–3	5412 *He* II	2	2
4388 *He* I	2–3	1	5721 [*Fe* VII]	0	3
4471 *He* I	3	2	D_3 *He* I	7	7
4634 *N* III	2–3	1–0	6086 [*Fe* VII]	0	6
			*H*α	15	15

[5] *Ap. J.*, **94**, 344, 1941. According to the variable-star observers of the Milwaukee Astronomical Society, the apparent visual magnitude of Z And was 8.8 at the time of our spectroscopic observations.

TABLE 2

SPECTRUM OF Z ANDROMEDAE (JULY–AUGUST, 1941)

λ	Int.	Identification		
		Element	λ	Int.
3420.83	0E	*Cr* II	1.20	75
3422.71	1E	*Cr* II	2.74	125
3426.05	1–0E	[*Ne* V]	5.8	....
3443.45	4E	*O* III	4.10	5
3554	0A	*He* I	4.39	7
3587	1A	*He* I *He* I	7.25 7.40	10 2
3633.45	3A	*He* I *He* I	4.24 4.37	15 2
3664.37	0–1E	H_{28}	4.68	....
3665.86	1E	H_{27}	6.10	....
3667.59	2E	H_{26}	7.68	....
3669.40	2E	H_{25}	9.47	....
3671.39	3E	H_{24}	1.48	....
3673.90	3–4E	H_{23}	3.76	....
3676.38	3–4E	H_{22}	6.36	....
3677.34	2E	*Cr* II *Cr* II *Cr* II	7.69 7.86 7.93	40 50 30
3679.42	4E	H_{21}	9.35	....
3681.02	1E	....	......	....
3682.66	4E	H_{20}	2.81	....
3684.71	1E	*Cr* II *Ti* II	4.25 5.20	25 700
3686.93	4E	H_{19}	6.83	....
3691.57	4E	H_{18}	1.56	2
3697.18	5E	H_{17}	7.15	3
3700.01	0E	*V* II	0.34	200
3703.42	5E	H_{16}	3.85	4
3705.55	4En*	*He* I *He* I	5.00 5.14	30 3

λ	Int.	Identification		
		Element	λ	Int.
3712.21	5En	H_{15} *Cr* II *Cr* II	1.97 2.97 3.04	5 35 15
3714.73	1E	*Cr* II *Cr* II *V* II *O* III	5.19 5.45 5.48 5.08	20 20 1200 6
3719.83	0E	*Fe* I	9.93	1000
3722.05	5E	H_{14}	1.94	6
3724.04	0E	*Cr* II	3.40	15
3726.88	1E	[*O* II] *Cr* II *V* II	6.12 7.37 7.35	.... 40 1000
3728.55	0–1E	[*O* II]	8.91	....
3734.51	6E	H_{13}	4.37	8
3737.03	2E	*Cr* II *Fe* I	7.55 7.13	10 1000
3739.19	0–1E	(*Cr* II	8.38	25)
3741.58	2E	*Ti* II	1.65	200
3745.71	2–3E	*V* II *Fe* I	5.81 5.56	800 500
3748.00	2E	*Fe* II *Fe* I	8.49 8.26	8 500
3750.30	6E	H_{12}	0.15	10
3754.60	2E	*Cr* II *O* III *N* III	4.59 4.67 4.62	20 7 6
3757.48	1E	*Ti* II *O* III	7.69 7.21	100 5
3759.23	2E	*Fe* II *Ti* II *O* III	9.46 9.30 9.87	6 400 9
3760.83	1E	*Ti* II	1.32	300
3764.22	1–0E	*Fe* I	3.79	500
3766.74	0E	*Fe* I (*Cr* II	7.19 6.65	500 4)

* Faint violet absorption.

