

WAS HARLOW SHAPLEY RIGHT ABOUT V CEPHEI?

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Abstract

V Cephei needs extensive UBV data before it can be decided whether it is really a *cst* or an Ia type of star.

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V Cephei ($6^m 59$ V, +0.05 B-V, +0.05 U-B, A3V) was discovered by C. S. Chandler in 1882. However, in the first edition of his catalogue of variable stars (Chandler 1890) he included it only among variable stars "awaiting confirmation before assigning Argelander letters." He had found an amplitude of 0.7 magnitude and assumed the star to be either a long period or irregular variable. Later numerous observers claimed to have verified the variability (see Müller and Hartwig 1920) and reported periods of 348, 360, or 362 days, and alternatively a short period of 0.9975 day (the sidereal day!). Still other observers, including E. C. Pickering (1904), failed to find any variation greater than the natural uncertainties of the observations.

Then a student at Princeton, Harlow Shapley (1913), using a polarimeter, made 13 observations on five nights (Oct. 27 - Nov. 5) in order to test which of the periods, 362 or 0.9975 days, was more likely to be correct. Because the star had an early type spectral class, he at first favored the short period. Shapley showed how observations obtained at nearly constant time-intervals of nearly a day could be satisfied by either a long or a short period. To his surprise his own observations definitely ruled out the short period. But they covered much too short a time-span to improve upon the long period.

Many photographic estimates have been acquired. In particular, Cecilia Payne-Gaposchkin (1952) made 1525 estimates on Harvard patrol plates. She concluded from the variation of photographic magnitude 6.3 to 6.9 that the star is either not variable or is irregular. The plates she used had been exposed to show stars to 10th magnitude. Hence a star as bright as V Cep would normally be over-exposed and the apparent amplitude unreliable. Similarly, other series of observations were for the most part too inaccurate either to substantiate or refute so small a change in brightness.

From the published literature I have tabulated the dates of maxima as published by observers who had confidence in their observations. See Table I. Between JD 2408886 and 2421455 thirteen maxima were recorded, with intervals indicating single cycle-lengths from about 270 to over 400 days. The 362-day period fits all but the last reasonably well. The apparently best set of observations comes from the Leiden Ph.D. thesis of W. J. Luyten (1922) as shown in Figure 1. He had obtained 49 observations between 1915 and 1919. It hardly seems likely that so smooth a curve could represent only accidental errors of measurement; and what sorts of systematic errors could show that kind of periodicity?

In his note Shapley had already pleaded for more observations. Here we wish to reiterate that plea, but now for high accuracy photoelectric observations spanning a period of at least a year to verify once and for all if this star is actually variable, and if so, how it is behaving. The type might well be Ia rather than *cst*, and stars of Type Ia all need further attention in order to define a rather ambiguous class described in the **General Catalogue of Variable Stars**

(Kukarkin *et al.* 1969) as "poorly studied irregular variables of early (O-A) spectral types." V Cephei, being circumpolar, could furnish excellent data. Older observers who found no variation could conceivably have chanced to observe only during intervals when the irregular star was quiescent. Hence long series of UBV observations may be necessary.

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TABLE I

Published Maxima of V Cephei

JD	Δt	$\frac{O-C}{362^d}$	Source of JD
2408886		0	Chandler 1893, <i>Astron. Journ.</i> 13 , 89.
	2492		
11378		-42	Yendell 1892, <i>Astron. Journ.</i> 11 , 141.
	407		
11785		+3	Yendell 1892, <i>Astron. Journ.</i> 11 , 141.
	338		
12123		-21	Yendell 1892, <i>Astron. Journ.</i> 11 , 141.
	2506		
14629		-49	Luizet 1904, <i>Astron. Nach.</i> 165 , 337.
	396		
15025		-15	Luizet 1904, <i>Astron. Nach.</i> 165 , 337.
	1113		
16138		+12	Luizet 1904, <i>Astron. Nach.</i> 165 , 337.
	348		
16486		-2	Luizet 1904, <i>Astron. Nach.</i> 165 , 337.
	370		
16856		+6	Luizet 1917, <i>Journ. des Obs.</i> 2 , 19.
	334		
17190		-22	Luizet 1917, <i>Journ. des Obs.</i> 2 , 19.
	387		
17577		+3	Luizet 1917, <i>Journ. des Obs.</i> 2 , 19.
	3609		
21186		-8	Luyten 1922, <i>Ann. Leiden Obs.</i> 13 , No. 2, 30.
	270		
21456		-100	Luyten 1922, <i>Ann. Leiden Obs.</i> 13 , No. 2, 30.

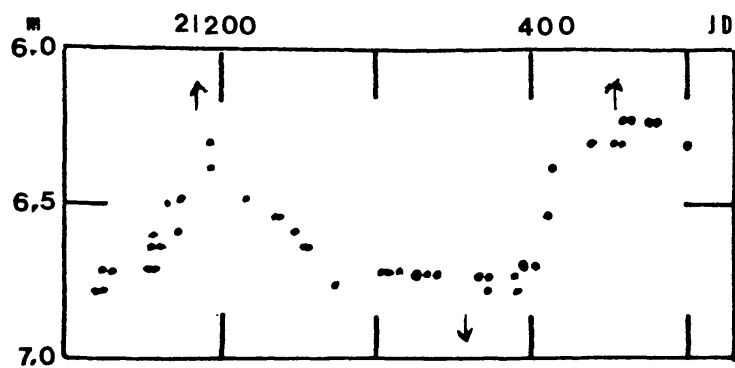


Figure 1. Visual observations of V Cephei by W. J. Luyten (1922).