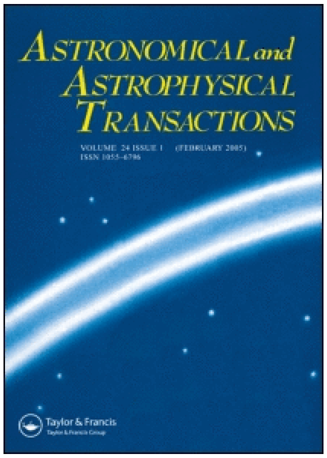

Astronomical & Astrophysical Transactions
The Journal of the Eurasian Astronomical Society
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713453505

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Online Publication Date: 01 January 1993
To cite this Article: Kurochkin, N. E. (1993) 'A new type of cataclysmic variability: FG serpentis and QW sagittae', Astronomical & Astrophysical Transactions, 3:4, 295 - 301
To link to this article: DOI: 10.1080/10556799308230567
URL: http://dx.doi.org/10.1080/10556799308230567

Astronomical and Astrophysical Transactions, 1993,
Vol. 3, pp. 295–301
Reprints available directly from the publisher.

A NEW TYPE OF CATACLYSMIC VARIABILITY: FG SERPENTIS AND QW SAGITTAE

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(16 July 1992)

FG Ser—a cataclysmic variable of a new type—has been studied using 250 plates obtained in 1949–1987 from Sternberg Astronomical Institute collection. The brightness increase by 3^{m} was observed in mid-1988 (Munari, 1988). Regular brightness variations in the range $B = 13^{m}–14^{m}.5$ prior to an outburst can be represented by the following elements: Min I = = JD 2 446 590.9 + 630^{d} E; Minimum II, with the magnitude $13^{m}.5$, is observed at the phase $0^{P}.45$. The light curve (Figure 1) is interpreted as resulting from reflection in the double system M 5 III + white dwarf at X-ray regime. The period of 630 days is, probably the orbital one.

QW Sge is a similar system with a red giant; it was considered as a symbiotic one. The star was detected on 464 plates in the interval 1898–1990. The brightness variations (Figure 3) are characterized by nova-like outbursts lasting for more than 3000 days. The brightness increases during several tens of days, as for slow novae, and reaches the magnitude $11^{m}.5$. At minimum, the brightness is nearly constant with weak variations in the range $12^{m}.9–13^{m}.2$. The periods of constant brightness are also about 3000 days long. At minimum, the giant star contributes mainly to the brightness of the system, and the brightness of the secondary component declines below the level of the primary state. This allows us to suggest that the outbursts are due to an accreting white dwarf.

We suggest to regard the symbiotic stars consisting of a red giant and a collapsed object, with the orbital periods of tens or hundreds days, with outbursts and other phenomena characteristic of cataclysmic variables, as representatives of a new type of cataclysmic variability. Observations are reported in Tables 1, 2.

KEY WORDS Cataclysmic variability, FG Ser, QW Sge.

The variability of FG Ser was discovered by Hoffmeister (1968). The star was poorly studied and was considered to be symbiotic. In June 1988 Munari (1988) has found it brightened to the magnitude $\sim 10^{m}$, or about 3^{m} brighter than the usual level of $13^{m}.0–14^{m}.5$. Changes in the emission spectrum and enhanced ultraviolet emission have been observed, which was connected with an increase of the temperature of the white dwarf (or of a spot on its surface) from 100,000° to 150,000°. The spectrum of the secondary component M 5 III did not change considerably (Munari *et al.*, 1989; Gutierrez *et al.*, 1990). The observations were not regular and the behavior of the star during the outburst was poorly studied.

We examined 240 plates from the Sternberg Institute archive obtained in 1976–1987 and 11 separate plates dating to 1949–1973 to recover the photometric history of FG Ser.

Light variations in the quiescent state (before the outburst) were periodic in the range $13^{m}.0–14^{m}.6$ B (with the mean values $13^{m}.2–14^{m}.4$) with possible fluctuations. The cyclic oscillations are represented by the following elements: Min I = JD 2 446 590.9 + $630^{d}(\pm 3)$E. The secondary minimum has the depth of $0^{m}.5$ (up to

