A CATALOGUE OF CORRELATIONS BETWEEN ECLIPSING AND OTHER CATEGORIES OF DOUBLE STARS

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Abstract

Among the 9110 stars in *The Bright Star Catalogue*, there are 225 eclipsing or ellipsoidal variables. A search has been made for these in catalogues of spectroscopic binaries, visual double or multiple stars, speckle interferometry, occultation binaries, and galactic clusters. The majority of the photometric binaries are also members of groups of higher multiplicity. The variables are in systems ranging from one to 91 stars, five on the average. 199 are either spectroscopic binaries (SB) or stars with variable radial velocity, with orbital periods known for 160. Photometric periods are lacking for 48 while SB periods are available for 23 of these. Observers with photoelectric equipment are encouraged to plan observations to test if the SB periods are consistent with photometric data. Observers are likewise encouraged to examine those stars for which the photometric and SB periods appear to be inconsistent. Parallaxes are available for 86 of the stars, 41 of them indicating distances nearer than 50 parsecs.

1. Introduction

The current version of *The Bright Star Catalogue* (Warren and Hoffleit 1995) contains 225 variable or suspected variables of the eclipsing or ellipsoidal types (Table 1). This indicates that approximately one in every forty naked eye stars has an unresolved companion in an orbit with sufficiently small inclination to the line of sight to reveal eclipses. The ellipsoidal are here lumped with the clearly eclipsing because the same stars are sometimes classified as eclipsing in some references but ellipsoidal in others. Besides the familiar designations E, EA, EB, EW, and Ell in the *General Catalogue of Variable Stars* (GCVS) (Kholopov *et al.* 1985), other less frequent designations are RS (stars such as the eclipsing RS CVn, showing effects of both orbital motion and the rotation of a spotted component), KE (contact binaries), FK Com (rapidly rotating stars with non-uniform surfaces, possibly related to W UMa types), VV Cep (eclipsing binaries of which one component is an intrinsic variable), and WR (binary of which one component is a Wolf Rayet star). All the stars in Table 1 have been searched in various catalogues of visual double stars, spectroscopic binaries, speckle interferometry and occultation binaries, and for membership in star clusters, as well as in the current *Catalogue of Trigonometric Parallaxes* (van Altena *et al.* 1995).

The successive columns in Table 1 contain:

1. HR numbers, the numbers in *The Bright Star Catalogue*.
2. Variable star designations, including NSV numbers, and in a few instances, just "Var" if the star has not yet received a variable star designation.
3. An asterisk (*) indicating a Remark following the Table. (All cluster memberships are indicated only in the Remarks.)

4. The type of variability, generally taken from the GCVS. An asterisk following the type refers to the extensive discussions of these stars in Strassmeier *et al.* (1989).

5. Approximate photometric period.

6. Spectroscopic binary period (rounded), or designations SB or VarRV in cases where no period is known. The variable radial velocity stars may or may not turn out to be SB.

7. Separation of components determined from speckle interferometry and from occultations (marked "Occ").

8. Separation and component designations of visual double or multiple stars, any one of whose components may be the eclipsing or ellipsoidal variable.

9. Trigonometric (van Altena *et al.* 1995) or dynamical parallaxes (Russell and Moore 1940).

10. The photometric amplitude (V unless otherwise specified). These data are put in the final column to enable observers more quickly to spot which stars they may be able to observe. All but 35 have amplitudes under half a magnitude and 81 under 0.10 magnitude V. Photoelectric or CCD observations are required for updating the vast majority. At the other extreme, seven of the stars have amplitudes in excess of a whole magnitude. All but one of these are well observed: the southern star HR 3133 = NSV 3841, 5.2–7.2 photographic, needs confirmation (Deutsch 1970).

2. Numbers in various categories

Table 2 gives the numbers of the variable stars in Table 1 that are also members of the other types of double or multiple systems, and those with known parallaxes. Of the 199 stars under the heading SB, 21 are stars with variable radial velocity. Orbital periods are available for 160. It is of especial interest to note those stars which have also been identified as spectroscopic binary systems and for which both photometric and SB periods have been determined (138 stars). In most instances the photometric and spectroscopic binary periods are approximately the same. In eight cases they differ by a factor of two (HR 3, 14, 215, 1221, 1970, 4430, 6626, and 8575). Here alternate minima are presumably of nearly equal depths: more precise measurements might reveal small systematic differences. In twelve other instances the periods differ by less obvious relations, indicating either spurious periods or unrelated components of multiple systems, or (e.g., HR 4527) changing photometric periods. All these discordant cases are called to the attention of variable star observers with photoelectric equipment, as all have photometric amplitudes under a few tenths of a magnitude. Those with an asterisk after the type in Table 1 (26 stars) are chromospherically active stars discussed by Strassmeier *et al.* (1989), all but seven of them indicating star-spot activity.

