REMARKS ON THE PHOTOMETRIC CRITERIA OF CHOICE OF THE STANDARD STARS

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Abstract. We propose, in several tables, a number of stars selected to be observed both by photometrists, spectroscopists, astrometrists. Properties of selected stars are discussed.

1. Definition of the 'HR Standard' Star

In astronomy we are familiar with several kinds of 'standard' stars, for instance: standard stars for spectral classification, those destined to define the scales of magnitudes and colours, stars selected to define an absolute energy distribution, etc. Practical considerations have often determined the choice of standard stars: uniform distribution in the sky, easy identification, necessity to cover a certain interval of magnitudes or colours. We propose here, in several tables, a number of stars selected to be observed by photometrists, spectroscopists and astrometrists. This list is of course not exhaustive. We will henceforth name the stars of our list 'HR standard' stars. Indeed, the object is to gather a sufficient amount of observations on each one of these stars to allow the precise fitting of stellar models liable to give us the absolute magnitude M_v, the gravity $\log g$, the effective temperature T_{eff}, the chemical composition χ. It would be ideal to dispose of these informations for typical stars distributed throughout a three-dimensional HR diagram (M_v, T_{eff}, χ). The three physical parameters M_v, T_{eff}, χ are generally obtained by means of indirect methods, very often photometrically. One must thus bear in mind that the photometric quantities such as magnitudes, indices, combinations of indices, depend in no negligible manner on multiplicity, rotational velocity of the star observed, on the quantity of interstellar matter and on the extinction law. Consequently, care must be given to avoid the use as 'HR standard' of stars having particularities liable to introduce errors in the photometric quantities.

2. Photometric Effects of Binarity, Rotation, Gravity and Chemical Composition

In the following diagrams, Figure 1a, b, Figure 2, Figure 3, Figure 4a, b, c, Figure 5a, b, we attempt to illustrate the deviations in colour to be expected for two stars slightly different in spectral class, or in luminosity class, or in chemical composition, or in rotational velocity, or due to the fact that one of them can be a binary. The conclusion derived from an inspection of these diagrams is that a difference in colour (between 3500 Å and 6500 Å) of ± 0.02 can be caused by:

a difference of 0.05 in spectral class;

a difference of 200° to 300° in T_{eff};

B. Hauck and B. E. Westerlund (eds.), Problems of Calibration of Absolute Magnitudes and Temperature of Stars, 275–297.

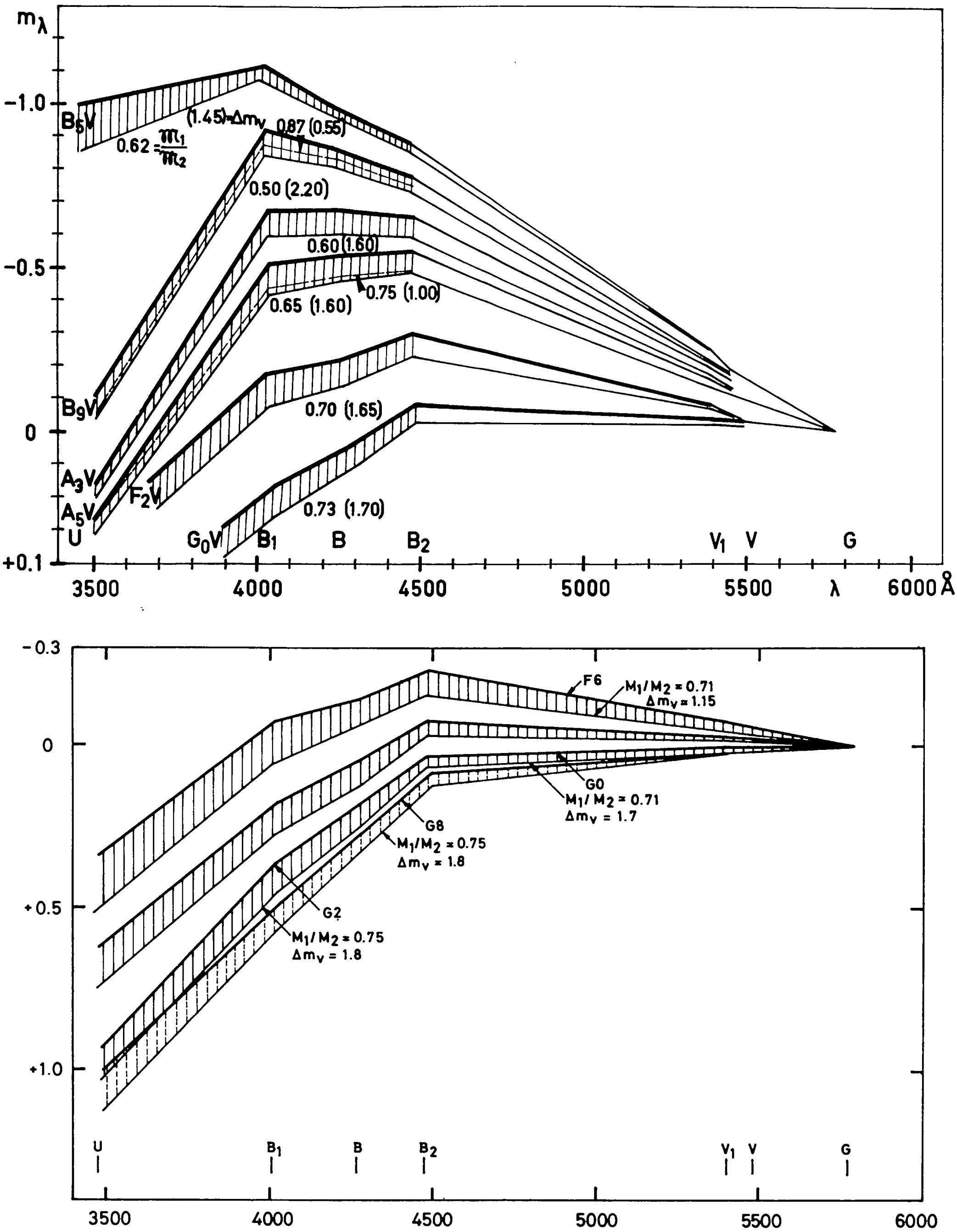

Fig. 1a, b. Effect of binarity for some spectral types. The thick solid line refers to a unit mass ratio. The thin solid line is for a mass ratio giving a pseudo-continuum of greatest deviation from the unit mass ratio.

a difference of 0.3 in $\log g$;

a difference of 0.1 in [Fe/H];

a difference of 150 km s^{-1} in rotational velocity;

a companion weaker by 5 mag.

These figures are only orders of magnitude, and can vary considerably individually according to the type of star (cold star, hot star, dwarf or supergiant).

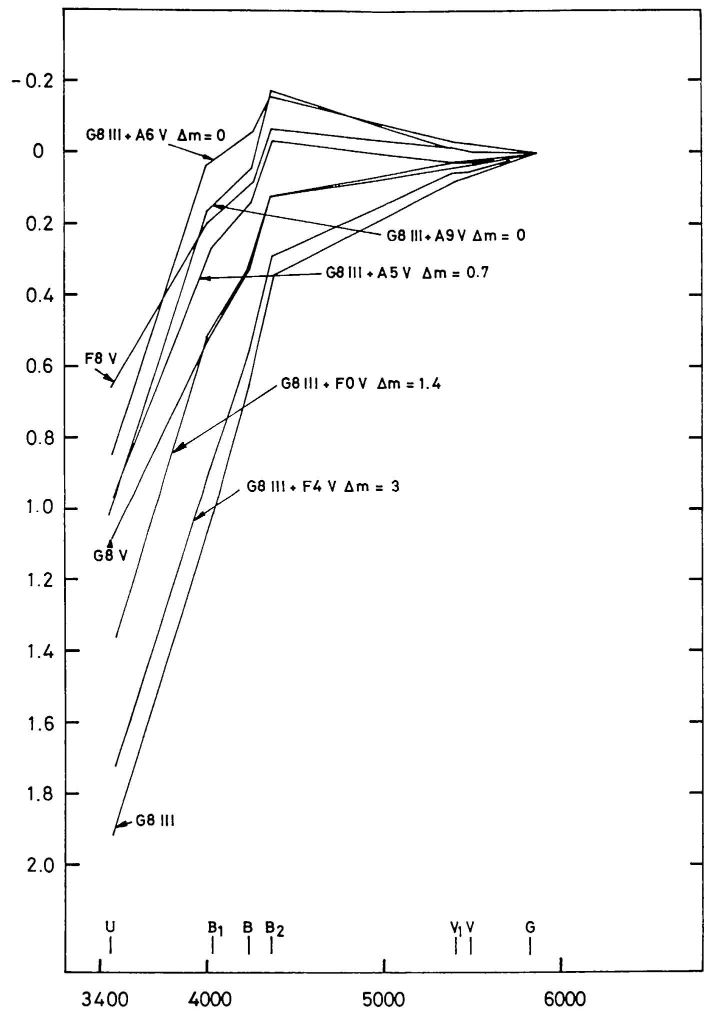

Fig. 2. Effect of binarity for some G8 III stars.