Table 1 FG Ser

JD 24 . . . (n)		JD 2443 . . . (n)		JD 2443 . . . (n)		JD 2445 . . . (n)	
33129.0	$13^{m}.15$	036.25(2)	$13^{m}.14$	694.40	$13^{m}.66$	114.46	$13^{m}.55$
35362.30	$13^{m}.60$	039.25	$13^{m}.06$	696.32	$13^{m}.57$	137.43	$13^{m}.60$
36836.34	$13^{m}.08$	046.27	$13^{m}.08$	699.34	$13^{m}.3$::	144.41	$13^{m}.40$
838.27	$13^{m}.28$	190.60	$13^{m}.24$	700.32	$13^{m}.65$	167.36	$13^{m}.52$
862.19	$13^{m}.10$	195.61(2)	$13^{m}.16$	702.39	$13^{m}.53$	171.39	$13^{m}.67$
37112.44	$14^{m}.55$	196.58	$13^{m}.30$	717.30	$13^{m}.60$	203.30	$13^{m}.66$
848.45	$13^{m}.78$	197.62	$13^{m}.22$	718.35	$13^{m}.50$	228.24	$13^{m}.87$
853.45	$13^{m}.80$	198.58(2)	$13^{m}.14$	726.32	$13^{m}.60$	230.24	$13^{m}.88$
41914.33	$13^{m}.68$	199.60(2)	$13^{m}.20$	728.30	$13^{m}.40$	232.24	$14^{m}.05$
915.30	$13^{m}.18$:	243.44	$13^{m}.48$	729.30	$13^{m}.45$	842.39	$13^{m}.73$
920.32	$13^{m}.22$:	249.55	$13^{m}.50$	731.33	$13^{m}.7$:	875.44	$13^{m}.88$
42812.65	$14^{m}.25$	253.52	$13^{m}.50$	757.26	$13^{m}.30$	915.33	$14^{m}.28$
867.54	$14^{m}.30$	254.52	$13^{m}.52$	759.26	$13^{m}.15$	941.31	$14^{m}.63$!
868.54(3)	$14^{m}.24$	258.52	$13^{m}.60$	804.20	$13^{m}.40$	2446 . . .	
869.54(2)	$14^{m}.18$	261.51(2)	$13^{m}.71$	933.61	$13^{m}.70$	344.24	$13^{m}.08$
870.51(3)	$14^{m}.13$	262.53	$13^{m}.62$	938.57(2)	$13^{m}.83$	591.46	$14^{m}.32$
871.54(4)	$14^{m}.24$	272.40(2)	$13^{m}.74$	987.55	$13^{m}.90$	596.48	$14^{m}.32$
872.52(3)	$14^{m}.21$	277.52	$13^{m}.78$	2444 . . .		612.42	$14^{m}.29$
873.57	$14^{m}.25$	279.47(2)	$13^{m}.75$	012.48	$14^{m}.20$	613.43	$14^{m}.26$
874.55(2)	$14^{m}.12$	282.47(2)	$13^{m}.75$	021.43	$14^{m}.28$	616.40	$14^{m}.34$
875.55(2)	$14^{m}.02$	283.33(2)	$13^{m}.79$	023.46	$14^{m}.28$	617.34	$14^{m}.27$
876.53(3)	$14^{m}.01$	284.47(2)	$13^{m}.74$	025.43	$14^{m}.32$	618.46	$14^{m}.30$
890.51	$13^{m}.85$	285.49	$13^{m}.80$	027.45	$14^{m}.27$	619.41	$14^{m}.28$
891.53	$13^{m}.9$::	287.43	$13^{m}.82$	040.36	$14^{m}.29$	623.46	$14^{m}.45$
892.54	$14^{m}.0$:	289.38(2)	$13^{m}.73$	043.43	$14^{m}.68$:	624.43	$14^{m}.28$
894.52	$13^{m}.75$	304.49	$13^{m}.72$	050.41	$14^{m}.27$	646.40	$14^{m}.10$
897.53	$13^{m}.80$	332.36	$13^{m}.90$	072.39	$14^{m}.53$	653.41	$13^{m}.95$
901.52	$13^{m}.74$	346.32	$13^{m}.84$	077.36	$14^{m}.53$	672.3:	$14^{m}.0$:
902.51	$13^{m}.72$	348.49	$13^{m}.90$	087.41	$14^{m}.50$	677.28	$13^{m}.80$
921.52	$14^{m}.0$::	349.37	$13^{m}.86$	102.27	$14^{m}.26$	934.42	$13^{m}.10$
922.49	$13^{m}.78$	370.31	$14^{m}.25$	105.28	$14^{m}.33$	971.39(2)	$13^{m}.08$
924.50	$13^{m}.78$	374.30	$14^{m}.22$	106.32	$14^{m}.30$	972.40(2)	$13^{m}.2$:
925.42(4)	$13^{m}.76$	390.26	$14^{m}.23$	107.29	$14^{m}.25$	973.39(2)	$13^{m}.15$:
926.50	$13^{m}.85$	391.28	$14^{m}.15$	110.30	$14^{m}.25$	974.41(2)	$13^{m}.14$
927.41	$13^{m}.75$	394.29	$14^{m}.42$	111.30	$14^{m}.27$	975.32	$12^{m}.96$!
928.48	$13^{m}.66$	395.26	$14^{m}.28$	112.30	$14^{m}.28$	975.48	$13^{m}.12$
929.44	$13^{m}.82$	399.26	$14^{m}.25$	113.30	$14^{m}.28$	976.40	$13^{m}.4$:
930.45(2)	$13^{m}.80$	400.25	$14^{m}.36$	131.30	$14^{m}.20$	977.46	$13^{m}.08$
933.45	$13^{m}.75$	417.21	$14^{m}.27$	397.42	$13^{m}.60$	978.31	$13^{m}.28$
934.38	$13^{m}.80$	418.21	$14^{m}.30$	410.36	13.64	979.40	$13^{m}.20$
949.33	$13^{m}.70$	420.25	$14^{m}.53$	428.35	$13^{m}.45$:	979.46	$13^{m}.35$:
951.36	$13^{m}.60$	422.20	$14^{m}.40$	455.30	$13^{m}.26$		
954.32	$13^{m}.75$	423.22	$14^{m}.36$	489.27	$13^{m}.25$		
954.50(2)	$13^{m}.73$	424.22	$14^{m}.33$	491.26	$13^{m}.50$		
957.37(3)	$13^{m}.67$	425.24	$14^{m}.45$	494.25	$13^{m}.57$		
957.47(3)	$13^{m}.64$	426.23	$14^{m}.40$	732.52	$14^{m}.40$		
961.41(2)	$13^{m}.61$	427.28	$14^{m}.35$	758.49	$14^{m}.28$		
963.42(2)	$13^{m}.62$	428.21	$14^{m}.50$:	761.48	$14^{m}.19$		
983.34	$13^{m}.58$	429.21	$14^{m}.5$::	782.33	$14^{m}.25$		
984.47	$13^{m}.60$	659.47	$13^{m}.3$::	789.39	$14^{m}.25$		
989.36(2)	$13^{m}.42$	663.41	$13^{m}.4$:	811.41	$14^{m}.15$		
992.36	$13^{m}.40$	668.48	$13^{m}.40$	815.38	$14^{m}.20$		
43015.39	$13^{m}.28$	672.36	$13^{m}.65$	839.27	$13^{m}.90$		
016.34	$13^{m}.20$	685.34	$13^{m}.25$:	847.28	$14^{m}.00$		
034.23	$13^{m}.30$	687.41	$13^{m}.40$	850.28	$14^{m}.10$		
035.24	$13^{m}.18$	692.39	$13^{m}.67$				