Forty-eight of the stars in Table 1 do not have photometric periods. Of these, 23 do have SB periods. It would be desirable to plan observations to test if the eclipsing are consistent with the spectroscopic. Among the 38 stars simply classified as Ell, 27 are also SB, of which 16 show approximately the same photometric and spectroscopic periods.

3. Frequencies of multiple systems

Table 3 gives the approximate numbers of the stars in Table 1 that are presumably single (ellipsoidal only), those that are eclipsing binaries not belonging to visual double or multiple systems, and those that do belong to stars in Worley's *Catalogue of Double Stars* (1986), many of which are multiple systems with up to 14 components in this sample. For each unresolved eclipsing pair the number of components indicated by Worley has been increased by one in view of the assumption that the visual observers would not have noted the eclipsing as two stars. Table 3A indicates that each star in

Table 1 constitutes on the average one component in a system consisting of three stars. In Table 3B, the corresponding numbers are tabulated, including the numbers of components in 17 galactic clusters, each containing an eclipsing or ellipsoidal variable. The numbers of stars in the clusters were taken from Collinder (1931), where Lundmark and Collinder counted numbers of cluster members on Franklin-Adams plates and charts, respectively. Here each of the variables in Table 1 belongs, on average, to a system of five stars.

The 225 stars in Table 1 probably represent a lower limit to the numbers of eclipsing and ellipsoidal variables actually present among the stars in the *Bright Star Catalogue*. For example, among the first 500 stars in the *Bright Star Catalogue* there are 96 SB pairs. Of these, 11 are known either eclipsing or ellipsoidal, and 14 are other types of variables, mainly pulsating. 11 others are suspected variables (stars of unknown type in the *New Catalogue of Suspected Variables* [Kholopov *et al.* 1981]), while for 60 there is as yet no indication of photometric variability. These figures suggest the possibility of more eclipsing variables than have already been discovered among the naked-eye stars.

4. Inferred distances

For the stars with trigonometric parallaxes $\geq$0.020", Table 4 summarizes the distribution of the inferred distances in parsecs. The parallaxes smaller than 0.020 arcseconds are generally too uncertain to reveal the distance, except to say it is probably greater than 50 parsecs. N_T and N_D are, respectively, the numbers of trigonometric and dynamical parallaxes between successive ten-parsec intervals of the corresponding distances. The column headed N_{TD} gives the numbers of stars with both trigonometric and dynamical parallaxes for the intervals in the trigonometric. (Thus, for the interval 10–19pc, there are only six N_D but seven N_{TD}, because one of the seven falls in the next interval according to N_D.) In general, the agreement between the trigonometric and dynamical parallaxes is reasonable. There is just one large discrepancy, for HR 1099 (V711 Tau): 36pc according to the trigonometric, 18pc from the dynamical, while spectroscopic parallaxes suggest a distance on the order of 10 pc.

5. Conclusions

Largely because photoelectric photometry is a relatively new field for amateur astronomers, the proliferation of discoveries and follow-up of small amplitude variables between the 4th edition (1982) and the current version (1995) of *The Bright Star Catalogue* has been impressive. The numbers of eclipsing and ellipsoidal variables has nearly doubled from 121 in 1982 (of which three have since proved to be pulsating variables) to 225 in 1995. Many of these stars require additional precise observations. Further contributions by AAVSO observers are eagerly anticipated.

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Author's note: All references in which McAlister is listed as author or co-author deal with speckle interferometry.

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Table 1. Catalogue of Bright Eclipsing and Ellipsoidal Variables.