3. Choice of the 'HR Standard' Stars

The 'HR standard' stars are to be used for the calibration of mean relations, such as:

M_v, colour indices;

θ_{eff}, colour indices or combinations of colour indices;

Spectrum, colour indices;

[Fe/H], colour indices or combinations of colour indices;

χ, colour indices or combinations of colour indices;

etc.

The colours can be those obtained with wide bandpasses (example *U B V R I*), narrow bandpasses (example *u v b y*), intermediary bandpasses (example $U\ B_1\ B_2\ V_1\ G$).

The determination of θ_{eff}, $\log g$, χ requires the fitting of stellar models to observed energy distributions or, at least, to the known colours of the star considered. This involves the necessity to know and to preserve the response functions of the photometric system with an accuracy equal to that of the intensity measurements. Thus,

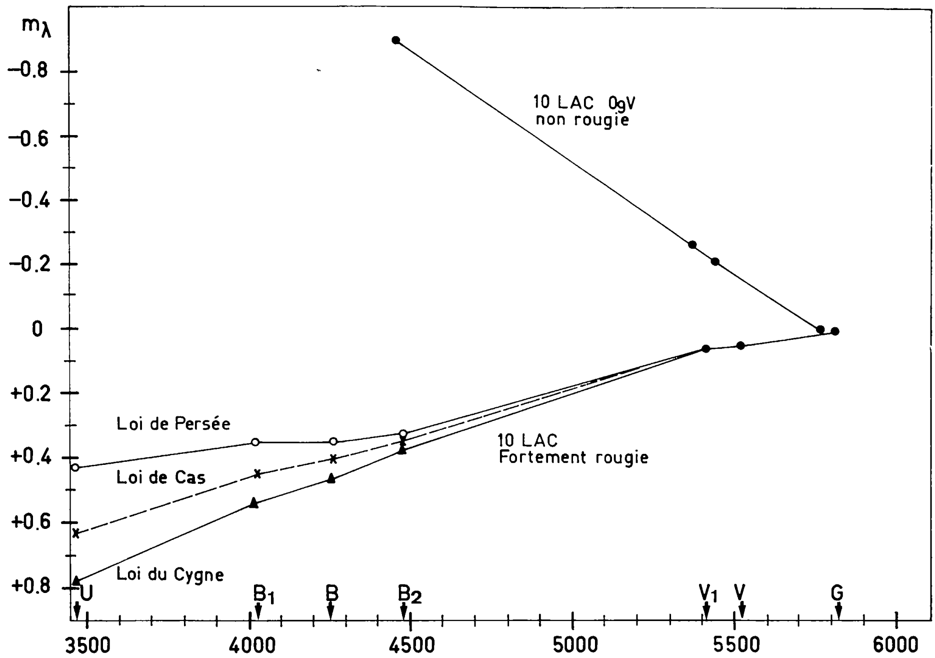

Fig. 3. Deformation of the pseudo-continuum for an O star resulting from three different laws.

these remarks imply that accurate photometric measurements of the stars proposed as 'HR standard' are available in a photometric system with well defined bandpasses. Moreover, the number of separate measurements of each star has to be sufficient to be able to detect any possible variability. The $U\,B\,V\,B_1\,B_2\,V_1\,G$ photometric system meets these conditions. This system has been in use at the Geneva Observatory since 1959. Its properties are described by Golay (1969, 1971, 1972). The last catalogue published by Rufener (1971) contains more than 1500 stars, and will very soon reach 2500. This publication contains the response functions of the seven filters as well as a discussion of the accuracy of the measurements. Here, we have only considered stars with a weight $p \geqslant 3$, which corresponds to the following standard deviations expressed in thousandths of a magnitude (Table I). In Table I we give the standard deviations and the mean wavelengths of the bandpasses (whose equivalent rectangular bandpasses are between 300 Å and 600 Å).

TABLE I

Mean wavelengths and standard deviations

	U	B	V	B_1	B_2	V_1	G
λ_0 [Å]	3456	4245	5500	4024	4480	5405	5805
σ	6,1	3,2	3,9	3,2	3,3	3,7	4,4

The stars we propose as 'HR standards' all fulfill the following conditions:

(1) Are not binaries, (except the interesting case with well separated components) or the two components are practically identical ($\Delta m \leqslant 0.1$ and same spectral type) or the difference in magnitude Δm is $\geqslant 5$.

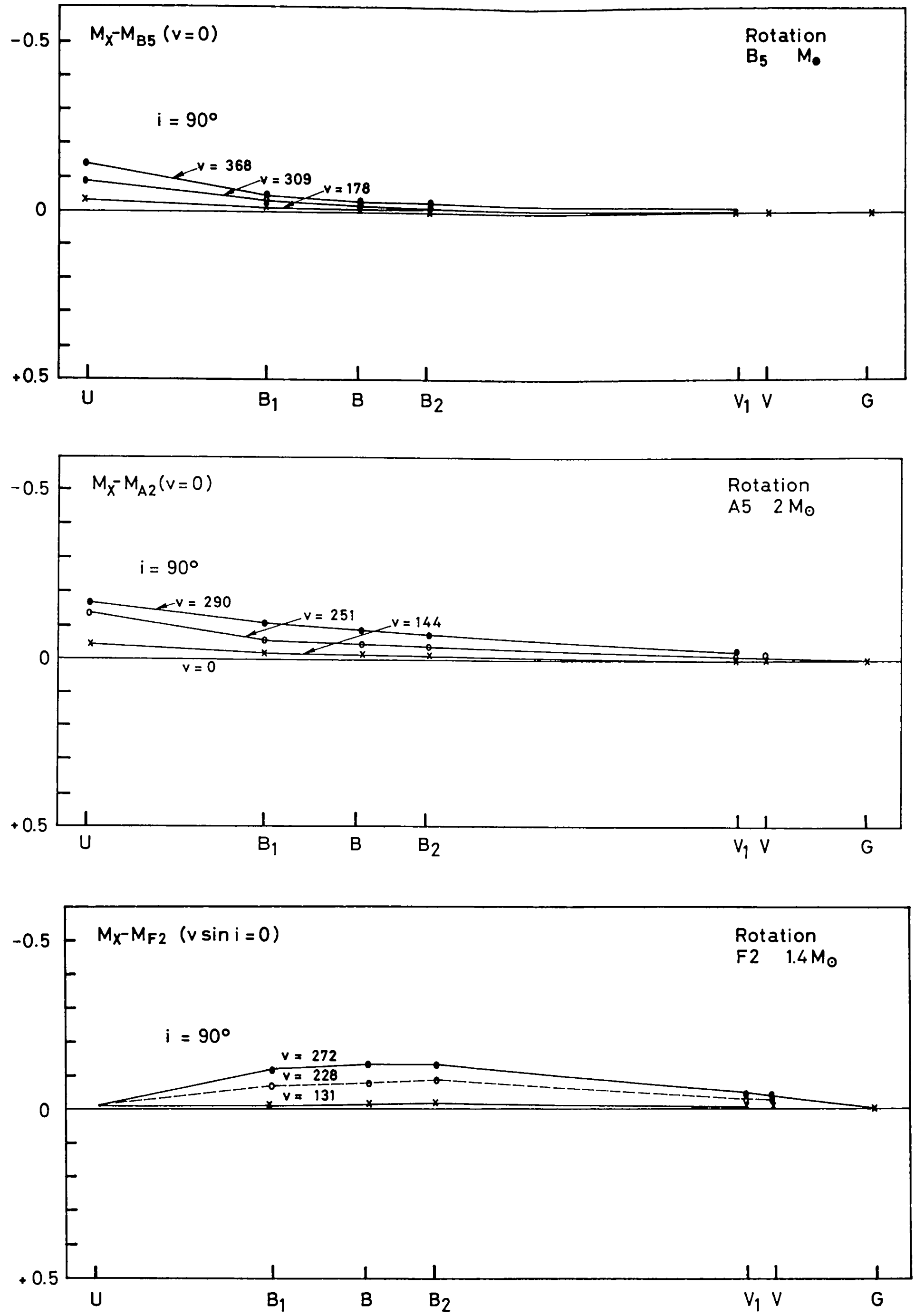

Fig. 4a, b, c. Deformation of the pseudo-continuum caused by stellar rotation (colours computed by Maeder with models of Maeder and Peytremann 1970, 1972).

