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NEW PERIOD INCREASE IN THE CEPHEID S Vul

The aim of this paper is twofold:
1. To emphasize that S Vul is a Cepheid variable not a semiregular star as classified in the General Catalogue of Variable Stars (Kukarkin et al. 1969-1970).
2. To call attention to a new period increase that occurred quite recently.

The stability of the light curve can clearly be seen when comparing Fernie's (1970) observations with the recent photoelectric light curve. Fernie also suggested that S Vul should be classified as a Cepheid. As a matter of fact, the only evidence which seems to support its belonging to the semiregular stars is the shape of the light curve during two or three cycles in the visual series of observations made by Schönfeld (Valentiner, 1900). The overwhelming majority of Schönfeld's light curves are typical of a Cepheid variable as are all the other visual, photographic and photoelectric light curves.

The variable star S Vul was observed photoelectrically in the B and V colours of the Johnson system at Konkoly Observatory. The telescope used was the 24 inch reflector equipped with an unrefrigerated EMI 9502B photomultiplier. The star BD $+26^{\circ}3672$ was used as the comparison star. Its magnitudes $V = 10^{m}.10$ and $B-V = 0^{m}.68$ were adopted from Fernie's (1969) paper. The observations (made in 1979 and 1980) are listed in Table 1 and shown plotted in Fig. 1. Systematic differences both in V and B-V between the average magnitudes determined by Fernie and on the basis of the present photometry can be pointed out; these differences are partly due to close companions of the comparison and of the variable stars as well as to the possibly different diameters of the diaphragm used in the two photometries.

Table 1

J.D.Hel. 2444000+	V	B-V	J.D.Hel. 2444000+	V	B-V
049.484	$9^m.27$	$1^m.73$	150.313	$8^m.98$	$1^m.47$
054.422	9.41	1.74	157.291	9.00	1.57
066.424	9.19	1.68	159.290	8.97	1.66
100.526	9.08	1.65	166.253	9.09	1.68
108.407	9.17	1.78	167.267	9.06	1.69
111.431	9.24	1.78	173.241	9.19	1.77
113.367	9.32	1.81	372.478	9.08	1.64
129.376	9.42	1.71	455.406	9.21	1.75
140.380	9.05	1.51	486.316	8.93	1.53
143.375	8.92	1.48	495.409	8.93	1.50
147.334	8.87	1.56			

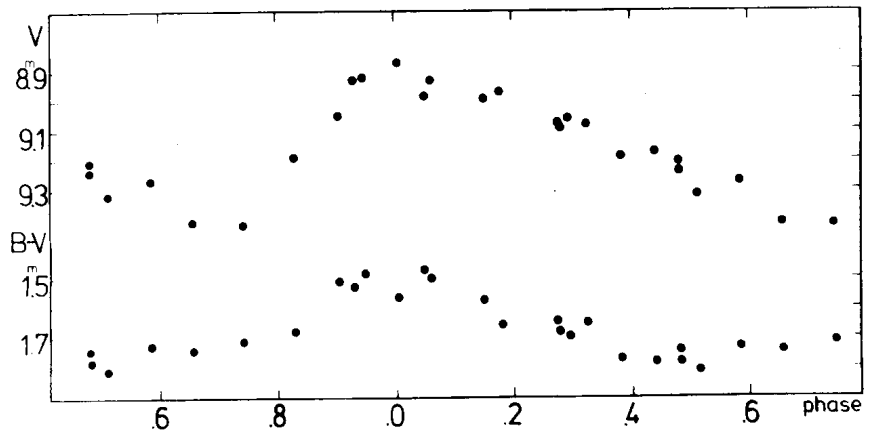

Figure 1

Although there are several papers dealing with the period changes in S Vul (Ahnert, 1948; Makarenko, 1978; Wachmann, 1966) a new O-C diagram has been constructed. In constructing this, newly determined maximum times based on the original observations of the individual observers have been used instead of the published normal maxima. When only the moments of the normal maxima were published the yearly average normal maxima were calculated. These points in the O-C diagram (see Fig. 2 and Table 2) have lower weight. The O-C diagram has a cyclic structure. The presence of a 25 year long cycle was revealed by Makarenko (1978). The new photoelectric observations support this value of the cy-