HR	*Var.*	*	*Type*	*Period (days) photom.*	*SB*	*Speckle Occultation sep"*	*Double sep "*	*Par "*	*Amp. m*
3	BC Psc		RS*	36.06	72.93			0.014	0.05
5	V640 Cas	*	E:	1.08	VarRV	1.399–1.465	1.5	0.046	0.07
								0.051D	
14	AP Psc	*	Ell*	48.16	96.41	0.002 Occ			0.2
50	UU Psc	*	Ell	0.84	0.8	<0.030	11.1AB	0.017D	0.07
65	AO Cas		Ell/KE	3.52	3.52	<0.030			0.17
91	155	*	E:		27.8	0.154- 0.178	0.2	0.004D	0.06
132	Var?	*	E:				27.7 AB		?
						0.078–0.271	Aa		
						0.196 Occ	Aa		
						0.226 Occ	Ab		
						0.031 Occ	ab		
142	BU Cet	*	RS		2.08	0.110–0.381	0.3AB	0.062	0.4
								0.049D	
192	YZ Cas		EA?	4.47	4.47		36.0		0.41B
215	ζ And		EB/RS*	8.92	17.77	<0.030	162.7AD	0.036	0.22
338	ζ Phe		EA	1.67	1.67		6.6ABxC	0.013D	0.51
342	424		E:		VarRV				0.24
373	AY Cet		RS*	75.12	56.82		177.6	0.016	0.23
403	δ Cas		EA:	759.	SB	<0.025	131.7	0.034	0.08
472	Var		EB or Ell*		VarRV			0.034	0.02
480	590		EA	16.77	SB			0.004	0.3
533	V436 Per		EA	25.94	15.6				0.36
559	RR Ari		EA:	47.9:					0.42p
642	TZ Tri	*	Ell/RS*	14.75	14.73		3.8AB	0.002	0.08
					2.24		B	0.007D	
649	769		E:		1642.1	<0.030–0.056		0.021	0.03p
						0.012 Occ			
815	RZ Cas		EA	1.20	1.20				1.54
854	τ Per		EA		1515.6	<0.022–0.080	51.7AxBC	0.019	0.13
857	EP Eri		RS	6.5	VarRV			0.100	0.05
897/8	1002	*	E?				8.3	0.034	?
								0.016D	
915	γ Per	*	EA	~5350:	5350.	<0.033–0.284	57.0AB	0.013	0.30
936	β Per	*	EA	2.87	2.87	<0.030–0.112	81.6AD	0.038	1.28
976	V423 Per		Ell:	5.54	5.54		29.3		0.12
1056	1173	*	EA	5.36					0.1
1078	IW Per		Ell	0.92	0.92				0.05
1081	TU Hor		Ell	0.94	0.94				0.14
1099	V711 Tau		RS*	2.84	2.84		6.6	0.028	0.23
								0.055D	
1131	o Per	*	Ell	4.42	4.42	<0.025	1.0	0.021	0.06
								0.005D	
1136	δ Eri		RS:	~10.				0.112	0.05
1163	1305	*	Ell?	0.97	1.94		3.2		0.00b
1177	V467 Per	*	Ell	1.77	1.77			-0.005	0.06b
1221	V817 Tau		Ell	1.48	2.98				0.05
1239	λ Tau		EA	3.95	3.95			-0.002	0.54
								0.004D	
1260	SZ Cam	*	EA	2.70	2.70		17.9 AB		0.3p
1324	b Per	*	Ell+E:	1.53	1.53	<0.022			0.06
					701.76				
1338	γ Dor		EW	0.75	VarRV:			0.051	0.04
1458	1658	*	E:		3.57	0.089–0.224	69.5AaxB	0.034	0.07
1471	HU Tau		EA	2.06	2.06	0.0004 Occ			0.78
1567	π^5 Ori		Ell	3.70	3.70			0.001	0.07

Table 1, continued.

HR	Var.	*	Type	Period (days) photom.	Period (days) SB	Speckle Occultation sep"	Double sep "	Par "	Amp. m
1605	ε Aur	*	EA	9892.	9890.	0.030	207.6 AE	0.004	0.91
								0.002D	
1612	ζ Aur	*	EA	972.16	972.16	<0.025		0.001	0.27
1623	BM Cam	*	RS*	82.8	80.17	<0.030	180.5 AB		0.14
1657	1831	*	E:	~2.	5.52		52.8	0.023	0.11
1706	KW Aur	*	δ Sct+Ell	0.09	3.79		14.3AC	0.007D	0.13
1726	1909	*	E:		434.8		4.2	0.012	?
1728	AR Aur		EA	4.13	4.13				0.67
1788	η Ori	*	EA+β Cep:	7.99	7.98	<0.030–0.060	0.1 Axab	0.006	0.29
						1.638-1.660	1.6 AB	0.005D	
							115.1 AC		
1811	ψ Ori		Ell	2.53	2.53		2.7AB	-0.016	0.06
1841	T Aur	*	NB+EA	0.20	0.20			0.001D	0.28
1852	δ Ori	*	EA	5.73	5.73	0.199– 0.268	32.1 AaxB	0.010	0.12
1868	VVOri		EA	1.49	1.49				0.35
1890	V1046 Ori	*	E+SXAri	0.95	0.90		8.7AB		0.04
1893	V1016 Ori	*	EA	65.43	65.43			-0.004	0.03
1894	BM Ori	*	EA	6.47	6.47		16.8BC	-0.004	0.57
1927	TX Pic		RS		SB2				0.04
1952	2556		E:		27.15				0.04
1970	V1197 Ori		Ell*	70.09	143.04				0.03B
1991	ι Men		Ell:	5.29					0.05
2001	V1031 Ori		EA	3.41	SB3	0.159–0.180			0.41
2027	TU Cam		EB	2.93	2.93	<0.038		0.011	0.17
2056	λ Col		Ell:	0.64				0.033	0.07
2059	TZ Men		EA	8.57	8.57				0.68
2088	β Aur		EA	3.96	3.96	0.0007–0.0021	184.6 AB	0.043	0.09
2142	V696 Mon		E:		80.86	<0.038			0.06B
2212	δ Pic		EB	1.67	1.67				0.25
2216	η Gem		SRa+EA	232.9	298.3	1.584–1.601	1.5 AB	0.016	0.8
						<0.028–0.058	Aa	0.007D	
						0.03 Occ			
2238	UZ Lyn		E+δ Sct		VarRV	<0.038		0.036	0.30
2291	RR Lyn	*	EA	9.95	9.95	<0.038	dbl?	0.023	0.39
2372	WW Aur		EA	2.53	2.53				0.75
2392	HR CMa		EA		458.6	0.161			0.08
2554	V415 Car		EA	195.24:	195.26			0.023	0.06
2583	EZ CMa	*	WR	3.77	3.76				0.74
2781	UW CMa	*	EB	4.39	4.39				0.49
2788	R CMa		EA	1.14	1.14	<0.038		0.028	0.64
2790	NW Pup	*	βCep+Ell:	1:	VarRV				0.04
2800	HQ CMa		EA	24.6	VarRV		8.2		0.26
2889	PS Pup		Ell	0.67			91.5 AB		0.03
2891	YY Gem	*	EA	0.81	0.81	<0.030	2.0AB	0.075	0.69
								0.052D	
2902	KQ Pup	*	Lc:,VVCep:		9752.	<0.030		-0.005	0.35
2944	PU Pup		EB	2.58	VarRV	<0.035	0.2		0.06
2973	σ Gem	*	RS*	19.42	19.60		182.2	0.018	0.16
3009	PV Pup		EA	1.66	SB2	<0.038	16.8AB		0.41
3119	AE Lyn	*	RS*	10.16	11.08	<0.038		0.035	0.06
3129	V Pup		EB	1.43	1.45		39.2 AD		0.57
3133	3841		E:						2.0 p
3141	V645 Mon	*	FK Com	0.21				0.008	0.02
3245	Var		E:		SB				0.06
3307	4058		E:	785:		<0.041			0.12