(2) Are not, or are but slightly reddened by interstellar matter.

(3) Are not suspected to be variable. We have retained as HR standard, stars suspected of variability in Literature, but not confirmed as such in our photometry. We identify with asterisks those stars not known to be variable, but which our measurements lead us to suspect of being variable.

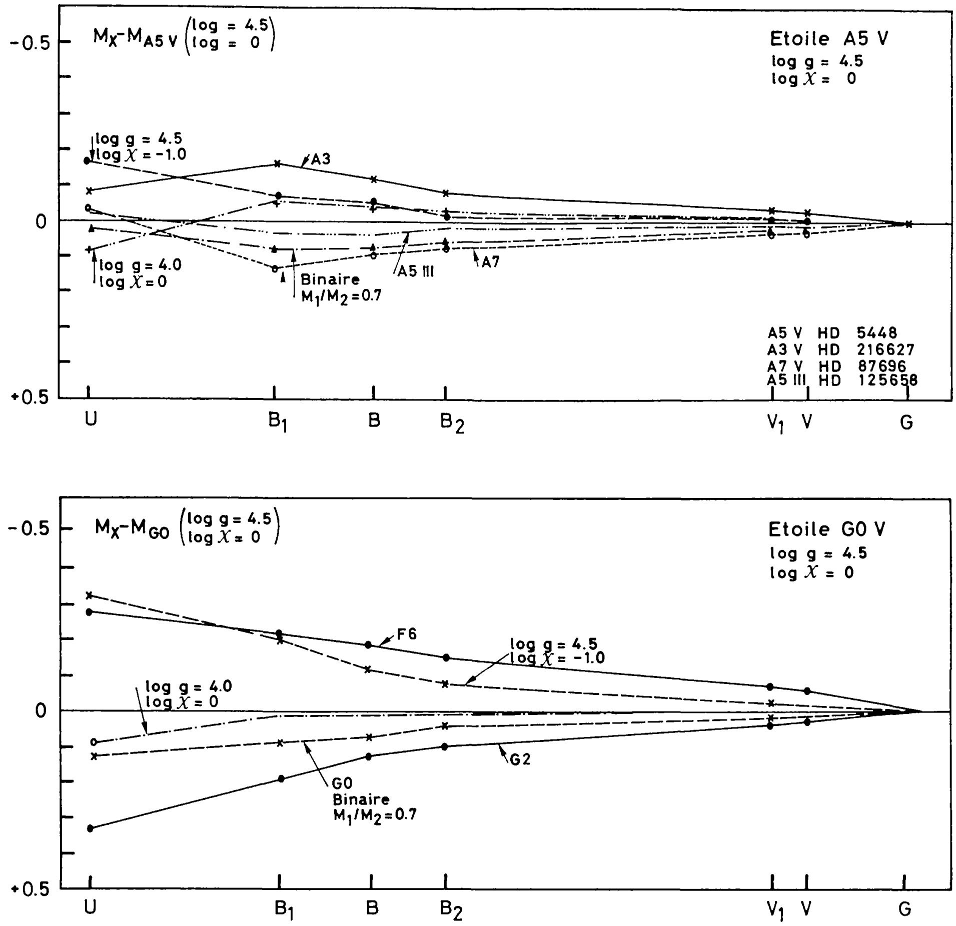

Fig. 5a, b. Comparison with help of models (Maeder and Peytremann) of the effects of binarity gravity, chemical composition ($\log\chi \simeq 0.6$ [Fe/H]), spectral type, for two normal stars A5 V, G0 V.

(4) Have $V \sin i > 150$ km s^{-1} when this is known.

Moreover, they must belong to one or more of the following series:

(a) They must be among the MK standards published by Morgan and Roman (1950), Johnson and Morgan (1953), and Morgan *et al.* (1953).

(b) Be among the A stars classified MK by Cowley *et al.* (1969).

(c) Be among the stars having a trigonometric parallax of class A, B, C in Gliese's catalogue (1969).

(d) Be among stars which have once been the object of a study of abundances by means of spectroscopic observations. The stars have been selected from the lists of Cayrel and Cayrel de Strobel (1966) and Powell (1970).

(e) Be probable members of open clusters of known distance modulus. Our list is limited for the moment to the Hydaes, Praesepe and Coma Berenices clusters.

In the following pages, we give a serie of tables. Tables 1 to 7 contain all the stars we propose as HR standard. Each table contains stars belonging to the same original list.

Table 1 contains the stars of series a
Table 2 contains the stars of series b
Table 3 contains the stars of series c
Table 4 contains the stars of series d
Table 5 members of the Hyades
Table 6 members of Praesepe
Table 7 members of Coma Berenices

TABLE 1

MK Standards

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
14633		O8	7.459	−0.285	***	126	
38771	2004	B0.5 Ia	(2.040)	−0.242	**	81	βy
163506	6685	F2 Ia	5.419	0.146	***	23	βy
212593	8541	B9 Iab	(4.530)	−0.038		29	
91316	4133	B1 Ib	3.858	−0.217		69	βy
87737	3975	A0 Ib	3.522	−0.142		18	1, 2
							βy
46300	2385	A0 Ib	(4.480)	−0.116		17	1, 2, βy
20902	1017	F5 Ib	1.811	0.241	**	18	1, 4, βy, DG
164136	6707	F2 II	4.402	0.177		27	1, 4, βy
571	27	F2 II	5.030	0.199		47	βy
35468	1790	B2 III	1.634	−0.297		64	1, 8, βy
30836	1552	B2 III	3.667	−0.248		42	βy
22928	1122	B5 III	3.012	−0.240		271	1, 8, βy
23302	1142	B6 III	3.704	−0.215		227	
123299	5291	A0 III	3.659	−0.180	***	12	1, 8, βy
89025	4031	F0 III	(3.430)	0.105		82	βy
13174	623	F2 III	(5.010)	0.127		154	βy
17584	840	F2 III	(4.220)	0.141		149	βy
21770	1069	F4 III	5.301	0.191		29	βy
27022	1327	G5 III	5.269	0.524		<19	βy, DG
28305	1409	K0 III	3.548	0.681		⩽ 8	1, 5, DG
1013	45	M2 III	4.837	1.188	***		1, 8
47105	2421	A0 IV	1.939	−0.151		37	1, 2, βy
211336	8494	F0 IV	4.185	0.072		86	
17094	813	F0 IV	4.268	0.097		54	βy
89449	4054	F6 IV	4.783	0.228		16	βy
82328	3775	F6 IV	3.183	0.253	***	13	1, 4, βy
11443	544	F6 IV	(3.530)	0.254		95	1, 4, βy
216385	8697	F7 IV	(5.220)	0.261		0	βy
220657	8905	F8 IV	(4.510)	0.350		79	βy
121370	5235	G0 IV	2.705	0.328			βy
23249	1136	K0 IV	3.548	0.601	***	<17	1, 3, 4, 8, DG
36512	1855	B0 V	4.592	−0.320		17	βy
3360	153	B2 V	3.646	−0.276		22	βy
74280	3454	B3 V	4.291	−0.274		132	βy
32630	1641	B3 V	3.155	−0.270		139	βy
83754	3849	B5 V	(5.060)	−0.250	***	185	βy
23338	1145	B6 V	4.302	−0.218		134	βy

Table 1 (Continued)

