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THE STRANGE CASE OF V 439 CYGNI:
CHEQUERED HISTORY OR MULTIPLE MIS-IDENTIFICATION?

During a search for carbon stars in open clusters, one candidate was found to lie within 1 arc-minute of the centre of the young open cluster Berkeley 87 (OCL - 161; C2019+372). This star, V439 Cygni, was first identified as a carbon star by Perraud and Pelletier (1959) as a result of an objective prism survey, and was included in the General Catalogue of Cool Carbon Stars (Stephenson 1973) as number 2896. The variable star designation is based on an approximately 260-day period reported by van Schewick (1941), who identified it as being a "red" star exhibiting shallow, semi-regular light variations.

Be 87 is a sparsely-populated, heavily reddened open cluster recently studied by Turner and Forbes (1982; TF). They give the colour for V439 Cyg as $(B-V)_o = +0.01$ (if $E(B-V) = 1.53$), that of a heavily-reddened early-type star.

In an attempt to reconcile the colours measured by TF with the identification as a carbon star, the ten minute reticon spectrum shown here as Figure 1 was taken by one of us (APC) with the 1.27 metre McGraw-Hill telescope on 14 October 1982, using a 600 line blue grating in the first order. The spectrum has been sky-subtracted, fluxed, and smoothed, and has been positively identified as that of star number 15 in TF and as V439 Cygni in the Mitteilungen über Veränderliche Sterne, No. 270 (1957; MVS).

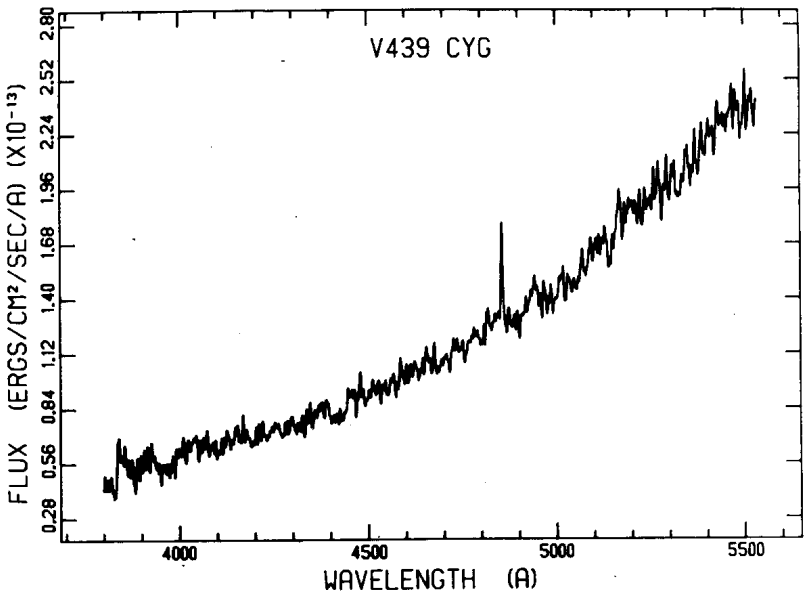

Figure 1

The Reticon spectrum of V439 Cygni as described in text. Spectrum has been sky-subtracted, fluxed, and smoothed

The spectrum is remarkably smooth - the only prominent features being a narrow $H\beta$ emission line and an absorption band at $\lambda\lambda$ 4400 - 4440; the latter is attributed to the λ4430 diffuse interstellar band. There are no Swan bands of C_2 which are characteristic of carbon stars, nor any metallic or molecular lines to suggest a late spectral type. The spectrum shows no prominent helium and carbon lines and in this respect does not resemble the hot hydrogen-deficient carbon stars (Warner 1967). The continuum is reddened, as might be expected from the high value of cluster reddening. It seems very unlikely that V439 Cyg was ever a carbon star; rather, the spectrum appears to be that of a peculiar emission-line star of equivalent spectral type ~B0. It differs from classical Be star spectra

in the narrowness of the Hβ emission line and in the lack of underlying photospheric absorption features. The possibility of time variations prevents us from making more definite conclusions regarding the nature of this star.

Two Warner and Swasey objective prism plates, one in the blue spectral region and the other infrared, show no carbon star within many minutes of arc of V439 Cyg, down to 13.5 and 10.0 photographic and infrared magnitudes respectively. V439 Cygni itself is underexposed on the blue plate but the spectrum, in agreement with the observations already cited, is non-banded.

The answer to the confusion concerning the identification of V439 Cygni may lie in the surrounding stars. The only star within 10 arc-minutes of V439 Cyg which is red enough to have been mistaken for a carbon star is the M3.5 Ia star BC Cygni, 7 arc-minutes north. This star has approximately the same magnitude as that given by van Schewick and Perraud and Pelletier, and it is also an irregular variable (TF and references therein), although of larger amplitude than that attributed to V439 Cygni.

Another possibility is that in the spectral region λλ 4000 - 4900 where Perraud and Pelletier made their classification, the spectrum of the nearby Wolf-Rayet star ST 3 (Stephenson 1966; type WC pec) may have been confused in the crowded field and at low dispersion with that of a middle C-type star.

The two photographic observations of V439 Cyg by TF are separated by only two months, however no variation in V magnitude was detected to within the photometric errors, but a difference of 0.06 ± 0.03 in U-B was found. In an attempt to explain the observed non-variability and the variable star designation, TF briefly discuss the possibility of V439 Cyg being a long-period eclipsing binary consisting of a hot and cool companion. This hypothesis is not supported by the spectrum, however, which shows no trace of a cool pre-main-sequence object.

Thus the problem of the non-variable, variable star remains.

V439 Cygni's anomalous position in the colour-magnitude diagram shown in TF can be explained simply if it is assumed to be a B-type star. TF assumed V439 Cyg to be composite and determined E(B-V) = 1.53 from an average reddening of the five nearest stars. De-reddening V439 Cyg as a B star gives E(B-V) = 1.86, resulting in intrinsic values of V_o= 6.26, $(B-V)_o$= -0.32, and $(U-B)_o$= -1.19. This places the star slightly to the blue side of the main sequence, not an uncommon location for an emission-line star. Assuming cluster membership gives an absolute magnitude of M_V = -3.6, which is quite reasonable for a B0 star.

We conclude that the star identified in the General Catalogue of Variable Stars (Kukarkin et al. 1969) as V439 Cygni is not now either a semi-regular red variable or a carbon star.

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