Table 1, continued.

HR	*Var.*	*	*Type*	*Period (days) photom.*	*SB*	*Speckle Occultation sep"*	*Double sep "*	*Par "*	*Amp. m*
3327	NO Pup		EA	1.26			8.0 AxBC	0.005D	0.40
3335	VV Pyx		EA	4.57	SB2	0.397–0.419	0.3		0.48
3337	LO Hya	*	EA	2.50	2.50	0.051–0.327	0.4AB	0.015D	0.24
3385	VX Pyx		RS		VarRV				0.10
3442	4194	*	Ell:		3.1		16.6		0.10
3462	HX Vel	*	Ell:	0.56		0.497	0.3		0.05
3467	HY Vel	*	Ell:	1.55			76.6 AB		0.07
3524	RS Cha	*	EA+δ Sct	1.67	1.67	<0.038			0.66
3655	KW Hya		EA	7.75	7.75				0.47
3659	V357 Car		E:	6.75	6.74				0.03
3798	S Ant		EW	0.65	0.65				0.5
3800	SU LMi	*	RS:	40.4	VarRV	<0.030	dbl?		0.02
3815	SV LMi		RS:	18.0	VarRV	<0.030	3.3	0.091	0.04
								0.14 D	
3872	IP Vel		E		VarRV		2.1		0.17B
4069	4829		E:		230.09	<0.030		0.033	0.34
4148	TX Leo		EA	2.45	2.45	<0.038	2.4	0.005D	0.09
						0.0005 Occ			
4188	V429 Car		EA		80.35				0.12B
4204	Var:	*	E:	~3.					0.03y
4317	χ^2 Hya		EA	2.27	2.27				0.29
4374/5	ξ UMa	*	RS*	59.88yrs		0.871–3.073	3.1 AB	0.113	0.05
								0.120D	
4374	ξ^2 UMa		Ell	810:	3.98	0.056	B	0.113	
4375	ξ^1 UMa				669.18		A	0.113	
4430	EE UMa	*	Ell*	37.72	74.86	<0.030			0.13
4492	GT Mus		E:/RS		SB	0.224–0.240	0.2 AB	0.004	0.13
4527	DQ Leo	*	RS*	55.0	71.70	<0.030	74.3	0.021	0.03
4560	DN UMa	*	EA	1.73	1.73	0.095–0.121	0.1 AB	0.003D	0.09B
							4.0 ABxC		
						<0.030	63.0 ABxD		
4624	V788 Cen		EA	4.97	SB2				0.19
4665	DK Dra		RS*	63.8	64.44				0.19
4716	Var		E:		SB			0.036	0.07
4814	FH Mus		Ell:	0.58:					0.03
4821	5855	*	E:		1.46	<0.038	5.4 AB	0.014D	0.15
4822	5855	*	E:		44.41	<0.038	5.4AB	0.014D	0.15
4823	CH Cru	*	γ Cas+EA:		SB	<0.030			0.15
4825	5859	*	E:		SB	3.461–3.674	2.8 AB	0.10l	0.02
								0.084D	
4952	θ Mus		E+WR	18.34	18.34		5.3		0.02
4968	6116	*	E:		VarRV	0.051–0.713	0.3AB	0.055	0.06
								0.058D	
4975	V831 Cen	*	Ell	0.64	SB	0.252	0.3AB	0.014D	0.11
4993	η Mus		E:		20.01		59.9		0.05
5034	V790 Cen	*	EB	1.28	VarRV	0.174	C		0.11
5055	6225	*	E:	28.5yrs	175.55	<0.025	0.1 AP	0.042	?
								0.046D	
5056	α Vir		Ell+β Cep	4.01	4.01	<0.038	0.0	0.022	0.07
5110	BH CVn		RS*	2.63	2.61	<0.038		0.019	0.07
5292	V883 Cen		E		VarRV				0.23b
5311	V716 Cen		EB	1.49	VarRV				0.56
5375	HX Lup		Ell	1.54					0.06
5388	6654		EA:			<0.030			0.5 p
5425	σ Lup		Ell	3.02					0.02
5586	δ Lib		EA	2.33	2.33	<0.038	106.3 AC	0.020	0.99