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
87901	3982	B7 V	1.375	−0.219		354	1, 8, βy
214923	8634	B8 V	3.416	−0.215		196	βy
135742	5685	B8 V	(2.610)	−0.209	*	230	1, 8, βy
222173	8965	B8 V	4.280	−0.209	*	84	βy
103287	4554	A0 V	2.452	−0.154		163	1, 2, 8, βy
71155	3314	A0 V	3.902	−0.159		122	1, 2, 8, βy
139006	5793	A0 V	(2.230)	−0.148		132	βy
97633	4359	A2 V	3.320	−0.154		14	1, 2, 8, βy
1280	63	A2 V	4.608	−0.113	*	107	1, 2, βy
106591	4660	A3 V	(3.313)	−0.089	**	177	1, 2, 3, βy
11636	553	A5 V	2.664	−0.061		73	1, 8, βy
8538	403	A5 V	2.653	−0.045	**	116	1, 8, βy
87696	3974	A7 V	4.484	−0.000		157	1, 2, βy
58946	2852	F0 V	4.169	0.119		63	1, 3, βy
110379	4825	F0 V	2.766	0.141	*	27	1, 3, 8, βy
91480	4141	F1 V	5.156	0.137		79	βy
128167	5447	F2 V	4.474	0.168	*	0	βy
134083	5634	F5 V	4.930	0.210	*	44	1, 3, βy
210027	8430	F5 V	3.770	0.216	***	7	1, 4, βy
30652	1543	F6 V	3.199	0.230		16	1, 3, 4, βy
173667	7061	F6 V	4.194	0.249		14	1, 8, βy
142860	5933	F6 V	3.880	0.258	**	7	1, 3, 4, 8, βy
120136	5185	F7 V	4.498	0.255		14	βy
16895	799	F7 V	4.110	0.261	***	6	1, 4, βy
126660	5404	F7 V	4.051	0.264	*	31	1, 3, βy
184960	7451	F8 V	5.719	0.252		$\leqslant$ 6	βy
90839	4112	F8 V	4.838	0.293		0	1, 3, 4, βy
9826	458	F8 V	(4.080)	0.294		8	1, 3, 4, βy, DG
102870	4540	F8 V	3.636	0.301		0	1, 3, 4, 8, βy
114710	4983	G0 V	4.252	0.332		6	1, 3, 4, βy, DG
19373	937	G0 V	4.059	0.335		$\leqslant$10	1, 3, 4, βy, DG
13974	660	G0 V	4.873	0.351		$\leqslant$10	1, 3, 4, βy, DG
109358	4785	G0 V	4.276	0.350		$\leqslant$ 3	1, 3, 4, βy, DG
115043		G2 V	6.811	0.356		<50	1, 4, βy
10307	483	G2 V	4.966	0.362		$\leqslant$ 3	1, 3, 4, βy, DG
20630	996	G5 V	(4.820)	0.407		<17	1, 4, βy, DG
6582	321	G5 Vp	5.166	0.431	**	<17	βy, DG
117176	5072	G5 V	4.967	0.441		$\leqslant$10	βy, DG
10700	509	G8 Vp	3.481	0.424		<17	1, 3, βy, DG
101501	4496	G8 V	5.317	0.449	*	<17	1,3, DG
154345		G8 V	(6.770)	0.457	**		1, 3, βy, DG
103095	4550	G8 VI	6.434	0.482			1, 3, 4, βy, DG
10780	511	K0 V	5.622	0.492			1, 3, DG
124752		K0 V	8.517	0.519	*		
3651	166	K0 V	5.900	0.526	***		1, 3, βy, DG
166620	6806	K2 V	6.393	0.552	***		βy, DG
109011		K2 V	8.103	0.599	*		DG
128165		K3 V	7.255	0.616	***		
219134	8832	K3 V	(5.570)	0.628			1, 3, 4, βy, DG
151288		K7 V	8.091	0.919	***		1,3

TABLE 2

Stars classified by C² J², Cowley *et al.* (1969)

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
6457	311	A0 Vn	5.549	−0.194		267	βy
85504	3906	A0 Vs	6.018	−0.185	***		βy
92728	4187	A0 Vs	5.794	−0.185		40	
118214	5109	A0 V	5.599	−0.167	*	197	βy
71155	3314	A0 V	3.902	−0.159		127	1, 2, 8, βy
23441	1152	A0 Vn	6.439	−0.154	**	267	
103287	4554	A0 V	2.452	−0.154		169	1, 2, 8, βy
6456	310	A1 Vn	5.329	−0.150	***	247	βy
2888	128	A1 Vn	6.697	−0.148		265	βy
14055	664	A1 Vnn	(4.080)	−0.147		225	βy
77327	3594	A1 Vn	3.584	−0.147		247	2, 8, βy
30739	1544	A1 V	4.353	−0.139		250	βy
25490	1251	A1 V	(3.900)	−0.127		110	2, 8, βy
111397	4865	A1 V	5.707	−0.125			βy
97633	4359	A2 V	3.320	−0.155		2	1, 2, 8, βy
50973	2585	A2 Vn	(4.890)	−0.129	*	210	βy
125642	5373	A2 V	6.308	−0.115			βy
12471	599	A2 V	5.505	−0.114		100	βy
1280	63	A2 V	4.608	−0.113	*	116	1, 2, βy
28978	1448	A2 Vs	5.685	−0.103			βy
146738	6074	A3 V	5.797	−0.108	***	80	βy
23848	1177	A3 V	(5.100)	−0.101		117	βy
216627	8709	A3 V	(3.290)	−0.096	***	96	βy
27820	1381	A3 V	5.112	−0.089		90	βy
106591	4660	A3 V	(3.313)	−0.088	**	179	1, 2, 3, βy
18331	875	A3 V	(5.170)	−0.084		300	βy
141003	5867	A3 V	3.674	−0.081		200	βy
56537	2763	A3 V	3.585	−0.076		157	βy
14417	684	A3 V	6.480	−0.069			βy
118098	5107	A3 V	3.373	−0.068		195	βy
119024	5142	A3 Vn	5.467	−0.068		215	βy
108382	4738	A4 V	4.986	−0.075		94	2, 8
105805	4633	A4 Vn	6.014	−0.055	**	172	2, 7
38091	1969	A4 Vn	5.935	−0.027	***	260	βy
5448	269	A5 V	(3.930)	−0.052		77	βy
116842	5062	A5 V	4.016	−0.020		250	βy
220061	8880	A5 V	4.589	−0.005		175	βy
79439	3662	A5 V	4.814	0.007		178	βy
32301	1620	A7 V	(4.640)	−0.036		131	2, 5, βy
177196	7215	A7 V	(5.000)	−0.009		140	βy
87696	3974	A7 V	4.484	0.000		168	1, 2, βy
27084	1330	A7 V	4.454	0.040		97	
95608	4300	A1 m:	4.423	−0.122		24	βy
17581	839	A1 m:	(6.380)	−0.072			βy
195479	7839	A1 m	6.202	−0.058			βy
78209	3619	A1 m	4.463	0.069		38	βy
36484	1850	A2 m	6.487	−0.091			βy
12869	613	A2 m:	5.031	−0.064		0	βy
223461	9025	A2 m	5.968	−0.020			βy
140232	5845	A2 m	5.795	0.003			βy

Table 2 (Continued)

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
72037	3354	A2 m	5.452	0.003		38	βy
166926	6811	A2 m	(5.820)	0.018			
33254	1672	A2 m	5.432	0.031		25	
99945	4429	A2 m	6.117	0.048	*		
221675	8944	A2 m	5.886	0.081			βy
18769	905	A3 m	(5.860)	−0.049	***	50	βy
79193	3655	A3 m	6.104	0.033			βy
141675	5887	A3 m	5.866	0.033		82	βy
195217	7833	A3 m	(6.330)	0.037			βy
27045	1329	A3 m	4.944	0.049		60	βy
102660	4535	A3 m	6.045	0.063			βy
27628	1368	A3 m	(5.720)	0.104		15	2, 5
33641	1689	A4 m:	(4.740)	−0.001		84	βy
32428	1627	A4 m	6.602	0.070			βy
159560	6555	A4 m	4.867	0.070		47	βy
76756	3572	A5 m	4.266	−0.046	*	74	βy
15385	723	A5 m	6.190	−0.038		60	βy
6116	290	A5 m:	5.955	−0.024			βy
24141	1192	A5 m:	5.795	−0.023			βy
60652	2914	A5 m	5.913	0.108			βy
111421	4866	A6 m:	6.250	−0.012		40	βy
3883	178	A7 m	6.059	0.046	*		βy
107168	4685	A8 m:	6.250	−0.024		⩽12	
90569	4101	A0 p	6.013	−0.207		90	βy
10221	478	A0 p	5.569	−0.205		30	βy
32549	1638	A0 p	4.666	−0.205		29	βy
111133	4854	A0 p	(6.350)	−0.203			βy
4778	234	A0 p	(6.140)	−0.173			βy
38104	1971	A0 p	5.467	−0.135		40	βy
74521	3465	A1 p	5.655	−0.242			βy
72968	3398	A1 p	5.735	−0.188			βy
151199	6226	A2 p	6.178	−0.106		110	βy
65339	3109	A2 p	6.035	−0.057			βy
81009	3724	A5 p	6.518	0.001	**		βy
87737	3975	A0 Ib	3.522	−0.142		29	1, 2, βy
46300	2385	A0 Ib	(4.480)	−0.115		17	1, 2, βy
196821	7903	A0 III	(5.910)	−0.185	***		βy
221756	8947	A1 III	(5.580)	−0.089	**	145	βy
50019	2540	A3 III	3.601	−0.063		140	βy
109307	4780	A5 III	(6.230)	−0.066		8	2, 7
173880	7069	A5 III	(4.300)	−0.048		81	βy
125658	5374	A5 III	6.450	−0.042	*		βy
47105	2421	A1 IV	1.939	−0.151		26	1, 2, βy
89021	4033	A2 IV	3.434	−0.115		43	βy
107966	4717	A3 IV	5.163	−0.085		50	2, 7
28527	1427	A6 IV	(4.780)	−0.019		65	
138341	5760	A4 IV	6.455	0.017			βy
27934	1387	A7 IV–V	(4.220)	−0.056		77	
107131	4684	A7 IV–V	6.423	−0.022		175	2, 7
203280	8162	A7 IV–V	2.461	0.019	*	260	2, 3, βy
21551	1051	B8 Vnn	5.819	−0.163		380	