Table 2 QW Sge

14578.26	$12^{m}.70$	2438 . . .		2439 . . .		2440 . . .	
909.375	$12^{m}.65$	669.22	$12^{m}.03$	706.41	12·33	502.26	$12^{m}.62$
15250.32	$13^{m}.25$:	673.30	$12^{m}.22$	707.30	$12^{m}.28$	509.24	$12^{m}.30$
614.34	$12^{m}.25$	673.34	$12^{m}.25$	707.34	$12^{m}.24$:	510.28	$12^{m}.40$
18566.30	$13^{m}.1$::	697.22	$12^{m}.05$	708.35	$12^{m}.35$	511.26	$12^{m}.43$
597.22	$13^{m}.04$:	698.22	$11^{m}.90$	711.38	$12^{m}.28$	512.31	$12^{m}.23$
888.44	$12^{m}.95$:	699.25	$12^{m}.06$	712.34	$12^{m}.25$	744.49	$12^{m}.56$
946.26	$13^{m}.05$	703.22	$11^{m}.98$	714.34	$12^{m}.25$	744.51	$12^{m}.52$
19251.40	$12^{m}.96$	880.52	$12^{m}.37$	716.43	$12^{m}.30$	747.51	$12^{m}.66$
21484.33	$13^{m}.4$::	886.50	$12^{m}.27$	730.31	$12^{m}.30$	775.46	$12^{m}.74$
28045.375	$12^{m}.84$	905.46	$11^{m}.95$	743.43	$12^{m}.28$	779.37	$12^{m}.65$
751.40	$13^{m}.05$	909.43	$12^{m}.08$	745.40	$12^{m}.33$	783.48	$12^{m}.72$
757.33	$12^{m}.94$	910.40	$11^{m}.93$	746.41	$12^{m}.07$	799.50	$12^{m}.70$
759.43	$13^{m}.3$::	913.48	$12^{m}.30$	764.35	$12^{m}.27$	800.52	$12^{m}.69$
776.34	$13^{m}.05$:	916.42	$12^{m}.26$	765.26	$12^{m}.28$	801.42	$12^{m}.64$
779.31	$13^{m}.2$::	942.42	$12^{m}.15$	765.35	$12^{m}.31$	802.46	$12^{m}.76$
786.31	$13^{m}.10$	946.40	$12^{m}.15$	767.26	$12^{m}.32$	806.42	$12^{m}.70$
789.33	$13^{m}.2$::	951.50	$11^{m}.80$	767.30	$12^{m}.37$	808.33	$12^{m}.70$
29188.19	$13^{m}.05$	964.44	$12^{m}.18$	767.35	$12^{m}.25$	809.54	$12^{m}.71$
962.145	$13^{m}.12$:	968.46	$12^{m}.16$	769.30	$12^{m}.29$	810.38	$12^{m}.66$
30607.25	13·15	970.52	$12^{m}.26$	770.24	$12^{m}.10$	812.54	$12^{m}.68$
617.26	$13^{m}.40$	972.46	$12^{m}.20$	770.28	$11^{m}.98$	819.27	$12^{m}.70$
34281.27	$13^{m}.07$	974.48	$12^{m}.06$	770.33	$12^{m}.30$	822.34	$12^{m}.6$:
623.33	$13^{m}.10$	977.47	$12^{m}.25$	770.37	$12^{m}.4$	823.44	12.74
628.31	$13^{m}.2$::	979.50	$12^{m}.06$	772.29	$12^{m}.25$:	827.41	12.78
683.18	$13^{m}.10$	980.49	$12^{m}.25$	968.53	$12^{m}.17$:	828.46	12.72
37136.50	$12^{m}.94$	999.43	$12^{m}.30$	968.55	$12^{m}.35$	2441 . . .	
159.30	$12^{m}.97$	2439 . . .		974.54	$12^{m}.40$	161.54	12.3:
160.36	$13^{m}.00$	236.54	$12^{m}.26$	999.41	$12^{m}.30$	177.45	12.70
163.36	$13^{m}.04$	237.55	$12^{m}.20$	2440 . . .		417.55	13.04