Table 1, continued.

HR	Var.	*	Type	Period (days) photom.	Period (days) SB	Speckle Occultation sep"	Double sep "	Par "	Amp. m
5618	i Boo		EW	0.27	0.27	0.630–1.702	1.7	0.084 0.073D	0.6
5664	δ Cir		Ell	3.90:	3.90				0.08
5687	GG Lup		EB	2.16	SB	<0.030			0.5 B
5793	α CrB		EA	17.36	17.36	<0.030		0.039	0.11B
5889	δ CrB		RS:					0.012	0.12
5902	Var	*	Ell:	1.07	14.48	0.0002 Occ	0.0		0.01
6063	TZ CrB	*	RS+δ Sct*	1.17 1000:yrs	1.14	<0.038	6.6AB	0.047 0.048D	0.05
6164	V918 Sco		Ell	9.81	9.81				0.08
6174	V1003 Sco		Ell		1.59				0.03
6212	7915	*	E:		34.44 yrs	<0.035–1.5 1.106–1.255	1.3AB	0.101 0.096D	0.07
6216	7935		E:				2.0AB	0.012D	0.03
6240	V1010 Oph		EB	0.66	0.66	<0.038			0.9
6247	μ¹ Sco		EB	1.44	1.45				0.28
6261	V900 Sco	*	Ell:	2.63: 6.20: 6.85:					0.05
6283	V861 Sco	*	EB	7.85	7.85				0.62
6322	ε UMi		EA/RS	39.48	39.48		76.9	0.009	0.06
6327	V923 Sco	*	EA	34.83	34.82	<0.030			0.35
6384	V829 Ara		Ell	80.		<0.030			0.08
6414	U Oph		EA	1.68	1.68	<0.038	20.7	0.000	0.28
6431	u Her		EA	2.05	2.05	<0.038	4.4	0.009 0.010D	0.68
6469	V819 Her	*	EA/D+By*	2.23 81.9	2.23 2018.0	<0.030–0.112		0.021	0.08
6485	8605	*	E:			<0.058–0.286 4.085	Aa 4.2 AaxB	-0.002 0.010D	?
6535	9167	*	Ell:	3.37	3.37		5.4 AB		0.03
6611	V624 Her		EA	3.89	3.89		39.7		0.18
6621	V3894 Sgr		EB	2.62	VarRV				0.12
6622	V539 Ara		EA	3.17	3.17		12.3		0.52
6626	V826 Her	*	Ell*	49.66	99.56	<0.038	A		0.03
6662	V906 Sco	*	EA	2.79	2.78	0.180	0.3 AB		0.26
6773	V3792 Sgr		EB	2.25	2.25		13.5		0.45
6812	μ Sgr		EA+α Cyg	180.45	180.45	<0.029 0.011 Occ	16.9 AE	0.010	0.13
6833	RS Sgr		EA	2.42	2.42		39. AB 94. 1 AC 16.5 CD		0.96
6902	V2291 Oph		EA	385.0	385.0	<0.030			1.1U
7084	CX Dra		γ Cas+Ell	6.70	6.70	<0.038			0.31
7106	β Lyr		EB	12.91	12.93	<0.030	45.7 AB	-0.006	1.11
7109	V822 Her		EB		1.39	0.063–0.105			0.18
7125	o Dra	*	RS*	142.8 54.6	138.42		34.6 AB	0.004	0.10
7152	ε CrA		EW	0.59	0.59			0.030	0.26
7248	Y Aql		E	1.30	1.30	0.031		0.016	0.04B
7275	V1762 Cyg	*	RS*	27.78	28.59			0.003	0.22
7326	U Sge	*	EA	3.38	3.38		92.0		2.60
7342	υ Sgr		EB	137.94	137.96	<0.030 0.011 Occ			0.10p
7422	V4089 Sgr		EA	4.63	4.63				0.13
7428	V1817 Cyg		RS:*	108.85	108.57				0.04

Table 1, continued.