Table 2 (Continued)

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
79469	3665	B9.5 V	(3.880)	−0.208		91	2, 8, βy
47964	2461	B8 III	5.793	−0.208		95	
182691	7381	B9 III	6.493	−0.192			
205551	8259	B9 III	(5.940)	−0.122		200	
35600	1804	B9 Ib	5.709	0.041			
133029	5597	B9 p	(6.380)	−0.256			βy
205087	8240	B9 p	6.701	−0.230	*		βy
68351	3215	B9 p	5.618	−0.216		0	βy
207857	8349	B9 p	(6.160)	−0.195	***		βy
184961	7452	B9 p?	6.328	−0.191	**	50	βy
145389	6023	B9 p	4.237	−0.185		0	βy
219749	8861	B9 p	(6.270)	−0.163		70	βy
148112	6117	B9 p	(4.560)	−0.156		44	2, 8, βy
173650	7058	B9 p	(6.500)	−0.137			βy
27176	1331	F0 V	(5.650)	0.073		105	2, 5
107326	4694	F0 IV	(6.080)	0.099		125	
108283	4733	F0 IIInp	4.922	0.085		227	
118295	5116	F0 III	6.841	0.008			βy
126661	5405	F0 m	5.408	0.031		50	βy
176232	7167	F0 p	5.915	0.038		103	βy

TABLE 3

Stars with trigonometric parallax *A*, *B*, *C*

HD or DB	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
63°0137		K7 V	8.983	0.873	**		8.29 DG
166	8	K0 V	6.085	0.462	*		5.3 3, DG
3651	166	K0 V	5.900	0.526	***		5.75 βy, DG, 1
4628	222	K2 V	(5.760)	0.549			6.55 3, 8, DG
9826	458	F8 V	(4.080)	0.294		8	3.06 1, 3, 4, βy, DG
10307	483	G2 V	4.966	0.362		⩽ 3	4.66 1, 3, 4, βy, DG
10700	509	G8 Vp	3.481	0.424		<17	5.72 1, 3, βy, DG
10780	511	K0 V	5.622	0.492			5.91 1, 3, DG
13974	660	G0 V	4.873	0.351		⩽10	4.80 1, 3, 4, βy, DG
17925	857	K0 V	6.057	0.542	**		6.57 DG
19373	937	G0 V	4.059	0.335		⩽10	3.72 1, 3, 4, βy, DG

Table 3 (Continued)

HD or BD	HR or other	Sp	m_v	$B_2 - V_1$	Variab.	$V \sin i$	Remarks
23249		K0 IV	3.548	0.601	***	<17	3.77 1, 3, 4, 8, DG
25329		K1 Vsd	8.495	0.561	**		7.10 3, 4, βy, DG
25680	1262	G5 V	5.900	0.368			5.09
30652	1543	F6 V	3.199	0.230		16	3.76 1, 3, 4, βy
34411	1729	G0 V	4.706	0.360		⩽ 3	3.84 3, 4, βy, DG
37394	1925	K1 V	6.224	0.524			6.07 DG
58946	2852	F0 V	4.169	0.119		63	2.84 1, 3, βy
65583		G8 V	(7.000)	0.451			5.82 βy, DG
72905	3391	G0 V	5.629	0.362		4	4.67 βy, DG
76644	3569	A7 V	3.127	0.015		138	2.24 βy
84035		K5 V	8.139	0.712	***		7.31
84737	3881	G1 V	5.089	0.362		⩽10	4.20 βy
88230		K7 V	6.597	0.931	***		8.32 βy, DG
89125	4039	DF3	5.820	0.279		⩽ 6	4.7 βy
90839	4112	F8 V	4.838	0.293		0	4.44 1, 3, 4, βy
95128	4277	G0 V	5.043	0.364		⩽ 3	4.4 βy, DG
101501	4496	G8 V	5.317	0.449	*	<17	5.55 1, 3, DG
102870	4540	F8 V	3.636	0.301		0	3.60 1, 3, 4, 8, βy
103095	4550	G8 VI	6.434	0.482			6.71 1, 3, 4, βy, DG
106591	4660	A3 V	(3.313)	−0.089	**	177	1.9 1, 2, 3, βy
109358	4785	G0 V	4.276	0.350		⩽ 3	4.46 1, 3, 4, βy, DG
110379	4825	F0 V	2.766	0.141	*	27	3.46 1, 3, 8, βy
110833		K3 V	7.017	0.585			6.0 DG
110897	4845	G0 V	5.961	0.329		⩽ 6	5.0 3, 4, βy, DG
114710		G0 V	4.252	0.332		6	4.66 1, 3, 4, βy, DG
126660	5404	F7 V	4.051	0.264	*	31	3.22 1, 3, βy
131156	5544	G8 V	4.555	0.483		<16	A: 5.53 B: 7.69

Table 3 (Continued)

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
131511	5553	K2 V	6.017	0.528	*		5.66
							DG
134083	5634	F5 V	4.930	0.210	*	44	3.9
							1, 3, βy
139323		K3 V	7.654	0.581	*		6.2
142860	5933	F6 V	3.880	0.258	**	7	3.4
							1, 3, 4, 8, βy
145417		K0 V	7.521	0.514			6.64
145675		K0 V	6.611	0.542			5.6
							DG
151288		K7 V	8.091	0.919	***		8.19
							1, 3
154345		G8 V	(6.770)	0.457	**		5.73
							1, 3, βy, DG
157214	6458	G8 V	5.388	0.381	*	0	4.71
							βy, DG
160346		K3 V	6.529	0.606			6.06
							DG
182488	7368	K0 V	(6.380)	0.504			5.14
							DG
190406	7672	G IV	5.795	0.363	***	4	4.6
							βy, DG
193664	7783	G5 V	5.905	0.345			5.07
203280	8162	A7 V–IV	2.461	0.018	*	240	1.5
							2, 3, βy
217987		M2 V	7.356	1.131			9.59
219134	8832	K3 V	(5.570)	0.628			6.41
							1, 3, 4, βy, DG

TABLE 4.1

Stars with abundances determinations, Cayrel and Cayrel de Strobel

HD or BD	HR or others	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
3627	165	K3 III	(3.210)	0.898		<17	0.00
							DG
5015	244	F8 IV–V	(4.860)	0.306		6	−0.15
							βy
5544		K0 III	(7.710)	0.783			0.33
10307	483	G2 V	4.966	0.362		≤ 3	0.20
							1, 3, 4, βy DG
10380	489	K3 III	4.466	0.995		<19	0.00
							DG
11443	544	F6 IV	(3.530)	0.254		95	−0.12
							1, 4, βy
37°00432		K2 III	(9.010)	0.680	***		−0.25
							DG, βy

Table 4.1 (Continued)