TABLE 2—*Continued*

λ	Int.	Identification: Element	Identification: λ	Identification: Int.
3770.73.....	7E	H_{11}	0.63	15
3783.14.....	2E	*Fe* II	3.35	4
3795.47.....	1E	*Fe* I	5.00	500
3797.96.....	7E	H_{10}	7.90	20
3806.26.....	0–1En	*He* I (*Si* III	5.76 6.56	3 5)
3813.73.....	2En	*Fe* II *Cr* II	4.12 4.00	4 12
3818.66.....	3A }	*He* I	9.61	50
3820.12.....	3E }			
3824.88.....	1E	*Fe* II	4.91	4
3827.11.....	0E	*Fe* II	7.08	4
3829.60.....	1–0E	*Mg* I	9.35	100
3832.90.....	1E	*Mg* I	2.31	250
3835.55.....	6E	H_9	5.39	40
3838.24.....	1–2E	*Mg* I	8.26	300
3845.23.....	1E	....	......	....
3848.39.....	1E	*Mg* II	8.24	10
3849.80.....	1–2E	*Mg* II *Fe* I	0.40 9.97	5 500
3854.84.....	1A }	*Si* II	6.03	8
3856.12.....	4E }			
3859.73.....	0–1E	*Fe* I	9.91	1000
3861.23.....	1A }	*Si* II	2.59	6
3862.40.....	4E }			
3865.45.....	1E	*Cr* II	5.59	75
3868.64.....	4E	[*Ne* III]	8.7	....
3872.35.....	1E	*He* I	1.82	5
3878.71.....	2E	*V* II	8.71	300
3887.76.....	2A† }	*He* I	8.65	1000
3889.03.....	9E }	H_8	9.05	60
3895.83.....	1E	*Fe* I	5.66	400
3900.12.....	2E	*Ti* II *Al* II	0.54 0.68	50 200
3903.19.....	1E	*V* II	3.26	250
3905.57.....	2E	*Si* I *Cr* II	5.53 5.64	15 25
3913.84.....	2–3E	*Ti* II	3.46	70
3926.57.....	1–2E	*He* I	6.53	7
3930.31.....	2–3E	*Fe* I	0.31	600
3933.78.....	3E	*Ca* II	3.67	600
3938.31.....	3–4E	*Fe* II	8.29	2
3943.38.....	1–0E	(*Al* I	4.03	2000)
3945.15.....	2E	(*Cr* II	5.11	1)
3951.50.....	0En	*V* II *Fe* I	1.97 1.17	500 150
3961.00.....	1En	*Fe* II *Al* I *O* III	0.89 1.53 1.59	3 3000 8
3965.01.....	4E	*He* I	4.73	50
3967.89.....	2E	[*Ne* III] *Ca* II	7.5 8.47	 500
3970.32.....	8E	$H\epsilon$	0.08	80
3973.78.....	1–2E	*Fe* II *V* II *O* II	4.16 3.64 3.27	3 300 125
3978.32.....	1–0E	(*Fe* I	7.75	300)
3981.89.....	1–0E	(*Fe* I	1.77	150)
3987.20.....	1–0E	....	......	....
3991.56.....	0–1E	(*Si* II	1.77	2n)
3997.87.....	0–1E	(*Si* II *Fe* I	8.00 8.05	1n) 150
4002.35.....	1E	*Fe* II	2.55	3
4005.36.....	0–1E	*V* II	5.71	800
4009.58.....	2E	*He* I	9.27	10

† The absorption component is due to *He* I only.

TABLE 2—*Continued*

λ	Int.	Identification: Element	λ	Int.
4012.60.....	1–2E	*Cr* II	2.50	30
4015.51.....	1E	*Ni* II	5.48	1
4025.61.....	2A }	*He* I	6.19	70
4026.65.....	5E }			
4054.02.....	1E	*Cr* II	4.11	8
4063.80.....	0E	*Cr* II *Fe* I	4.05 3.60	 400
4066.97.....	1E	*Ni* II	7.05	30
4069.28.....	0E	[*S* II] *C* III *C* III *C* III	8.5 7.87 8.94 0.43	.... 6 7 8
4071.56.....	1E	*Fe* I (*Cr* II	1.74 0.90	300 10)
4075.87.....	2E	*O* II *Si* II	5.87 5.45	800 2
4097.40.....	4E	*N* III	7.31	10
4102.20.....	10E	*H*δ *N* III	1.75 3.37	100 9
4121.16.....	1–2E	*He* I	0.81	25
4122.46.....	1–2E	*Fe* II	2.64	4
4124.88.....	0E	*Fe* II	4.79	1
4128.15.....	1–2E	*Si* II *Fe* II	8.05 8.73	20 3
4131.19.....	1E	*Si* II	0.88	25
4143.71.....	3E	*He* I	3.76	15
4161.27.....	0–1E	*Ti* II	1.54	30
4163.71.....	2E	*Ti* II	3.65	150
4166.11.....	1–0E	....	......	....
4169.00.....	1–0E	*He* I	8.97	7
4171.51.....	1–0E	*Ti* II	1.90	70
4173.68.....	2–3E	*Fe* II	3.45	8
4178.63.....	3E	*Fe* II	8.85	8