HR	*Var.*	*	*Type*	*Period (days) photom.*	*SB*	*Speckle Occultation sep"*	*Double sep "*	*Par "*	*Amp. m*
7464	V4090 Sgr		EA	11.42	VarRV				0.23
7474	σ Aql		EB	1.95	1.95		47.8AB		0.18
7484	V1143 Cyg		EA	7.64	7.64			0.036	0.52
7486	QS Aql		EA	2.51	2.50	0.144–0.19	0.2		0.12
7508	PS Vul		E:		VarRV	0.353–0.372	0.3	-0.011 0.004D	0.08
7536	δ Sge	*	Lb:	118.	3720.	<0.030–0.112	dbl:	0.000	0.15
7551	V1765 Cyg		EB+α Cyg		13.37				0.06
7567	V380 Cyg		EA	12.43	12.43				0.17
7571	V505 Sgr		EA	1.18	1.18	0.214–0.311 0.0002 Occ			1.03
7574	QZ Sge		E:	32.51:	SB	<0.030			0.05
7735	V695 Cyg		EA	3784.3	3784.3	<0.022–0.035	337.5AD	0.005	0.11
7741	QS Vul		EA	249.10	251.0			0.003	0.05
7751	V1488 Cyg		EA	1147.4	1147.8	<0.018	208.9	0.010	0.24
7777	V1773 Cyg		Ell	2.98	2.98				0.05
7792	DE Dra		EA	5.30	5.30				0.15
7843	13115	*	E:				0.8 AB		?
7923	Var		RS	100:					0.2
7940	V379 Cep		EA	24.45:	5.1:				0.06b
8024	DV Aqr		EB	1.58	1.58	<0.030			0.30
8053	V1931 Cyg	*	E+BE	2.48:	2.48		2.6AB		0.14
8153	13646		Ell:	5.4	5.41 225.44		4.1 AB		0.04
8154	V1809 Cyg		Ell	3.39	SB				0.11
8204	Var	*	E:		2422.		21.3	-0.011	0.4B
8322	δ Cap		EA	1.02	1.02	0.0018 Occ	6.9 AB 18.9 AC	0.076	0.22
8369	BG Ind		EA	1.46	SB2				0.25
8383	VV Cep		EA+SRc	7430.	7430.5	<0.030	0.1	0.005	0.56
8396	DX Aqr		EA	0.95	0.95	<0.038 3.520 Occ	3.6AB	0.006D	0.41
8406	LZ Cep	*	Ell	3.07	3.07	<0.038		-0.011	0.10B
8427	V365 Lac		Ell	2.17	2.17				0.08
8448	AR Lac		EA/RS*	1.98	1.98	<0.038			0.69
8523	14130		Ell:		2.62		48.2	0.039	0.03
8575	V350 Lac		Ell+RS*	8.88	17.76	<0.038	66.0		0.20
8690	V360 Lac		EB	10.08	10.	<0.030			0.07
8703	IM Peg		RS*	24.44	24.65				0.20
8725	EN Lac	*	β Cep+EA	12.10	12.10	<0.038	62.1AC		0.04
8854	V649 Cas		EA	2.39	2.39				0.08
8864	AN And		EB	3.22	3.22				0.2 p
8926	AR Cas		EA	6.07	6.07	0.003 Occ	75.7AC	0.006D	0.14
8961	λ And	*	RS*	54.20	20.52	<0.030	217.6 AC	0.048	0.28
8963	KS Peg	*	EB/KE	0.50	0.50		27.9A		0.12B
9024	OU And		FKCom	23.25	RV var?				0.04
9049	AL Scl		EA	2.45	2.45				0.24
9052	V373 Cas		E:	13.42	13.42		CPM 9045	0.028	0.4 v
9059	14773		E:		12.16				0.05

Table 1, continued.