HD or BD	HR or others	Sp	m_v	$B_2 - V_1$	Variab.	$V \sin i$	Remarks
13974	660	G0 V	4.873	0.351		≤10	−0.43 −0.18 −0.51 1, 3, 4, βy, DG
16895	799	F7 V	4.110	0.261	***	6	+0.07 −0.02 1, 4, βy
18474	885	G4p	5.484	0.594			0.15 DG
19373	937	G0 V	4.059	0.335		≤10	0.14 0.26 1, 3, 4, βy, DG
19445		F7 VI	8.041	0.269	***		−0.77 −1.75 −1.75 βy
20630	996	G5 V	(4.820)	0.407		<17	0.38 1, 4, βy, DG
20902	1017	F5 Ib	1.811	0.241	**	18	−0.45 1, 4, βy, DG
22484	1101	F8 V	4.288	0.335		0	0.37
22879		F9 V	6.673	0.316			−0.57 βy
23230	1135	F5 II	(3.770)	0.209		44	−0.19 βy, DG
23249	1136	K0 IV	3.548	0.601	***	<17	0.00 −0.09 1, 3, 4, 8, DG
25329		K1 V	8.495	0.561	**		−2.30 3, 4, βy, DG
30455		G2 V	6.954	0.374	**		−0.09 −0.26 DG
30649		G1 V–VI	6.959	0.355			−0.32 −0.20 βy, DG
30652	1543	F6 V	3.199	0.230			−0.40 1, 3, 4, βy
31398	1577	K3 II	2.707	1.149		<17	0.00 βy, DG
34411	1729	G0 IV	4.706	0.360		≤ 3	0.14 0.22 3, 4, βy, DG
55575	2721	G0 V	5.554	0.342		≤ 6	−0.21 βy, DG
64491	3083	Ap	6.224	0.082		70	−0.70 βy
72324	3369	G9 III	6.353	0.688			0.32 DG
73665	3427	K0 III	6.396	0.648	*	0	−0.04 DG, 4, 6, βy
73710	3428	K0 III	6.418	0.671		<45	−0.17

Table 4.1 (Continued)

HD or BD	HR or others	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
82328	3775	F6 IV	3.183	0.253	***	13	DG, βy −0.44
86728	3951	G4 V	5.390	0.398		⩽10	1, 4, βy 0.34 0.34
90508	4098	G1 V	6.435	0.366		⩽10	βy, DG −0.23
90839	4112	F8 V	4.838	0.293		0	βy, DG 0.23
102870	4540	F8 V	3.636	0.301		0	1, 3, 4, βy 0.33
103095	4550	G8 VI	6.434	0.482			1, 3, 4, 8, βy −1.50
106516	4657	F6 V	(6.110)	0.234		8	1, 3, 4, βy, DG (+0.05) (−0.86)
109358	4785	G0 V	4.276	0.350		⩽ 3	βy 0.02
109995		A0 V	7.589	−0.098		30	1, 3, 4, βy, DG −1.20
110897	4845	G8 V	5.961	0.329		⩽ 6	βy −0.32
114710	4983	Go V	4.252	0.332		6	3, 4, βy, DG 0.19 0.05 0.08
114762		F9 V	7.302	0.311	***		1, 3, 4, βy, DG −0.59
115043		G0 V	6.811	0.356		<50	−0.06 −0.14
122563	5270	Pop II gi.	6.177	0.642	*		1, 4, βy −2.90 −2.65
142267	5911	G2 V	6.087	0.359	**		βy, DG −0.28
142860	5933	F6 IV	3.880	0.258	**	7	βy −0.40 −0.36
152792		G0 V	6.822	0.388			1, 3, 4, 8 −0.45
157089		G0 V	(6.960)	0.333			βy, DG −0.57
160693		G0 V	8.381	0.336	***		βy, DG −0.69
161817		A2 VI	6.963	−0.008	***		DG (−0.41)
164136	6707	F2 III	4.402	0.177		27	βy 0.08
170153	6927	F7 V	3.546	0.279	**	11	1, 4, βy −0.64
185657	7477	G6 V	(6.350)	0.677			4, 8, βy −0.51

Table 4.1 (Continued)

HD or BD	HR or others	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
187923	7569	G2 V	(6.154)	0.389	**	⩽10	0.12 0.00 βy, DG
190404		K2 V	7.288	0.502	*		−0.20 DG
191046		K0 III	(7.200)	0.821			−0.42 DG
193370	7770	F5 Ib	(5.220)	0.401		13	−0.19 βy
197461	7928	A7 III	4.443	0.091	**	41	0.50 βy
198149	7957	K0 IV	(3.430)	0.605		<17	0.00 βy, DG
201626		K0 IIIp	8.121	0.823	***		−1.45 βy, DG
210027	8430	F5 V	3.770	0.216	***	7	−0.10 1, 4, βy
215648	8665	F7 V	(4.190)	0.265		7	−0.05 βy
218804	8825	F5 IV	(5.950)	0.224		18	−0.21, βy
219134	8832	K3 V	(5.570)	0.628			0.00 1, 3, 4, βy, DG
221170		Pop II gi.	7.677	0.803	**		−2.70 βy, DG
221345	8930	G8 III	(5.220)	0.705	*	<19	−0.20 DG
224930	9088	G3 V	(5.760)	0.420	*	⩽ 6	−0.59 −0.70 −0.55 −0.60, βy, DG

TABLE 4.2

Stars with abundances determinations, Powell

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
9826	458	F8 V	(4.080)	0.294		8	−0.11 1, 3, 4, βy, DG
19373	937	G0 V	4.059	0.335		⩽10	0.05 βy, DG
30652	1543	F6 V	3.199	0.230			0.18 βy
82328	3775	F6 IV	3.183	0.253	***	13	−0.03 βy
102870	4540	F8 V	3.636	0.301		0	0.15 1, 3, 4, 8, βy
109358	4785	G0 V	4.276	0.350		⩽ 3	−0.23 βy, DG

Table 4.2 (Continued)

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
136202	5694	F8 IV–V	(5.060)	0.299		0	−0.17 βy
142373	5914	F9 V	4.614	0.340		0	−0.35 βy
142860	5933	F6 IV	3.880	0.258	**	7	−0.11 1, 3, 4, 8, βy
222368	8969	F7 V	4.130	0.269	**	6	0.09 βy

TABLE 5

Stars members of the Hyades

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
27176	1331	A8 V	(5.650)	0.073		97	2, 5, βy
27397	1351	F3 V	(5.590)	0.068		109	βy
27459	1356	F0 V	5.280	0.025		65	βy
27524		(F8)	(6.800)	0.203		94	βy
27628	1368	Am	(5.720)	0.104		15	2, 5, βy
27946	1388	A7 V	(5.280)	0.048		153	βy
28294	1408	(F0)	5.916	0.119		102	βy
28305	1409	K0 III	3.548	0.680		⩽ 8	1, 5, βy, DG
28406		(F8)	6.899	0.231		20	βy
28527	1427	A7 V	(4.780)	−0.019		69	βy
28546	1428	Am	5.499	0.043		23	βy
28556	1430	(F1)	(5.400)	0.048		95	βy
28568		(F2)	(6.510)	0.209		53	βy
30780	1547	A5	(5.100)	0.022		141	βy
32301	1620	A7 V	(4.640)	−0.036		127	2, 5, βy

TABLE 6

Stars members of Praesepe

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
	Prae 23	G		0.428	***		
19°02050	Prae 34	F2 V	9.446	0.193		<45	βy
73174	Prae 40	Am	7.759	−0.010		29	βy
19°02052	Prae 47	F4 V	9.812	0.239	**		βy
73345	Prae 114	F0 V	8.152	0.000		96	βy
	Prae 127	G2	10.818	0.340	***		βy
73430	Prae 143	A9 V	8.311	0.021	**	73	βy
20°02145	Prae 155	F6	9.393	0.192	**		βy
73598	Prae 212	K0 III	6.593	0.632	***	<45	βy, DG
73616	Prae 226	F2 V	8.899	0.111		131	βy
73641	Prae 227	F2 V	9.475	0.195	*	15	βy
73617	Prae 232	F5 V	9.221	0.156		127	βy

Table 6 (Continued)