λ	Int.	Identification: Element	λ	Int.
4227.35.....	0E	*Ca* I *Al* II *Al* II *Al* II *Fe* I	6.73 6.81 7.50 7.98 7.43	500 35 30 20 300
4232.89.....	5E*	*Fe* II	3.17	11
4267.37.....	1E*	*C* II *C* II	7.02 7.27	350 500
4286.85.....	1E	[*Fe* II]	7.40	
4289.81.....	1E	*Ti* II	0.23	60
4293.53.....	1E	*Ti* II *Fe* I	4.12 4.13	80 700
4296.56.....	1E	*Fe* II	6.58	6
4307.42.....	1E	*Ti* II *Fe* I	7.90 7.91	100 1000
4313.12.....	1E	*Ti* II	2.87	100
4315.07.....	1E	*Ti* II *Fe* I	4.98 5.09	20 500
4320.97.....	1E	*Ti* II *Sc* II	0.96 0.74	40 40
4331.36.....	1E	*Fe* II	1.53	3
4340.79.....	10E	*H*γ	0.48	200
4351.60.....	4E	*Fe* II *Mg* I	1.76 1.91	9 15
4358.66.....	1E	[*Fe* II]	9.34	....
4363.21.....	5E	[*O* III]	3.20	....
4368.22.....	0E	*O* I *Fe* II *Ti* II	8.30 8.26 7.66	1000 1 25
4384.30.....	2–3E	*Fe* II *Fe* I (*Mg* II	5.38 3.55 4.64	7 1000 8)
4387.47.....	3E	*He* I	7.93	30
4390.48.....	1–0E	*Mg* II	0.58	10
4394.91.....	2En	*Ti* II	5.04	150
4399.60.....	2E	*Ti* II	9.77	100

TABLE 2—*Continued*

λ	Int.	Identification		
		Element	λ	Int.
4404.88.....	1E	*Fe* I	4.75	1000
4414.70.....	1E	[*Fe* II] *O* II	3.78 4.89	 300
4417.08.....	3En	*Fe* II [*Fe* II] *Ti* II	6.82 6.28 7.72	7 80
4443.20.....	1E	(*Ti* II	3.80	125)
4468.40.....	1E	*Ti* II	8.50	150
4472.12.....	5E*	*He* I	1.48	100
4480.93.....	3E	*Mg* II	1.33	100
4488.75.....	1–2E	*Fe* II *Ti* II	9.18 8.32	4 125
4491.62.....	1–2E	*Fe* II	1.40	5
4501.21.....	1E	*Ti* II	1.27	100
4508.73.....	2E	*Fe* II	8.28	8
4515.43.....	2E	*Fe* II	5.34	7
4520.54.....	2E	*Fe* II	0.22	7
4522.86.....	2E	*Fe* II	2.63	9
4529.11.....	1E	*Ti* II *V* II	9.46 8.51	40 300
4534.17.....	2E	*Ti* II *Fe* II *Mg* II	3.97 4.17 4.26	150 2 4
4541.46.....	2En	*Fe* II *He* II	1.52 1.63	4 5
4549.74.....	3–4E	*Fe* II *Ti* II	9.47 9.63	10 200
4555.95.....	3E	*Fe* II	5.89	8
4558.19.....	1E	*Cr* II	8.66	100
4564.04.....	0E	*Ti* II	3.77	200
4571.57.....	0E	*Mg* I *Ti* II	1.10 1.98	20 300
4576.89.....	0E	*Fe* II	6.33	4