REMARKS

HR

5 SB triple, third component 7.5v at 0.002".
14 SB sep 0.002".
50 SB is ADS 191A.
91 Var is ADS 328A. Binary appeared single in 1993.
132 Triple occultation system 6.2, 6.9, sep 0.031"; 8.8v at 0.196". Eclipsing suspected because invisible on 2 Jan. 1971, the time of an occultation; not seen by H. Povenmire and R. Woods (Hoffleit 1979; Dunham 1995).
142 ADS 490. From combination of speckle and visual data the period is 6.89 ± 0.18 yrs, a = 0.240".
642 Var is ADS 1697A. Photometric half-period decreasing from 7.377 to 7.370 between 1984 and 1986 (Strassmeier *et al.* 1989).
897/8 $\theta^{1,2}$ Eri. NSV records Δm variable. H.P. Hertzog (1994) suggests that eclipses might be possible. Present combined magnitude of the two components is 2.90V. However, Hipparchus (190-123BC) and Al Sufi (903–986AD) both recorded it as first magnitude (Gore 1899, 1900).
915 Aa 14.65 yrs, a 0.159".
936 Algol. ADS 2362A. ABxC = SB. 1.86 yrs.
1056 Open cluster Mel 20, No. 934.
1131 In open cluster IC 348.
1163 ADS 2772 (6.9, 9.4v). Component A is the ellipsoidal variable, amp. 0.002b (Jerzykiewicz 1993). The photometric period has been determined as half the SB because the two minima are of approximately equal magnitude. NSV gives range 6.50–6.81V, while Hopmann (1953) indicated that B-A varies from 2.76 to 4.46, indicating that perhaps both components are variable.
1177 Current data from Jerzykiewicz (1993). However, GCVS, based on Kolykhalova *et al.* (1978) gives eclipsing 5.05–5.18V, 22.58 d.
1260 SZ Cam is ADS 2984B, 7.0–7.29B. Component A is NSV 1458, 7.1v. Open cluster NGC 1502, No. 1.
1324 Open cluster NGC 1545, No.1. A radio flare star. Possible triple spectroscopic system. Both the short and the long periods correspond to spectroscopic components ab, while the period of the variable corresponds to an ellipsoidal variable. A third component, c, which may eclipse component a, is suspected.
1458 Var. is ADS 3317A.
1605 RV and light also show physical variation in period about 110 d, amp. 0.24V.
1612 The fainter K-type component is probably SR type, amp. about 0.1V.
1623 Component A of quadruple system. Rotational periods have been found to vary from 78.22 to 85.2 d. Component B is HR 1622, a γ Cas type pulsating variable. Components C and D are 10.8 and 13.3v.
1657 ADS 3698A. Component B, 10.71V.
1706 SB and var. are ADS 3824A. The photometric period and amplitude refer to the δ Sct type variability, 0.08809 d, amp. 0.13V.
1726 Var. is ADS 3572A.
1788 ADS 4002 is a quintuple system of which Component A is a triple SB. Magnitudes A 3.8, B 4.8, C 8.4v. At maximum the eclipsing variable has also shown a pulsation period of about 0.30 d, amp. 0.05V.
1841 T Aur is Nova 1891.
1852 In open cluster Collinder 70.
1890 Periods of 0.96429 and 0.9015 d superimposed yielding a beat period of about 18.93 d. The original SB period was determined as 18.65 d.
1893/4 HR 1893 is ADS 4186A (6.72-7.65V) of a 13 component system. B is HR 1894 (7.95-8.52V). C is HR 1895, NSV 2294 (5.10-5.16V); D is HR 1896, NSV 2295 (6.65-6.72V); E is NSV 2291 (11.4v, amp. 0.41V); F is NSV 2296 (11.0v); G (16.5v); and H is NSV 2292 (15.6v).
2291 Possibly has a visual companion at 50".
2583 Open cluster Collinder 121, No. 1. Central star of a ring nebula.
2781 In open cluster NGC 2362.
2790 β Cep-type variability, 0.125 d, amp. 0.02V. Ell amp. 0.045V, period ~1 d. GCVS gives total amp. 0.07V.
2891 Var. is ADS 6175C, 8.91-9.60V.
2902 Open cluster NGC 2422, No. 9. Spectral type M2epIab+B2V. Originally classified as a symbiotic star similar to VV Cep. The late-type star is SB with a period of 9752: d (Cowley 1965). Photometric observations of the system (4.82-5.17V) have been classified as Lc (irregular).
2973 A spot cycle of 27 years has also been suspected.
3119 Period varies from 10.16 to 10.35 d.
3141 FK Com-type variables are rapidly rotating stars supposed to have bearing on the evolution of EW-type eclipsing variables.
3337 ADS 6828, 7.0, 7.1v, sep. 0.4", var. 6.37-6.61V is for combined light.
3442 Probable member of open cluster IC 2391.

Table 1, continued.