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
73640	Prae 239	F4 V	9.661	0.215		32	βy
20°02157	Prae 250	F6 V	9.775	0.230		120	βy
73665	3427 Prae 253	K0 III	6.396	0.648	*	0	4, 6, βy, DG
20°02161	Prae 271	F2 V	8.779	0.087	***	86	βy
73730	Prae 286	Am	8.006	−0.011	**	30	βy
	Prae 293	–	9.836	0.236			βy
20°02170	Prae 295	(F6)	9.347	0.189		95	βy
73746	Prae 318	F0 V	8.644	0.079		95	βy
73763	Prae 323	A9 V	7.814	0.018		130	βy
73798	Prae 340	F0 Vn	8.467	0.062		166	βy
73819	Prae 348	A6 Vn	6.766	−0.023		140	βy
73854	Prae 370	F5 V	9.014	0.133		116	βy
20°02180	Prae 396	F4 V	9.815	0.234			βy
73937	Prae 411	F4 V	9.321	0.170		49	βy
73974	Prae 428	K0 III	6.910	0.653		<45	βy, DG
73993	Prae 429	F0 V		0.093	**	195	βy
74028	Prae 445	A7 V	7.962	0.001		180	βy
20°02190	Prae 454	–	9.881	0.230	*		βy
74058	Prae 459	F2 V	9.204	0.164		130	βy
20°02192	Prae 472	–	9.765	0.213			βy
20°02193	Prae 478	F4 V	9.674	0.218		<45	βy
72779	3387 PraeVL 133	G8 III	6.584	0.429		95	βy
72846	PraeVL 166	A5 V	7.494	−0.039		140	βy

TABLE 7

Stars members of Coma Berenices

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
105805	4633	A4 V	6.014	−0.055	**	172	2, 7, βy
106103		F5 V		0.190	***	<12	βy
106691		F2 V	8.090	0.188	**	30	βy
106946		F2 V	7.836	0.158	***	50	βy
107067		F8 V	8.696	0.282		⩽12	βy
107132		G0 V	8.787	0.281		12	βy
107131	4684	A5 V	6.423	−0.022		175	2, 7, βy
107168	4685	Am	6.250	−0.024		⩽12	βy
107276		Am	6.625	−0.011		95	βy
107399		G0 V	9.016	0.326			βy
107611		(F7)	8.503	0.237		15	βy
107685		(F7)	8.529	0.237	**	⩽12	βy
107877		F5 V	8.358	0.219	***	20	βy
107966	4717	A4 p	5.163	−0.085		54	2, 7, βy
108154		(F8)	8.559	0.251		⩽12	
108226		F6 V	8.337	0.221	**	⩽12	βy
108486		Am	6.676	−0.012	*	30	
109307	4780	Am		−0.066		8	2,8

TABLE 8.1

Stars with known spectral energy distribution, Willstrop

HD or BD	HR or other	Sp	m_v	$B_2 - V_1$	Variab.	$V \sin i$	Remarks
1013	45	M2 III	4.837	1.188	***		1, 8
3196	142	F8 V		0.315		18	DG
4628	222	K2 V		0.549			3, 8, DG
9270	437	G8 III	3.654	0.664		<19	βy, DG
11636	553	A5 V	2.664	−0.061		73	1, 8, βy
14386	681	(gMbe)	4.684	1.500	***		
20630	996	G5 V		0.407		<17	βy, DG
23249	1136	K0 IV	3.548	0.601	***	<17	1, 3, 4, 8, DG
36673	1865	F0 Ib	2.607	0.018	***	13	βy
129247	5478	A3 III	3.769	−0.119		156	
142860	5933	F6 V	3.880	0.258	**	7	1, 3, 4, 8, βy
166197	6788	B1 V	6.117	−0.222			βy
173667	7061	F6 V	4.194	0.249		14	1, 8, βy
203504	8173	K1 III	4.104	0.758		<17	βy, DG
209747	8413	K4 III		1.041	**	<17	DG
217987		M2 V	7.356	1.131			

All these stars have also to satisfy conditions 1 to 4 (except complementary information given in the column 'remarks'). For each star we give the colour indice $B_2 - V_1$. The 7 heterochromatic colours normalised to B can be found in (1971); the 7 monochromatic colours (deduced from the 7 heterochromatic colours) normalised to G and the 7 effective wavelengths of the monochromatic colours can be obtained at the Geneva Observatory (Monochromatic colours Catalogue). Let us point out that the λ_{eff} of filter U may not always be very accurate for stars having a large Balmer discontinuity.

Many stars are common to several tables; the numbers of the tables are given in the 'remarks' column. The magnitudes given are the V magnitudes established by Rufener and Maeder (1972), the magnitudes in brackets are taken from Literature. The spectral classifications given in tables 3 to 7 are taken from the catalogues of Jaschek *et al.* (1964) and from its extension by Kennedy. In the remarks column we also indicate by βy the stars also measured in the $u\ v\ b\ y\ \beta$ system, the general catalogue of which is being prepared by Lindemann and Hauck (1973); and by DG the cool stars measured in the Copenhagen system (1970).

The selection presented here gathers together stars which may serve to calibrate criteria for M_v, Sp, [Fe/H], etc. But these are also stars to which we believe it is important to give some attention and to attempt to determine the fundamental parameters M_v, θ_{eff}, $\log g$, χ. The proposed selection should be enriched with hot stars of well known absolute magnitude and reddening. For this purpose, one must measure young clusters of well determined distance modulus.

TABLE 8.2

Stars with known spectralenergy distribution, Terechtchenko and Kharitonov

HD or BD	HR or other	Sp	m_v	B_2-V_1	Variab.	$V \sin i$	Remarks
3196	142	F8 V		0.315		18	DG
4727	226	B5 V	4.525	−0.242		75	βy
8538	403	A5 V	2.653	−0.045	**	116	1, 8, βy
11636	553	A5 V	2.664	−0.061		73	1, 8, βy
16970	804	A2 V		−0.087		183	
20320	984	Am	4.797	0.023	*	68	βy
22928	1122	B5 III	3.012	−0.240		271	1, 8, βy
25490	1251	A1 V		−0.127		71	2, 8, βy
35468	1790	B2 III	1.634	−0.297		64	1, 8, βy
58715	2845	B8 V		−0.208		270	βy
71155	3314	A0 V	3.902	−0.159		122	1, 2, 8, βy
77327	3594	B9n	3.584	−0.147		219	2, 8, βy
79469	3665	B9.5 V	–	−0.208		86	2, 8, βy
87901	3982	B7 V	1.375	−0.219		354	1, 8, βy
90089	4084	F5 IV	5.259	0.180	*	107	βy
97633	4359	A2 V	3.320	−0.156		14	1, 2, 8, βy
102870	4540	F8 V	3.636	0.301		0	1, 3, 4, 8, βy
103287	4554	A0 V	2.452	−0.154		163	1, 2, 8, βy
106112	4646	Am	5.145	0.109		69	βy
108382	4738	A2	4.986	−0.074		89	2, 8
110379	4825	F0 V	2.766	0.141	*	27	1, 3, 8, βy
120315	5191	B3 V	1.856	−0.258		216	βy
123299	5291	A0 III	3.659	−0.180	***	12	1, 8
129247	5478	A3 III	3.769	−0.119		156	
135742	5685	B8 V		−0.209	*	230	1, 8, βy
148112	6117	A1p		−0.156		28	βy
170153	6927	F7 V	3.546	0.279	**	11	4, 8, βy
202444	8130	F0 IV		0.185		94	
207098	8322	Am		0.095	*	104	βy
212061	8518	B9 III		−0.193		82	βy
218658	8819	G2 III	4.401	0.510		22	DG
224617	9072	F4 IV		0.206	*	34	βy

4. Stars With Known Spectral Energy Distribution

In Table 8 we give the 7 colours of the stars whose spectral energy distribution is given by Willstrop (1965) and by Terechtchenko and Kharitonov (1972). The selected stars do not satisfy the 4 conditions given in paragraph 3. They have a weight $p \geqslant 3$ in the $U\ V\ B\ B_1\ B_2\ V_1\ G$ photometry, but can be binaries, reddened, and have a high rotational velocity. Nevertheless, they are useful for the photometrist who can use them to check the quality of the determination of his system's bandpasses.

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DISCUSSION

Pecker: When trying to apply to observed stars the very fine rotating models built by Maeder, for example, we should keep in mind that the measured '$V \sin i$' plotted in the tables of Golay are not necessary measured *rotations*, they are just measurements of broadening, and stellar lines can be broadened by other causes, such as macro-velocity fields. Therefore, the 'rotating models' are not necessarily adequate to fit the observations.

Kodaira: I am of the same opinion as Dr Pecker, but as the zeroth approximation, one can ıegard the broadening of lines as the result of the rotation. It is worthwhile to try to establish the possible rotation effect observationally. But Dr Golay limits the value of $V \sin i$ to below 150 km s^{-1}s, in order to avoid the influence of the stellar rotation. In doing so, however, you would bias your data, by mixing the intrinsic slow rotators with stars of high or moderate rotational velocity whose axises have small or moderate inclination (near 'pole-on'). My suggestion is to extend the standard stars as far as possible to a higher value of $V \sin i$ ($\sim$ 350), so far as no emission lines are observed.