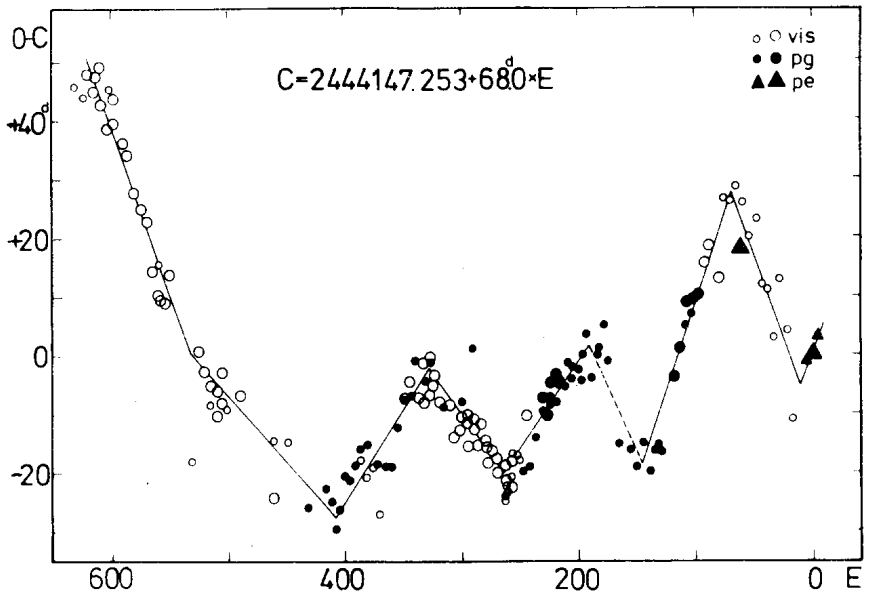

Figure 2

Table 2 The O-C residuals

J.D.Hel.	E	O-C	Type	Weight	Reference
2401353.129	-630	+45d.876	vis	0.5	Turner, Blagg[1] (1917)
2401827.161	-623	+43.908	vis	0.5	Turner, Blagg[1] (1917)
2402103.238	-619	+47.985	vis	1	Turner, Blagg[1] (1917)
2402440.436	-614	+45.183	vis	1	Turner, Blagg[1] (1917)
2402510.712	-613	+47.459	vis	1	Valentiner[2] (1900)
2402784.518	-609	+49.265	vis	1	Valentiner[2] (1900)
2402846.258	-608	+43.005	vis	1	Turner, Blagg[1] (1917)
2403182.080	-603	+38.827	vis	1	Valentiner[2] (1900)
2403256.691	-602	+45.438	vis	0.5	Turner, Blagg[1] (1917)
2403522.788	-598	+39.535	vis	1	Valentiner[2] (1900)
2403527.262	-598	+44.009	vis	1	Turner, Blagg[1] (1917)
2403995.650	-591	+36.397	vis	1	Valentiner[2] (1900)
2404333.399	-586	+34.146	vis	1	Valentiner[2] (1900)
2404667.087	-581	+27.834	vis	1	Valentiner[2] (1900)
2405072.289	-575	+25.036	vis	1	Valentiner[2] (1900)
2405478.180	-569	+22.927	vis	1	Valentiner[2] (1900)
2405741.661	-565	+14.408	vis	1	Valentiner[2] (1900)
2406009.754	-561	+10.501	vis	1	Valentiner[2] (1900)
2406150.9	-559	+15.6	vis	0.5	Chandler (1877)
2406213.078	-558	+9.825	vis	1	Beljawsky[3] (1910)
2406416.470	-555	+9.217	vis	1	Zinner[4] (1932)
2406829.175	-549	+13.922	vis	1	Zinner[4] (1932)
2408021.035	-531	-18.218	vis	0.5	Turner, Blagg[1] (1917)
2408379.984	-526	+0.731	vis	1	Wilsing (1897)
2408716.424	-521	-2.829	vis	1	Wilsing (1897)

Table 2 (cont.)