164.38	$13^{m}.07$	269.51	$12^{m}.16$	007.42	$12^{m}.28$	427.55	13.00
165.41	$13^{m}.06$	292.48	$12^{m}.28$	033.48	$12^{m}.05$	452.52	13.05:
166.36	$12^{m}.98$	294.41	$12^{m}.26$	036.46	$12^{m}.23$	454.50	12.97
168.42	$13^{m}.07$	301.44	$12^{m}.26$	037.43	$12^{m}.23$	475.47	13.07
175.37	$13^{m}.12$	323.50	$12^{m}.2$:	071.40	$12^{m}.10$:	482.51	13.28
176.38	$13^{m}.07$	329.50	$12^{m}.30$	072.46	$12^{m}.20$	486.48	$13^{m}.04$
194.36	$13^{m}.05$	334.51	$12^{m}.18$	086.30	$12^{m}.10$	492.54	$13^{m}.08$
196.30	$13^{m}.10$	344.30	$12^{m}.25$	093.46	$12^{m}.05$	508.35	$13^{m}.14$
220.22	$13^{m}.06$	346.30	$12^{m}.26$	094.42	$12^{m}.17$	510.49	$13^{m}.00$
223.21	$13^{m}.05$	379.32	$12^{m}.25$	095.32	$12^{m}.20$	513.49	$13^{m}.09$
527.54	$13^{m}.0$:	382.30	$12^{m}.30$	097.50	$12^{m}.15$	514.50	$13^{m}.12$
546.40	$12^{m}.91$	383.45	$12^{m}.30$	098.36	$12^{m}.08$	518.50	$13^{m}.14$
576.32	$12^{m}.94$	384.31	$12^{m}.40$	117.42	$12^{m}.43$	522.52	$13^{m}.12$
578.31	$12^{m}.98$	385.29	$12^{m}.30$	118.27	$12^{m}.15$	530.29	$13^{m}.09$
843.49	$13^{m}.17$	385.38	$12^{m}.30$	119.27	$12^{m}.15$	532.28	$13^{m}.06$:
876.52	$12^{m}.30$	387.35	$12^{m}.30$	122.29	$12^{m}.50$	536.52	$13^{m}.10$
877.46	$12^{m}.30$	387.40	$12^{m}.35$	123.28	$12^{m}.38$	546.43	$13^{m}.08$
885.47	$12^{m}.07$	391.38	$12^{m}.32$	125.31	$12^{m}.40$	548.42	$13^{m}.15$
887.48	$11^{m}.97$	406.30	$12^{m}.43$	153.20	$12^{m}.38$	564.32	$13^{m}.10$
902.34	$11^{m}.95$	646.50	$12^{m}.20$	157.36	$12^{m}.36$	565.33	$13^{m}.08$
38144.50	$11^{m}.60$	647.48	$12^{m}.30$	386.51	$12^{m}.46$	566.32	$13^{m}.10$
227.40	$12^{m}.16$	652.47	$12^{m}.16$	387.50	$12^{m}.30$	567.34	$13^{m}.17$
261.46	$11^{m}.55$	655.49	$12^{m}.26$	420.52	$12^{m}.38$	568.31	$13^{m}.15$
268.43	$11^{m}.52$	677.48	$12^{m}.30$	421.52	$12^{m}.4$:	569.31	$13^{m}.15$
281.31	$11^{m}.80$	678.46	$12^{m}.05$	425.46	$12^{m}.30$	570.31	$13^{m}.08$
282.27	$11^{m}.60$	681.47	$12^{m}.28$	426.40	$12^{m}.48$	571.34	$13^{m}.14$:
554.49	$11^{m}.95$	684.50	$12^{m}.15$	427.48	$12^{m}.35$	573.32	$13^{m}.08$
561.41	$12^{m}.17$	686.47	$12^{m}.33$	428.46	$12^{m}.44$	575.35	$13^{m}.08$
623.46	$11^{m}.87$	689.47	$12^{m}.28$	473.34	$12^{m}.40$	576.28	$13^{m}.10$
668.35	$12^{m}.06$	704.33	$12^{m}.30$	475.32	$12^{m}.37$	577.39	$13^{m}.12$