Maeder: In connexion with Prof. Pecker's remark, I will firstly add that the fact that we do not know the law of rotation inside the stars is a black point in the theory of rotating models. In that respect, we may perhaps hope that the comparisons between observations and models bring some information on this subject. Secondly, so-called *observable* quantities like $V \sin i$ in fact are estimated by means of *theoretical* models.

Garrison: This may seem to be a comical remark, but I will make it semi-seriously. Perhaps we should choose stars with large $V \sin i$ as standards. At least then we know they are not pole-on and it should be a more homogeneous group.

FitzGerald: To add to Dr Garrison's remark that perhaps the fast rotation should be used as standards, it should be remarked that there was a paper at Athens suggesting that Am stars were slow rotators, in which element differentiation could occur, whereas in the moderate rotation mixing occurs preventing element differentiation. Thus the 'normal' stars suitable for standards should be the moderate rotators.

Hanbury-Brown: The angular diameters of 32 stars have been measured at Narrabri Observatory ranging in spectral type from O5 to F8. I will send a list of these stars to Prof. Golay for consideration as possible members of his list of standard stars.

Pecker: When one shifts from a group of stars of a given brightness to a less bright, methods of observation are changed. For example, (1) very bright stars are studied with very large dispersion; abundances etc. are determined. (2) bright stars are studied with lower spectrographic resolution and are more numerous. (3) still more numerous, less bright stars are available for 7-colour photometry (for example) etc.... The stars to be used as standards for group (n) have to be taken in groups (1) (2)... ($n-1$), but the smaller the n is, the smaller is the number of standard stars that are not monsters, that are 'safe'. By going to larger and larger groups, one improves the sampling, one deteriorates the quality of the 'standard' physical characteristics of this sampling. The whole thing is essentially a matter of successive approximations, and of the choice of 'proper equilibrium' between the completeness of the sampling and the physical meaning of this sampling.

Lamla: Which effects have faint lines in your 7-colour system? You compare your integrated brightness values with model intensities which give, I guess, the continuum without lines.

Golay: No, we use the models of Peytremann (Thesis, Geneva (1970) which include the opacities of metallic lines.

Garrison: It is perhaps useful to clarify the situation regarding 'standard' stars in the MK system. For this purpose we can talk about fundamental standards, which are those stars to which the MK system is anchored; about primary standards, which are those stars that have been studied extremely carefully, such as the ones listed in the Johnson-Morgan paper; about secondary standards, which are stars within a given set of plates which fit the above standards and look very normal; and about the non-standard types which are stars that are observed carefully and classified carefully using the MK system. These latter stars should not be used with the same weight, in general, as the fundamental or primary standards as representatives of the MK system. In Prof. Golay's paper, for example, he has referred to the paper by the Cowley's and the Jaschek's as standard. I think that Prof. Jaschek would agree that his paper is in the last category.

Hack: Because of the uncertainty of oscillator strengths and because of the difficulty to fit stellar atmospherical models and observations, probably the safest way to derive atmospherical chemical composition is the method of the differential curve of growth. Hence we need standard stars for which we have good data on spectral energy distribution, Balmer discontinuity etc. so as to have reliable data on T_{eff} and g, and $V \sin i < 20$ km s^{-1}, and to correlate all these standards to the Sun by a 'grid' of standards covering the whole HR diagram, that is by comparing a G0 V to the Sun, a F8 V to the G0 V and so on.

Keenan: In connection with your list of standard stars for observation in as many ways as possible I would recommend first the inclusion of all the stars in the lists that Morgan and I will include in our review article that is coming out in *Annual Reviews of Astronomy and Astrophysics* next year. These lists are not ready yet, but in the meantime I shall send you soon a short list of some stars, mostly fainter than $V = 6.5$, that can be considered as type stars of some of the special population groups. If you do observe these in your colour system it will be very interesting to see how you distinguish them from the ordinary stars of types G, K and M. The types that I give in the list represent my most recent ones.

Murray: I would like to put in a plea for more late type dwarfs among the standards; there is only one in Golay's lists. There are obvious difficulties due to faintness and probable duplicity of many of these stars, but accurate calibration of their luminosities are very important. Fortunately many of these stars have good trigonometric parallaxes, and soon there will be more parallaxes available for Vyssotsky's stars which are on the observing lists of several parallax observers.

Gliese: The distance determinations of Vyssotsky's stars (which are dK8 to dM2) is not sufficient since the maximum of the luminosity function in the solar neighbourhood is supposed to be in the region of the dM8 stars. Probably the most promising way is by the parallax program of the USNO in combination with R, I measurements which allow the calibration of the (M_v, $R-I$) relation of these very red dwarfs. This relation should be used for late-type red dwarfs, for instance, near the galactic poles.

Jones: I have observed 700 M stars with 30 Å interference filters:

7460 Window
7100 TiO
6830 Ca H
6076 Window.

As was first shown by Ohman Ca H is luminosity sensitive. On the present system TiO: CaH is a dwarf/giant discriminator with amplitude ~ 0.4 mag. 7460–6076 correlates well with $R-I$ and photometric parallaxes can be determined from the m_{7460} vs $m_{7460} - m_{6076}$ plot. The TiO strength correlates well with that observed by Wing. At the Cordoba Symposium he proposed a new spectral type scale for dwarfs, based on giants with the same TiO strength. I suggest the same standards be adopted here. In particular I confirm Wing's conclusion that Proxima Centauri is ~ .04 of a spectral type earlier than Wolf 359. I have observed the 100 M stars discovered by McCarthy and his co-workers in the South Galactic Cap. About 25 are dwarfs with median proper motion ~ 0″.2. Only a couple are closer than 20 pars. Of course, the volume of space searched at M6 V is much smaller than at M0 V.

Pecker: Theoreticians want to get from obseivers *L*, *M*, *R*, – to induce results on evolutionary properties, etc. It seems to me that from our point of view, interesting stars are necessarily falling in the region of the conceptual (M_v, apparent Radius, apparent binary separation) diagram where data at present are sufficiently well known. 'Standards' are there in *small* numbers; but the use of photometry, using this small number of objects as primary standards, may extend the number of stars that could be used as secondary standards.

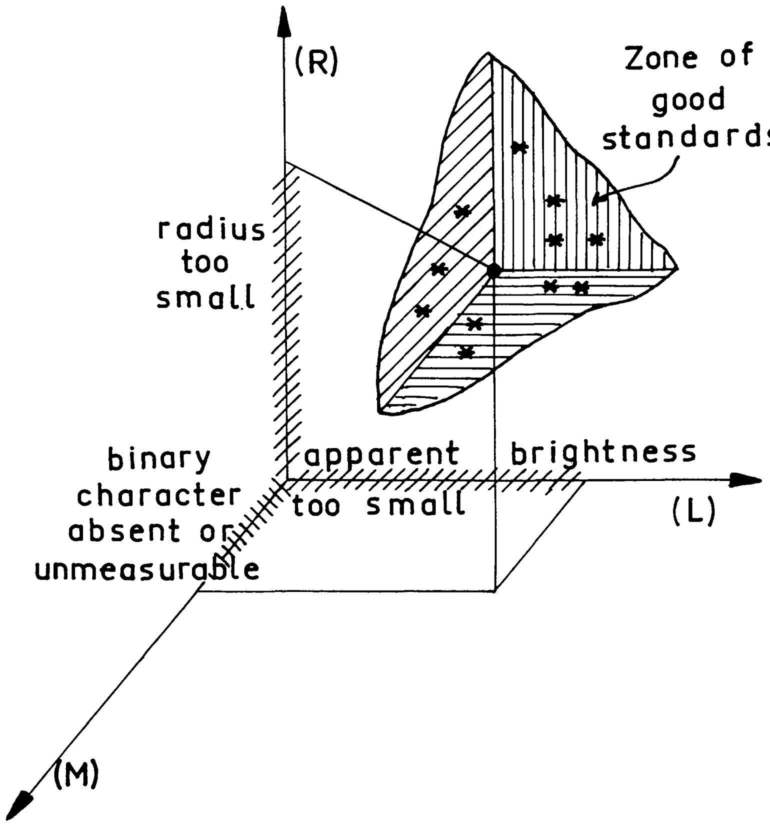

Fig. 6