3462 Cluster IC 2395, No. 1.
3467 Open cluster IC 2391, No. 24. GCVS (1985) gives period 3.106 d. Later (Waelkens 1991) more extensive data indicate multiple periods: 1.5511, 1.6455, 1.7370 and, less convincingly, 2.3571 d, the shortest period indicating the largest amplitude, about 0.03V. Component B of the visual system is HR 3466, KT Vel, 5.52V, an α CVn-type variable at 76.6".
3524 Also δ Sct type, amp. 0.04V with changing period, 0.074-0.097 d.
3800 Suspected double unconfirmed by speckle interferometry.
4204 Open cluster IC 2602, No. 40.
4374/5 ADS 8119AB. Variable is blend of the two, but probably it is the B-component, HR 4374, that is the variable. A quintuple system of which both visual components are spectroscopic binaries, and a third component to ADS 8119B has been discovered by speckle interferometry (McAlister *et al.* 1995). The 810 d period probably corresponds to spot activity.
4430 Photometric period varies from 37.30 to 39.45 d.
4527 Photometric period varies from 55.04 to 72.1 d. Significant spot activity observed only in 1984-85, when the photometric period was the smallest reported (Strassmeier *et al.* 1989).
4560 Merged components ADS 8347ABC measured. Probably component A is the variable. Component D is HR 4561, possibly an α CVn-type variable.
4821 ADS 8627B. Binary with HR 4822 = component A, HR 4822, q.v.
4822 ADS 8627A. AB 6.1, 6.0, amp. of combined light 0.15v. Uncertain which component is the variable (Corben 1971). Component C at 59" is optical.
4823 γ Cas type var., amp. 0.04V., suspected of being eclipsing because it had been observed at 7.5v on May 22, 1896. Unconfirmed.
4825/6 γ Vir. Amp. of combined light 0.02V. Uncertain which component variable. Eclipse or closest approach expected about 2007 (Hoffleit 1992).
4968/9 ADS 8804AB. On basis of orbit eclipses are possible. From combined speckle and visual observations the period is 25.804 ± 0.085 yrs, a = 0.6684 ± 0.0013". The orbit appears as a straight line, i.e., edge-on (Hartkopff *et al.* 1989).
4975 AB 5.2, 5.7, sep. 0.3", uncertain which component is the variable. Component C 8.4 at 2". Component A is SB.
5034 Probable optical component C at 60" of triple system, of which components AB, sep 0.1", are HR 5035. Available radial velocities satisfy the photometric period, which may be decreasing.
5055 ζ^2 UMa, ADS 8891B. Astrometric double, sep. 0.13", period 57 years. Mädler may have observed an eclipse on April 18, 1841. Period 28.5 or 57 years? Minima expected approximately 1926 + 28.5E (Nielsen 1941). Binary with HR 5054, ADS 8891A at 14.4", also SB, 20.54d, and NSV 6224, type and amp. undetermined.
5902 λ Librae.
6063 ADS 9979A assumed to be δ Sct type, 1.139789d, is more probably the RS type. AB period about 1000 years.
6212 ζ Her. ADS 10157A suspected of being double by W. Herschel in 1795. On the basis of the orbit another eclipse could occur between 2000 and 2004 (Hoffleit 1992).
6261 In open cluster NGC 6231.
6283 In open cluster Collinder 316.
6327 Open cluster NGC 6281, No. 1.
6469 Speckle interferometry indicates triple system. Observations outside eclipse also reveal the period of about 82d, probably the rotation period of the secondary, G5IV, component (Scarfe *et al.* 1994).
6485 ADS 10526B is HR 6484.
6535 Open cluster NGC 6383, No. 1.
6626 SB is ADS 10782A.
6662 Open cluster NGC 6475, No.86.
7125 The photometric period, 142.8 d (Strassmeier *et al.* 1989), is close to the orbital. The earlier determination of 54.6 d is probably spurious; 5 x 56.4 is close to the average of the more recent determination and the orbital period. Component B is 7.9v and does not share proper motion of A. Component C, 11.5v at 139.4", is receding from A.
7275 RS type binary but may also show intrinsic variability with amplitude about 0.06V. Photometric period varies from 27.78: to 28.773d.
7326 Nonmember of Collinder 399.
7536 Atmospheric eclipse indicated spectroscopically.
7843 The frequently invisible variable suspect is 8.5v component B of double, 0.8" from A.
8053 ADS 14549AB. Component B is 4.5 mag. fainter than A at 2.6".
8204 ζ Cap. Photometric periods uncertain, at least 80 to 500 d, possibly 4 years or more (Srivastava 1988).
8406 Cep OB2 Association.
8725 Amp. of combined light 0.11B. Primary is the β Cep type pulsating var. with periods of 0.17–0.18 d.
8961 Photometric period varies between 51.6 and 55.8 d.
8963 Usually designated as ellipsoidal. Secondary of visual double is 11.6v.

Table 2. Summary of numbers of stars in various categories.

Var.	*SB*	*Speckle Observed*	*Speckle Resolved*	*Occulting*	*Visual Double*	*Trig π*	*π ≥ 0.020″*	*Dyn π*
225	199	98	38	13	104	86	44	37

Table 3. Numbers of stars in the systems to which the eclipsing and ellipsoidal variables belong.

A. From double-star catalogues (+1 for each eclipsing binary):

n	1	2	3	4	5	6	7	8	9	13	14	**Av.n/var**
N	23	105	45	20	16	5	8	0	1	1	1	**3**

B. Including data from the *Collinder Catalogue of Galactic Clusters* (+1 for each eclipsing binary):

n	1	2	3	4	5	6	7	8	9	10	11	12	14
N	22	94	44	19	14	5	8	0	1	2	1	1	1

n	19	21	23	26	29	31	34	51	53	59	91	**Av.n/var**
N	1	1	1	3	1	1	1	1	1	1	1	**5**

n = number of variables in each system; **N** = number of systems

Table 4. Distribution of distances (in parsecs).

Range pc	N_T	Av.T pc	N_D	Av.D pc	N_{TD}	Av.(T-D) pc	Range (T-D) pc
0–9	2	9.	2	7.5	1	+1.	
10–19	9	12.6	6	15.	7	-1.3	-6 to +4
20–29	19	25.9	4	20.8	4	+1.3	0 to +2
30–39	5	33.5	0		1	+18.	
40–49	8	45.8	0		1		
50	1	50.	0		0		
>50	42	>50	25	>50	9		
Totals	86		37		23		