Table 2 (continued)

2441 . . .		2442 . . .		2444 . . .		2445 . . .	
594.26	$13^{m}.12$	661.33	$13^{m}.09$	000.46	$13^{m}.40$	492.48	$12^{m}.09$
595.27	$13^{m}.08$	662.30	$13^{m}.06$	020.50	$13^{m}.38$	496.50	$12^{m}.20$
596.26	$13^{m}.10$	665.28	$13^{m}.08$	028.50	$13^{m}.27$	504.51	$12^{m}.26$
597.29	$13^{m}.16$	667.29	$13^{m}.06$	040.40	$13^{m}.10$	522.50	$12^{m}.08$
598.30	$13^{m}.13$	668.37	$13^{m}.08$	046.43	$13^{m}.20$	523.47	$12^{m}.06$
803.54	$13^{m}.14$	684.32	$13^{m}.07$	072.42	$13^{m}.13$	524.40	$12^{m}.10$
813.52	$13^{m}.12$	744.17	$13^{m}.09$	076.51	$13^{m}.20$	524.42	$12^{m}.18$
837.46	$13^{m}.07$	747.16	$13^{m}.08$	099.35	$13^{m}.1:$	524.44	$12^{m}.22$
838.52	$13^{m}.12$	749.17	$13^{m}.07$	104.36	$13^{m}.10$	525.44	$12^{m}.14$
839.50	$13^{m}.14$	869.58	$13^{m}.08$	111.38	$13^{m}.08$	526.37	$12^{m}.28$
842.50	$13^{m}.07$	930.43	$13^{m}.08$	117.43	$13^{m}.08$	526.44	$12^{m}.20$
860.47	$13^{m}.13$	960.45	$13^{m}.06$	130.34	$13^{m}.05$	526.45	$12^{m}.10$
864.49	$13^{m}.08$	961.39	$13^{m}.05$	134.31	$13^{m}.09$	526.45	$12^{m}.15$
865.52	$13^{m}.12$	965.48	$13^{m}.08$	136.38	$12^{m}.12$	526.52	$12^{m}.08$
869.49	$13^{m}.08$	2443 . . .		159.31	$13^{m}.1::$	528.51	$12^{m}.07$
873.51	$13^{m}.07$	039.28	$13^{m}.07$	164.20	$13^{m}.12$	535.44	$12^{m}.06$
875.52	$13^{m}.10$	945.36	$13^{m}.12$	186.26	$13^{m}.08$	535.46	$12^{m}.08$
887.41	$13^{m}.08$	047.33	$13^{m}.09$	194.27	$13^{m}.07$	535.47	$12^{m}.10$
892.45	$13^{m}.05$	063.22	$13^{m}.07$	399.45	$13^{m}.10$	535.49	$12^{m}.25$
901.46	$13^{m}.02$	064.23	$13^{m}.09$	408.45	$13^{m}.10$	558.42	$12^{m}.23$
902.52	$13^{m}.05$	069.25	$13^{m}.07$	413.46	$13^{m}.08$	846.52	$12^{m}.32$
916.38	$13^{m}.08$	072.23	$13^{m}.08$	433.46	$13^{m}.11$	859.44	$12^{m}.35$
918.44	13·06	198.62	$13^{m}.08$	442.35	$13^{m}.10$	2446 . . .	
922.45	$13^{m}.08$	232.54	$13^{m}.1:$	457.38	$13^{m}.13$	707.27	$12^{m}.80$
924.42	$13^{m}.07$	303.44	$13^{m}.1:$	483.33	$13^{m}.07$	937.52	$12^{m}.50$
928.40	$13^{m}.05:$	312.51	$13^{m}.08$	489.36	$13^{m}.25$	943.52	$12^{m}.60$
931.45	$13^{m}.11$	321.45	$13^{m}.08$	493.34	$13^{m}.07$	971.45	$12^{m}.35$
974.31	$13^{m}.08$	344.36	$13^{m}.10$	494.32	$13^{m}.08$	973.35	$12^{m}.38$
