A REMARKABLE VARIABLE SPECTRUM

By J. S. Plaskett

The star +5°1267, H. D. 45910, R. A. $5^h\ 25.2^m$, Dec. +5° 57′, vis. mag. 6.67, is one of a subsidiary observing program, compiled after the massive star 6° 1309 was investigated and including all the early type stars within three degrees of that system and brighter than eighth magnitude. It is classified as B3 without remarks in the *Henry Draper Catalogue* and it was not noticed until this paper was in preparation that it had been observed by Humason and Merrill* and noted as having hydrogen lines of the P *Cygni* type.

The first spectrum secured here on October 7, 1922, showed so unmistakably the P *Cygni* characteristic that three more were obtained during October and November. A change in the relative displacements of the hydrogen components in the last plate made it seem desirable to obtain further plates, but, owing to winter conditions and an accident which prevented personal observing, no more spectra were obtained until February. The remarkable changes occurring since then have caused it to be closely followed and justify this preliminary discussion as it seems desirable that both the spectrum and the apparent magnitude should be concurrently observed when the star is again within reach. The dates of observation, the measured displacements and velocities are given in the following table, with the ratio of intensity of λ4481 to λ4472 and an estimate of type. This information requires supplementing and will hence be followed by a description of the peculiar features and the changes in the spectrum. The latter will be shown more vividly by the reproduction, in the accompanying plate, of the spectrum at its principal phases with spectra of P *Cygni* and *α Cygni* for comparison.

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Observations of +5° 1267

Date G. M. T.	Instrument*	Displacements Hydrogen Lines Emission	Absorption	α *Cygni* Lines	Ratio 4481 to 4472	Probable type	Remarks
1922, Oct. 7.994	IS	+100	−119		0.2	B0	Traces metallic emission.
Oct. 9.052	IS	+95	−122		0.2	B0	Also central H emission.
Oct. 13.957	IS	+94	−120		0.25	B0	Also central H emission.
Nov. 12.956	IS	+78	−243		0.25	B0	Stronger metallic emission.
1923, Feb. 27.731	IS	+57	−151		0.2	B0	He 4922, 5015, P *Cygni* type.
Mar. 2.693	IM	+41	−99		0.3	B2	He 4922, 5015, P *Cygni* type.
Mar. 17.653	IS	+80	−172	−14.5	1.2	B8	Metallic emission and absorption.
Mar. 25.672	IS	+90	−168	−21.2	2.5	A0	Strong α *Cygni* stage.
Mar. 26.669	IM	+68	−177	−23.8	3.0	A2	Strongest α *Cygni* stage.
Mar. 27.657	IS	+84	−171	−20.3	2.0	B9	Emission 4352, 4233, H.
Mar. 28.726	IS	+69	−169	−14.1	1.7	B9	Emission 4233, H.
Mar. 29.669	IS	+69	−155	− 6.8	1.7	B9	α *Cygni* lines stronger.
Mar. 31.664	IS	+56	−175	−25.4	1.4	B8	α *Cygni* lines much weaker.
Apr. 1.646	IS	+72	−156	−19.1	1.3	B8	α *Cygni* lines weaker.
Apr. 3.681	IS	+61	−146	−33.5	1.1	B8	Weak plate.
Apr. 4.737	IS	+52	−157	−25.7	1.1	B8	α *Cygni* lines weak.
Apr. 9.664	IM	+66	−147	−13.9	1.0	B6	Central H emission.
Apr. 10.673	IS	+71	−150	−10.1	0.6	B5	Only α *Cygni* lines easily
Apr. 11.719	IS	+82	−143	−17.6	0.5	B5	seen are 4352, 4233.
Apr. 24.698	IS	+85	−127	+20.0	0.4	B3	α *Cygni* lines stronger than
Apr. 25.692	IS	+80	−119	+21.0	0.4	B3	on Apr. 9, 10, 11.

*Linear dispersion IS=50A, IM=29A to the millimeter at Hγ.