J.D.Hel.	E	O-C	Type	Weight	Reference
2409051.145	-516	-8.108 d	vis	0.5	Wilsing (1897)
2409122.246	-515	-5.007	vis	1	Hagen (1891)
2409393.161	-511	-6.092	vis	1	Hagen (1891)
2409457.036	-510	-10.217	vis	1	Turner, Blagg[1] (1917)
2409799.189	-505	-8.064	vis	1	Turner, Blagg[1] (1917)
2409804.214	-505	-3.039	vis	1	Hagen (1891)
2410138.108	-500	-9.145	vis	0.5	Turner, Blagg[1] (1917)
2410888.287	-489	-6.966	vis	1	Hagen (1891)
2412774.986	-461	-24.267	vis	1	Parkhurst (1894)
2412784.9	-461	-14.4	vis	0.5	Hisgen (1896)
2413532	-450	-15	vis	0.5	Hisgen (1896)
2414881	-430	-26	pg	0.5	Hufnagel (1929)
2415768.4	-417	-22.9	pg	0.5	Hufnagel (1929)
2416174.4	-411	-24.9	pg	0.5	Hufnagel (1929)
2416441.9	-407	-29.4	pg	0.5	Hufnagel (1929)
2416648.9	-404	-26.4	pg	0.5	Hufnagel (1929)
2416926.6	-400	-20.7	pg	0.5	Hufnagel (1929)
2417129.9	-397	-21.4	pg	0.5	Hufnagel (1929)
2417472.4	-392	-18.9	pg	0.5	Hufnagel (1929)
2417813	-387	-18	vis	0.5	Sperra (1909)
2417815	-387	-16	pg	0.5	Hufnagel (1929)
2418150.3	-382	-21.0	vis	0.5	Sperra (1913)
2418223.9	-381	-15.4	pg	0.5	Hufnagel (1929)
2418560.0	-376	-19.3	pg	0.5	Hufnagel (1929)
2418832.6	-372	-18.7	pg	0.5	Hufnagel (1929)
2418959.843	-370	-27.310	vis	0.5	Jost (1913)
2419308.4	-365	-18.9	pg	0.5	Hufnagel (1929)
2419648.4	-360	-18.9	pg	0.5	Hufnagel (1929)
2419994.9	-355	-12.4	pg	0.5	Hufnagel (1929)
2420407.5	-349	-7.8	pg	0.5	Hufnagel (1929)
2420407.820	-349	-7.433	vis	1	Doberck (1919)
2420748.4	-344	-6.9	pg	0.5	Hufnagel (1929)
2420750.593	-344	-4.660	vis	1	Doberck (1919)
2421026	-340	-1	pg	0.5	Hufnagel (1929)
2421155.864	-338	-7.389	vis	1	Doberck (1919)
2421427.123	-334	-8.130	vis	1	Leiner (1922)
2421433.731	-334	-1.522	vis	1	Doberck (1919)
2421566.9	-332	-4.4	pg	0.5	Hufnagel (1929)
2421768.038	-329	-7.215	vis	1	Leiner (1922)
2421842	-328	-1	pg	0.5	Hufnagel (1929)
2421842.925	-328	-0.328	vis	1	Doberck (1919)
2422109.848	-324	-5.405	vis	1	Leiner (1922)
2422247.852	-322	-3.401	vis	1	Leiner (1923)
2422447.253	-319	-8.000	vis	1	Leiner (1923)
2422650	-316	-9	pg	0.5	Hufnagel (1929)
2422990.390	-311	-8.863	vis	1	Leiner (1923)
2423257.038	-307	-14.215	vis	1	Leiner (1923)
2423666.163	-301	-13.090	vis	1	Ahnert (1931)
2423736.714	-300	-10.539	vis	1	Beyer (1930)
2423739	-300	-8	pg	0.5	Hufnagel (1929)
2423941.070	-297	-10.183	vis	1	Beyer (1930)
2424071.709	-295	-15.544	vis	1	Ahnert (1931)
2424075.977	-295	-11.276	vis	1	Beyer (1930)
2424279.301	-292	-11.952	vis	1	Beyer (1930)

Table 2 (cont.)