λ	Int.	Identification		
		Element	λ	Int.
4583.93.....	4E	*Fe* II	3.84	11
4589.29.....	1–0En	*Cr* II *Cr* II *Ti* II	8.22 9.89 9.95	75 3 100
4619.87.....	2Enn	*Cr* II *Fe* II	8.83 0.51	35 3
4629.53.....	4E	*Fe* II	9.34	7
4635.06‡....	3–4E	*N* III *Fe* II *Cr* II	4.16 5.33 4.11	8 5 25
4641.23‡....	4–5E	*N* III *N* III	0.64 1.90	10 3
4649.19‡....	3Enn§	*C* III *C* III *C* III	7.40 0.16 1.35	10 9 8
4657.53‡....	1E	*C* IV *C* IV	8.64 6.5	5 4
4685.58.....	12E	*He* II	5.81	300
4709.65.....	1–0E	(*Fe* II	8.97	3)
4713.99.....	3E†	*He* I *He* I	3.14 3.37	40 7
4732.17.....	1E	*Fe* II	1.44	3
4861.95.....	15E	*Hβ*	1.34	500
4919.64..... 4922.80.....	1A } 6E }	*He* I *Fe* II	1.93 3.92	50 12
4936.55.....	1E	....	......	....
4959.36.....	4E	[*O* III]	8.91	....
4993.96.....	1E	*Fe* II	3.35	1
5007.05.....	6E	[*O* III]	6.84	....
5017.33.....	5E	*He* I *Fe* II	5.67 8.43	100 12
5040.16.....	1–0E	(*Si* II	1.13	8)
5048.01.....	1E	*He* I	7.74	15

‡ These "nuclear" features have a violet absorption component, and their general structure has not changed since August, 1940.

§ Extends from λ 4646.3 to λ 4651.9.

TABLE 2—*Continued*

λ	Int.	Identification			λ	Int.	Identification		
		Element	λ	Int.			Element	λ	Int.
5168.82.....	3E	*Fe* II	9.03	12	5283.95.....	1E	*Fe* II	4.09	3
5183.66.....	1–0En	*Mg* I	3.62	500	5316.92.....	4E	*Fe* II	6.61	8
5197.60.....	2E	*Fe* II	7.57	6	5362.82.....	2E	*Fe* II	2.86	5
5226.66.....	0E	*Ti* II *Fe* I	6.55 7.19	50 400	5534.79.....	2E	*Fe* II	4.86	4
5234.64.....	1–2E	*Fe* II	4.62	7	5876........	10E	*He* I	5.62	1000
5275.16.....	3E	*Fe* II	5.99	7	6563........	20E	*Hα*	2.82	2000

series are faint; this shows that the continuous spectrum at λ 3613 is practically all due to the Balmer continuum. Hence, this continuum is absorbed by overlying *He* I atoms.

The radial velocities on August 6, 1941, have the following values:

H: Mean $V_{em} = +5$ km/sec; from $H\gamma$ and $H\epsilon$ alone: $V_{em} = +20$ (against +16 in 1940)

He I: Mean $V_{em} = +21$ km/sec; individual values in the 2p $^3P^\circ$ —nd ^3D series:
$n = 5$, λ 4026, $V_{abs} = -43$, $V_{em} = +34$, $V_{em} - V_{abs} = 77$
$n = 6$, λ 3820, $V_{abs} = -75$, $V_{em} = +40$, $V_{em} - V_{abs} = 115$
$n = 8$, λ 3634, $V_{abs} = -59$
Mean $V_{em} - V_{abs} = 96$ (against a mean value +81 in 1940)

Si II: $V_{abs} = -99$; $V_{em} = +10$, $V_{em} - V_{abs} = 109$ km/sec

Metallic ions: V_{em} of *Fe* II: −2; *Ti* II: −13; *Cr* II: −11; *Mg* II: −27; *Ca* II: +8

High excitation features: $V_{em} = +9$ (against +6 in 1940)

Nuclear features: No variation in either V_{em} or V_{abs} since 1940

On the whole, we may say that all the emission lines not accompanied by violet absorptions have about the same radial velocity; that the velocity of expansion of *He* I is essentially the same as in 1940; that *He* I and *Si* II have practically the same ejection velocities; and that the "nucleus" and the "forbidden nebular lines" have, as a whole, simply become fainter in the course of 1941.

Whatever may be the true origin of the "nuclear" features—either an exciting Wolf-Rayet nucleus or deep layers in the nebula—their intensity decrease, which was simultaneous and similar to that of the forbidden nebular lines, is easily understood. The other spectroscopic variations observed in 1941 are presumably due to the fact that more abundant matter was ejected with practically the same velocity as last year. Part of the emissions and violet absorptions (excluding the "nuclear" features) arise in the new shell, which is still fairly close to the photospheric surface. The opacity of the new shell reduces the excitation in the nebula.

This general picture is crude and qualitative; but it is hoped that additional observations may provide data for a more or less quantitative treatment.

AG Pegasi (*BD* + *11°4673*).—The general trend toward higher excitation has continued.[6] Comparing our 1941 spectrograms[7] with those of 1939–1940, it is apparent (1) that *Si* I 3905 has disappeared; (2) that *Ca* II and *Fe* II have decreased in intensity; and (3) that *He* II, *N* III, and *Si* IV have increased appreciably.