The principal lines showing in the spectra first obtained were the complex hydrogen lines of the P *Cygni* type consisting of a bright narrow emission sharply bordered at the violet by strong, sharply limited absorption. The displacements of these components are given in the table and are expressed for convenience in kilometers. It can not, however, be too strongly emphasized that these displacements do not necessarily represent actual motions of the gases but are more probably due to unsymmetrical broadening and interference. The appearance of these lines and the relative displacement of the components agree closely with those found by Frost* and Merrill† in P *Cygni* and the resemblance is made more striking by the presence of an additional faint bright line nearly central in the absorption band in the spectra of October 9 and 13, March 26 and April 9, as a similar line was also observed and measured by Merrill† in P. *Cygni.* The hydrogen emission decreases with

Ap. J. **35,** p. 286.
†*L. O. B.* **8,** p. 24.

progression to the violet being most prominent in Hβ and Hγ, weaker in Hδ and practically absent in Hε. In addition to the hydrogen lines the only ones visible are those of ordinary helium at λλ4026, 4144, 4388, 4472, 4713, 4922 and 5016, a faint magnesium 4481 and strong H and K. The helium lines are broad, diffuse and rather weak and although the measurement is uncertain are displaced, on the early plates, to the violet nearly as much as the hydrogen absorption. As they are not accompanied by the usual enhanced silicon, nitrogen and oxygen it is difficult to judge of the spectral type but from the relative intensity of 4481 to 4472 it should be placed at B0.

The first indication of change was given by the spectrum of November 12 in which, as the table shows, the absorption displacement of the hydrogen lines increased by 120 km, nearly 2A. This displacement might be due to increased strength of the central emission noted above displacing the maximum to the violet but this is contradicted by the fact that the violet edge of the absorption is also shifted by nearly the same amount. The displacement hence seems a bodily one and indicates a real change in the spectrum. One can hardly avoid comparing this shift with the similar change of position of hydrogen absorption in novæ. There appear also discontinuities in the continuous spectrum, possibly incipient emission near 4584, 4549, 4352 and 4233.

But the most striking phenomenon of the spectrum of this star is the relatively sudden and startling superposition of a complete set of the *α Cygni* lines of enhanced iron, titanium, and chromium upon the P *Cygni* and helium absorption lines which remain throughout of nearly unchanged strength. The first indication of this change is given in the spectra of February 27 and March 2 where emission begins to show distinctly near the stronger metallic lines and this is bordered at the violet by absorption on March 17. The *α Cygni* absorption lines reach their full strength on March 25 and 26 when the emission borders have nearly disappeared and when the lines are even stronger than in *α Cygni* itself. These spectra when compared with *α Cygni* on the spectro-comparator show almost complete identity in position, relative intensity and sharpness of the en-

hanced metallic lines. The maximum of this phase is, however, a very transient one for a decline in the strength of the metallic lines is noticeable on March 27 and marked on March 28. The progress of this decline can be fairly well judged by the ratio of 4481 to 4471 in the table, but just as in the novæ, the progression does not seem continuous but is interrupted by temporary increases in the strength of the metallic lines. On April 10 and 11, except for traces of 4352 and 4233, the spectrum is almost identical with those obtained before March 2. The whole *α Cygni* stage seems to have occupied only about a month but unfortunately the incompleteness and interruption of the record makes the time uncertain and it can not be said whether it is a recurrent phenomenon or an isolated outburst.

As previously indicated, the displacements of the components of the hydrogen lines are most probably not due to motion of the gases, but the velocities obtained from the *α Cygni* lines, (and in these later plates the helium absorption gives practically the same displacement), probably represent fairly accurately the motion of this particular reversing layer. It is possible, of course, that the presence and varying strength of the emission borders to the red of several of the stronger lines may produce a spurious shift. Nevertheless the interagreement of all the metallic lines whether with or without emission borders is so good as to make it probable that the values given in the table correspond to actual velocities. There can be no doubt of the variability of this velocity but as yet it can not be coordinated with change in type. In this connection the apparent brightness should be concurrently measured and the principal purpose of this preliminary note is to draw attention to the interesting nature of this object in order that some one with the necessary facilities, which we do not possess, may undertake its photometric study in cooperation with our further investigation of the spectrum.

In conclusion it may be of interest to mention some curious resemblances to novæ in this spectrum. The similarity to P *Cygni,* which apparently had nova characteristics, and the complex structure of the hydrogen lines with their changing relative and absolute displacements form one link. A second is

given by the sudden appearance and fading away of the *a Cygni* spectrum which is also, although much more displaced, a characteristic feature in novæ in their early stages. A third similarity may be found in the rapid and irregular variability of the spectral features of this star reproducing in some fashion some of the features of the novæ, the most striking variable spectra known. It seems to be at least worth while to bear these resemblances in mind in future investigation of this interesting object.

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