J.D.Hel.	E	O-C	Type	Weight	Reference
2424360	-291	+1[d]	pg	0.5	Hufnagel (1929)
2424414.689	-290	-12.564	vis	1	Beyer (1930)
2424415.584	-290	-11.669	vis	1	Ahnert (1931)
2424683.746	-286	-15.507	vis	1	Beyer (1930)
2424755.467	-285	-11.786	vis	1	Ahnert (1931)
2425092.458	-280	-14.795	vis	1	Beyer (1930)
2425156.608	-279	-18.645	vis	1	Nielsen[5] (1932)
2425159.361	-279	-15.892	vis	1	Ahnert (1931)
2425498.968	-274	-16.285	vis	1	Beyer (1930)
2425701.879	-271	-17.374	vis	1	Beyer (1930)
2425834.996	-269	-20.257	vis	1	Ahnert (1931)
2426170.4	-264	-24.9	vis	0.5	Ahnert (1948)
2426170.73	-264	-24.52	pg	0.5	Nassau, Townson (1932)
2426241.4	-263	-21.9	vis	0.5	Kukarkin (1931)
2426241.782	-263	-21.471	vis	1	Nielsen[5] (1932)
2426244.260	-263	-18.993	vis	1	Terkán (1935)
2426307.9	-262	-23.4	vis	0.5	Ahnert (1948)
2426514.4	-259	-20.9	vis	0.5	Ahnert (1948)
2426580.425	-258	-22.828	vis	1	Nielsen[5] (1932)
2426584.899	-258	-18.354	vis	1	Terkán (1935)
2426654.4	-257	-16.9	vis	0.5	Ahnert (1948)
2426858.3	-254	-17.0	vis	0.5	Ahnert (1948)
2426993.6	-252	-17.7	vis	0.5	Ahnert (1948)
2427331.7	-247	-19.6	pg	0.5	Nassau, Ashbrook (1943)
2427544.802	-244	-10.451	pvis	1	Azhusenis (1956)
2427672.4	-242	-18.9	pg	0.5	Nassau, Ashbrook (1943)
2428017.3	-237	-14.0	pg	0.5	Nassau, Ashbrook (1943)
2428363.673	-232	-7.580	pg	1	Azhusenis (1956)
2428429.9	-231	-9.4	pg	0.5	Nassau, Ashbrook (1943)
2428432.3	-231	-6.9	pg	0.5	Ahnert (1948)
2428633.142	-228	-10.111	pg	1	Azhusenis (1956)
2428703.4	-227	-7.9	pg	0.5	Ahnert (1948)
2428840.4	-225	-6.9	pg	0.5	Ahnert (1948)
2428842.592	-225	-4.661	pg	1	Azhusenis (1956)
2428974.8	-223	-8.5	pg	0.5	Nassau, Ashbrook (1943)
2429114.4	-221	-4.9	pg	0.5	Ahnert (1948)
2429115.985	-221	-3.268	pg	1	Azhusenis (1956)
2429247.4	-219	-7.9	pg	0.5	Ahnert (1948)
2429455.0	-216	-4.3	pg	0.5	Ahnert (1948)
2429522.4	-215	-4.9	pg	0.5	Nassau, Ashbrook (1943)
2429793.9	-211	-5.4	pg	0.5	Ahnert (1948)
2429934.0	-209	-1.3	pg	0.5	Ahnert (1948)
2430135	-206	-4	pg	0.5	Nassau, Ashbrook (1943)
2430205.3	-205	-2.0	pg	0.5	Ahnert (1948)
2430544.9	-200	-2.4	pg	0.5	Ahnert (1948)
2430678.9	-198	-4.4	pg	0.5	Ahnert (1948)
2430819	-196	0	pg	0.5	Ahnert (1948)
2431026.9	-193	+3.6	pg	0.5	Ahnert (1948)
2431291	-189	-4	pg	0.5	Ahnert (1948)
2431635.4	-184	+0.1	pg	0.5	Ahnert (1948)
2431772.4	-182	+1.1	pg	0.5	Ahnert (1948)
2432048.4	-178	+5.1	pg	0.5	Ahnert (1948)
2432178.0	-176	-1.3	pg	0.5	Ahnert (1948)
2432844.0	-166	-15.3	pg	0.5	Wachmann (1966)