R Aquarii.—Spectrograms of this object secured on July 30 and August 12, 1941, when the late-type companion was near minimum,[8] reveal that this peculiar star has recovered its [*Fe* III] stage.[6] The [*Fe* III] lines were observed by Merrill from 1919 to 1926, inclusive, when the nebular spectrum was strong, as a whole. On a 1924 plate, λ 4658 was "probably accompanied by λ 4701 and λ 4733." In 1939 there was no trace of [*Fe* III]. The emission lines observed on our spectrograms of August, 1941, are:

H:	$H\alpha$ (20), $H\beta$ (12), $H\gamma$ (6), $H\delta$ (4), $H\epsilon$ (4, bl), H_8 (4, bl)
He I:	D_3 (3), 4471 (1–2), 4144 (0–1), 3889 (4 bl)
[*O* II]:	3727 (2)
[*O* III]:	N_1 (15), N_2 (6), 4363 (5)
[*S* II]:	4069 (3), 4076 (1)
[*Ne* III]:	3869 (6), 3967 (4 bl)
Fe II:	4303 (1–2), 4352 (1–2)
[*Fe* II]:	4244 (1), 4287 (1), 4414–4416 (2)
[*Fe* III]:	4658 (2), 4702 (1), 4755 (0)
Mg I (or unidentified):	4571 (3)

The presence of the transitions of nebular type of [*O* II] is interesting, since they have an extremely low transition probability; they must undoubtedly arise in a nebular region of extremely low density.

MWC 349.[9]—The line emission in this star has been described by Merrill, Humason, and Burwell as follows:[10] "In addition to the hydrogen lines, the bright nebular line at λ 4658 is well marked and the companion line λ 4701 is visible. Bright lines of neutral helium are also present and possibly λ 4583 of ionized iron."

MWC 349 bears a striking spectral analogy to MWC 17[11] and should also be compared to the star of slightly higher excitation, RY Scuti.[12] It is located in a dark region of the Milky Way and is reddened to a considerable extent; the total absorption is probably of the order of 10 mag.

[6] This was also observed by Dr. P. W. Merrill (communication at the Yerkes Observatory Symposium on Stellar Spectra, September 10–12, 1941).

[7] According to the Milwaukee observers, the magnitude of AG Peg was 7.7 at the time of our spectroscopic observations in July and August, 1941.

[8] According to the Milwaukee observers, the magnitude of R Aqr was 11.0 at the time of our spectroscopic observations.

[9] α(1900): $20^h29^m.2$; δ(1900): $+40°19'$; 22^s preceding and 3′ north of BD+40°4226. Magnitude given by Merrill in 1932: 13.2; the star was fainter than the fourteenth magnitude when observed on July 31 and August 1, 1941. Galactic co-ordinates: $l = 47°$, $b = 0°$.

[10] *Ap. J.*, **76**, 156, 1932, star MW 203.

[11] *Ap. J.*, **93**, 349, 1941.

[12] *Ap. J.*, **91**, 581, 1940.

The lines observed on our spectrograms are:

H:	*Hα* (20), *Hβ* (3), *Hγ* (1)
He I:	D_3 (7)
[*O* I]:	6300 (2)
[*N* II]:	5755 (5)
Fe II:	5169 (1), 5317 (1–0)
[*Fe* III]:	5270 (3), 5010 (2), 4658 (1), 4701 (0)

The reddening is especially noticeable in the [*Fe* III] lines. In unreddened stars, λ 4658, which is the leading component of the $^5D - {}^3F$ multiplet, is always at least as strong as λ 5270, which is the strongest $^5D - {}^3P$ transition, and λ 5010 is always weaker than λ 4658. But in MWC 349, λ 5270 and λ 5010 are appreciably more intense than λ 4658. This gives conclusive evidence in favor of a considerable color excess (of the order of 2 mag.) and consequently of a tremendous general absorption. The general intensity distribution in the continuous spectrum is similar to a late M star, but no late-type absorption feature is apparent. By comparison with RY Scuti we should expect the spectral type to be early B.

In RY Scuti the [*Fe* III] lines are also strong, but *He* II is present and *Fe* II is absent; in MWC 17 both *Fe* II and [*Fe* III] are present, and *He* II is absent.

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