2442 . . .		347.32	$13^{m}.08$	521.25	$13^{m}.05$	973.49	$12^{m}.50$
211.42	$13^{m}.08$	350.51	$13^{m}.1::$	705.54	$13^{m}.12$	974.39	$12^{m}.40$
216.50	$13^{m}.06$	365.32	$13^{m}.10$	759.50	$13^{m}.08$	975.47	$12^{m}.40$
218.50	$13^{m}.09$	369.30	$13^{m}.05$	763.49	$13^{m}.04$	975.36	$12^{m}.30$
221.41	$13^{m}.11$	389.27	$13^{m}.07$	764.46	$13^{m}.05$	977.50	$12^{m}.35$
252.53	$13^{m}.0::$	390.30	$13^{m}.04$	765.44	$13^{m}.03$	978.50	$12^{m}.40$
254.48	$13^{m}.00$	393.28	$13^{m}.12$	785.45	$13^{m}.07$	979.44	$12^{m}.42$
257.50	$13^{m}.17$	399.30	$13^{m}.08$	795.46	$13^{m}.07$	979.49	$12^{m}.50$
300.37	$13^{m}.3:$	418.24	$13^{m}.05$	811.45	$13^{m}.10$	2447 . . .	
507.57	$13^{m}.08$	423.26	$13^{m}.04$	819.40	$13^{m}.12$	013.35	$12^{m}.07$
539.54	$13^{m}.12$	430.31	$13^{m}.06$	824.51	$13^{m}.08$	026.48	$12^{m}.30$
542.51	$13^{m}.17$	667.50	$13^{m}.27$	838.39	$13^{m}.12$	027.36	$12^{m}.05:$
546.50	$13^{m}.10$	672.40	$13^{m}.08$	845.27	$13^{m}.08$	035.39	$12^{m}.45$
551.49	$13^{m}.12$	687.45	$13^{m}.09$	848.30	$13^{m}.10$	042.44	$12^{m}.30$
567.42	$13^{m}.07$	693.43	$13^{m}.12$	851.27	$13^{m}.08$	055.35	$12^{m}.42$
577.52	$13^{m}.11$	700.42	$13^{m}.10$	873.32	$13^{m}.10$	061.32	$12^{m}.45$
579.49	$13^{m}.08$	722.40	$12^{m}.9::$	899.20	$13^{m}.02$	310.51	$12^{m}.90$
597.45	$13^{m}.10$	729.43	$13^{m}.0::$	905.26	$13^{m}.07$	324.51	$13^{m}.00$
599.48	$13^{m}.06$	745.33	$13^{m}.20$	906.24	$13^{m}.06$	358.51	$12^{m}.9:$
601.44	$13^{m}.11$	747.39	$13^{m}.28$	2445 . . .		367.47	$12^{m}.76$
605.42	$13^{m}.08$	751.39	$13^{m}.10$	057.56	$12^{m}.91$	379.42	$12^{m}.84$
607.46	$13^{m}.12$	779.32	$13^{m}.07$	116.47	$13^{m}.06$	383.51	$12^{m}.73$
625.40	$13^{m}.03$	784.30	$13^{m}.12$	144.48	$12^{m}.97$	407.33	$13^{m}.06$
626.52	$13^{m}.07$	785.32	$13^{m}.08$	164.40	$13^{m}.00$	420.27	$12^{m}.94$
630.53	$13^{m}.10$	800.18	$13^{m}.08$	169.47	$12^{m}.98$	681.50	$12^{m}.90$
637.35	$13^{m}.03$	815.26	$13^{m}.12$	173.46	$13^{m}.03$	818.23	$13^{m}.00$
642.49	$13^{m}.07$	866.16	$13^{m}.16$	192.34	$13^{m}.07$	825.19	$12^{m}.91$
654.27	$13^{m}.06$	938.61	$13^{m}.16$	199.41	$13^{m}.04$	2448 . . .	
658.39	$13^{m}.08$			227.25	$13^{m}.08$	091.48	$13^{m}.10$
659.34	$13^{m}.23$			256.31	$13^{m}.10$		