Table 2 (cont.)

J.D.Hel.	E	O-C [d]	Type	Weight	Reference
2433523	-156	-16	pg	0.5	Wachmann (1966)
2433928	-150	-19	pg	0.5	Wachmann (1966)
2434204.4	-146	-14.9	pg	0.5	Wachmann (1966)
2434675.4	-139	-19.9	pg	0.5	Wachmann (1966)
2435018.9	-134	-16.4	pg	0.5	Wachmann (1966)
2435155.9	-132	-15.4	pg	0.5	Wachmann (1966)
2435358.7	-129	-16.6	pg	0.5	Wachmann (1966)
2436119.506	-118	-3.747	pg	1	Chuprina (1968)
2436464.413	-113	+1.160	pg	1	Chuprina (1968)
2436808	-108	+5	pg	0.5	Wachmann (1966)
2436811.936	-108	+8.683	pg	1	Chuprina (1968)
2437150	-103	+7	pg	0.5	Wachmann (1966)
2437152.576	-103	+9.323	pg	1	Chuprina (1968)
2437493.422	-98	+10.169	pg	1	Chuprina (1968)
2437906	-92	+15	pg	0.5	Wachmann (1966)
2437906.746	-92	+15.493	pg	1	Chuprina (1968)
2438249.795	-87	+18.542	pg	1	Chuprina (1968)
2438652.244	-81	+12.991	pvis	1	Chuprina (1968)
2439006.9	-76	+26.6	pvis	0.5	Makarenko (1978)
2439345.7	-71	+26.4	pvis	0.5	Makarenko (1978)
2439755.9	-65	+28.6	pvis	0.5	Makarenko (1978)
2440017.349	-61	+18.096	pe	3	Fernie (1970)
2440093.5	-60	+26.2	pvis	0.5	Makarenko (1978)
2440495.4	-54	+20.1	pvis	0.5	Makarenko (1978)
2440906.4	-48	+23.1	pvis	0.5	Makarenko (1978)
2441235.4	-43	+12.1	pvis	0.5	Makarenko (1978)
2441506.6	-39	+11.3	pvis	0.5	Makarenko (1978)
2441906	-33	+3	pvis	0.5	Makarenko (1978)
2442256	-28	+13	pvis	0.5	Makarenko (1978)
2442655.4	-22	+4.1	pvis	0.5	Makarenko (1978)
2442980	-17	-11	pvis	0.5	Makarenko (1978)
2443738.161	-6	-1.092	pe	1	Turner (1980)
2444147.253	0	0.000	pe	3	present paper
2444422.573	+4	+3.320	pe	2	present paper

Remarks: [1] Observer: Baxendell, [2] Obs.: Schönfeld, [3] Obs.: Glasenapp, [4] Obs.: Hartwig, [5] Obs.: Möller Nicolaisen and Pedersen

Table 3

Interval	P [d]
E<-532	67.379
-532<E<-408	67.804
-408<E<-331	68.299
-331<E<-264	67.764
-264<E<-190	68.298
-190<E<-143	67.511
-143<E< -73	68.672
-73<E< -11	67.496
-11<E	68.464

cle length since a new period increase took place at about J.D. 2443000. The value of the instantaneous period is about $68^{d}.5$. The values of the period for the earlier intervals (see Table 3) are essentially the same as determined by Wachmann (1966).

Further observations of S Vul are planned at Konkoly Observatory.

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