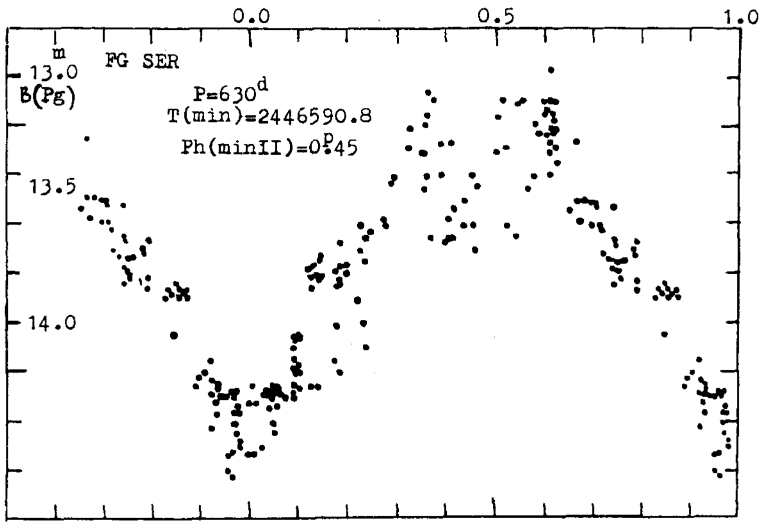

Figure 1 The composite light curve of FG Ser with the period of 630 days according to photographic observations of 1949–1987.

13^{m}.5) and occurs at the phase of 0^{P}.45. The light curve (Figure 1) has a symmetric shape at the minima, but the location of the minima is asymmetric. There are the signs of eclipses at the minima. The shape of the light curve is similar to that of HZ Her, with the reflection effect, but with a deeper secondary minimum.

Unlike HZ Her, which consists of a normal star and a neutron one, FG Ser consists of the giant star M 5 III and a white dwarf. Assuming mean parameters for the M star (the mass 6 $m_\odot$ and $T \sim 3000$°K) and for the white dwarf (0.6 $m_\odot$ and $T_e \sim 100\,000°)^e$ we obtain a crude model of the system with $P = 630$ days, the major semiaxis of the circular orbit $A = 405 \cdot 10^6$ km, the radius of the M star $134 \cdot 10^6$ km (basing the data for the duration of the eclipses at the minima). The model of the system is shown in Figure 2. The position of the Roche lobe is indicated. The M star is close to the Roche lobe and probably fills it, as the accepted parameters for the stars are approximate. The temperature of the cold

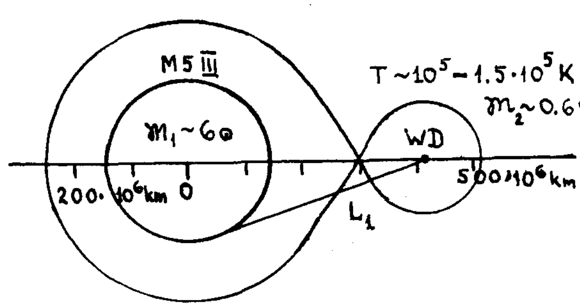

Figure 2 A model of FG Ser. For the comparative sizes of the giant M 5 III and the Roche lobe with q = 10, see tables of Plavec and Kratochvil (1964).

and hot sides of the M giant should be 3000° and 4100° (for the amplitude of $1^m.5$), but the spot can be smaller if the temperature is higher. We suggest that the heating of the one side of the giant is due to the X-ray emission of the white dwarf in accreting stage, with the luminosity of about 10^{37} erg/s. However, the X-ray emission has not been detected, probably because the emission is confined to some direction. The suggested interpretation for the light curve of FG Ser should be considered as preliminary. But, undoubtedly, FG Ser can be regarded as an unusual variable of cataclysmic type, with a reflection effect and eclipses in the quiescent state.

QW Sge = AS 360 = MH 80-5 is another symbiotic star with signs of cataclysmic variability. Brightness variations were discovered by Hoffmeister (1964): the star was bright (about 12^m) in September–October 1963. According to our data, at that time a long outburst up to B magnitude $11^m.5$ was taking place. A symbiotic spectrum of a late M 6e star with H emission was noticed by many observers (Esipov *et al.*, 1986: during outburst in September 1982; Bidelman, 1954; Merrill *et al.*, 1950).

QW Sge was detected on 464 plates from the Sternberg Institute collection, obtained during JD 2 414 578-48 092 (among them, 438 plates in the interval JD 2 437 118-48 929). The comparison stars are marked on the map shown in Figure 4.

The light curve of QW Sge (Figure 3–4) is characterized by two active nova-like outbursts. The rise and decline of brightness are slow and take about 3000 days. After these outbursts, the brightness of the star is relatively constant, with magnitude in the range $12^m.9$–$13^m.2$. However, we suppose that brightness of the flare component continued to decline at that time, being below the level of the primary. During the first observed flare at JD 2 437 876-41 400, the brightness increased from $13^m.17$ to $11^m.95$ in the period JD 2 437 843-37 902, as for a slow nova. The maximum magnitude of $11^m.5$ was achieved about JD 2 438 261-268 but, perhaps, the star was even brighter during the intervals not covered by observations. A slow light decline with strong fluctuations was observed during 3000 days, until JD 2 441 400. Then, between JD 2 441 417-45 000, the brightness was nearly constant at $13^m.05$–$13^m.3$; but it declined by $0^m.1$–$0^m.2$ occasionally (during JD 2 444 000-44 029). The variable component at that time is apparently significantly fainter than the M giant.

The second active period was observed at JD 2 445 492-47 387, when the brightness reached $12^m.0$ during local maxima at JD 2 445 523-535 and 47 013-027.

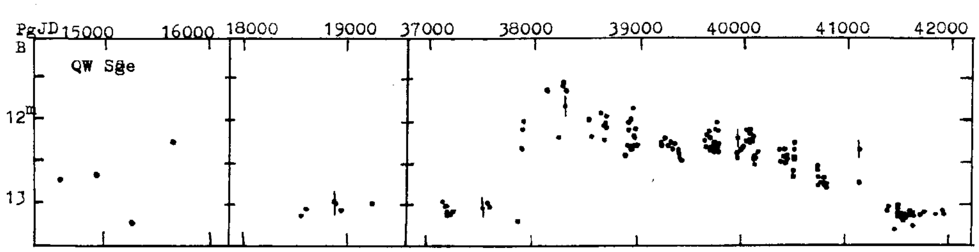

Figure 3 The photographic light curve of QW Ser (1960–1990).

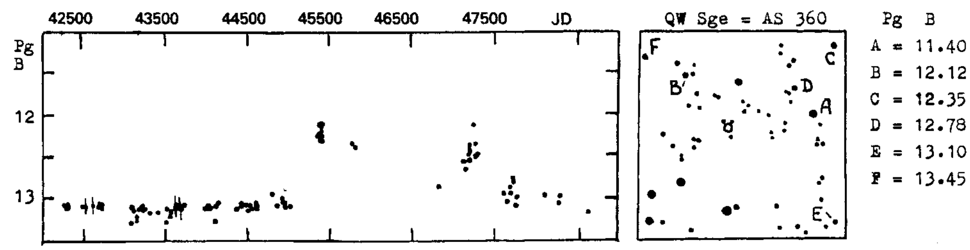

Figure 3–4 The map with comparison stars for QW Sge.

The light variations resemble the outbursts of GK Per-type cataclysmic stars. The star likely belongs to a new type of cataclysmic variables.

Red giants in double systems with a white dwarf or a neutron star probably represent a special group of cataclysmic stars. Their behavior is distinguished by considerable diversity, as for other cataclysmic variables, and this is due to the same reason, namely unsteady disk accretion on the collapsed object. Many nova-like and symbiotic stars can also be related to this type with, MWC 560, HM Sge, V 1027 Cyg and others among them. Some of them, like MWC 560 and HM Sge, have stages of high and low brightness. The behavior of the stars discussed above is distinguished by nova-like outbursts. The behavior of symbiotic stars is complicated by the effects typical of cataclysmic variables which are connected with the ejection of the red giant envelope and temporary filling of Roche lobe with flow of matter into the accretion disk near the collapsed object. The stars of this type have a long orbital period of tens or hundreds of days, while for cataclysmic variables the periods are shorter than one day. Optical manifestations of the cataclysmic nature of these systems can be accompanied by reflection effects, physical variability and pulsation of the giant star or by a spot activity. These factors result in the observed variety of the types of variability for symbiotic stars, which should also be regarded as cataclysmic ones.

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