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BLUE STRAGGLERS IN THE SOLAR VICINITY: NEWBORN OR REBORN

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ABSTRACT

A selected sample of 1400 A0/1 to F2/(log T_e=3.96 to 3.82) stars with accurate photometric and astrometric data are discussed on the basis of luminosities obtained from both Strömgren+Hβ and Geneva photometry. The sample contains members of the Hyades, Sirius, and HR 1614 superclusters, all of which show an appreciable age spread. The spread of 6 to 20×10^8 yr in the Hyades supercluster is reflected in a spread of about 6 to 10×10^8 yr in the Praesepe and Hyades clusters within the supercluster. Strong arguments are presented for the presence of a larger age spread in the noncluster supercluster members than in the contained clusters. The age range for members of the Sirius supercluster is 2 to 6×10^8 yr and nearly all of this range is seen in the UMa nucleus of the Sirius supercluster, contained within the supercluster. The HR 1614 supercluster is near 4×10^9 yr old and may include the old disk cluster NGC 6791. About three-quarters of bright A-star sample consists of young disk stars, on the basis of their (U, V) velocities. The Am, USPC (Sct), and λ Boo stars represent about 10%, 6%, and 1%, respectively, of the total sample as well as of the young disk and old disk constituents of the sample. Although at least 7 USPC (δSct) are also Am stars, the two types, generally, are separated by about 2×10^8 yr. The rotational velocities, at various temperatures intervals, of the Am stars are about one-half those of the USPC(δSct) in the same intervals, whereas these velocities for the USPC and normal stars are nearly identical. At least 50% of the Am stars are spectroscopic binaries, half of which are double lined, whereas only 20% of the USPC are known spectroscopic binaries. The 15 λ Boo stars discussed here contain 8 young disk and 4 old disk stars, with 3 objects of unknown population because of radial velocity variations. Six young disk λ Boo stars are members of the Hyades (3) or Sirius (3) supercluster. The age of the λ Boo stars appears to be between 6 and 10×10^8 yr. The so-called "A2 IV" stars, labeled as possible peculiar objects by Abt (1994), may define the blue edge of the instability region. The USPC in the sample place the blue edge near log T_e=3.904 for M_v>+0.75 mag. Four stars classified as USPC are considerably hotter than the blue edge and are probably a different type of object. The old disk (BS) stars constitute about one-quarter of the bright A-star sample in each of the stages—normal stars, Am stars, USPC, and λ Boo stars. The spectroscopic binary frequency ranges from at least 50% for the Am stars to less than 5% for normal stars. This situation is the strongest argument for new birth as the origin of BS or, if rebirth, that whatever the required conditions they must mimic those for new birth. The strongest argument for rebirth as the origin of BS may be in the Am stars. Despite the fact that Am and USPC appear to be successive stages of evolution, separated by the blue edge of the instability region, and that at least a half-dozen USPC are also Am stars, the large difference in the apparent rotational velocity and large difference in the spectroscopic binary frequency makes such successive evolutionary stages seem unlikely. However, this very difficulty suggests the possibility that forward evolution for Am stars ends near the blue edge and coalescence or merger of the components ensues.

1. INTRODUCTION

Blue stragglers (BS) are stars for which there is a conflict between the age indicated by their motion and that inferred from their evolutionary state. In disk populations the "old disk" (OD) and "young disk" (YD) stars are distinguished by their position in the (U, V) velocity plane. This division separates stars that are younger than about 2×10^9 yr, which ignite helium in small, nondegenerate cores at luminosities comparable with those they had on the main sequence, from older stars that form an electron degenerate helium core and evolve toward higher luminosity, along an extended red giant branch, to a luminosity about $1500L_\odot$, before igniting helium. A careful mapping of the (U, V) plane, using wide binaries and nearby clusters, delineates mutually exclusive domains occupied by the YD and the OD populations (e.g., Eggen 1989).

Most BS are AF stars with OD space motions and the best known are AF stars in such OD clusters as M67. The clusters older than about 2×10^9 yr (i.e., clusters with OD motion), should have no main-sequence or near-main-sequence stars that are hotter than about 7000 K, so BS are objects hotter than this. The best-documented database in which to find BS near the sun is the HR Catalogue stars of spectral type be-

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TABLE 1. Recalibration of Geneva photometry.

(B2–V1)	d	M_V	ρ_o
$-0^m.100$	$1^m.390$	$+1^m.65$	6.0
−0.075	1.360	+1.73	6.0
−0.065	1.350	+1.78	6.0
−0.050	1.325	+1.83	6.0
−0.025	1.280	+1.90	6.0
0.000	1.230	+2.00	6.0
0.050	1.148	+2.35	6.0
0.075	1.098	+2.60	6.0
0.100	1.040	+2.80	6.0
0.150	0.930	+3.20	6.0
0.175	0.880	+3.40	7.5

tween about A0 and F2, with accurately known distances and kinematics.

The temperature range adopted for the present discussion is between β=2.910 and 2.680 and Strömgren photometry is available for all but a half-dozen of the HR stars in the range (Hauck & Mermilliod 1980). The reddening determinations are described in Eggen (1984b) and the luminosity calibrations are

$$M_v=3.978(b-y)_0-4.406(c_1)_0+10.38(m_1)_0 +12.952\beta-33.762, \quad \beta>2.850,$$

$$M_v=-12.0(\beta-2.800)+2.05-F\Delta[c_1], \quad \beta \leq 2.850,$$

where

$$[c_1]=c_1-0.20(b-y),$$

$$\Delta[c_1]=[c_1]-2.60(\beta-2.800)-0.790,$$

$$F=-18.5(\beta-2.800)+7.25.$$

These calibrations are based on earlier results (Eggen 1971, 1977, 1979), corrected for the currently accepted distance of the Hyades cluster (Eggen 1992a). The very small effect of stellar rotation on the β indices has been ignored. A full discussion of this effect can be found in Lester *et al.* (1986) and in Gray & Garrison (1987,1989).

The calibration of the Geneva photometry (Rufener 1988) is based on a procedure developed by Hauck (1973) and the standard (Hyades) parameters are listed in Table 1. The luminosity determinations are from

$$M_v=M_v(\mathrm{Std})-\Delta M_v,$$

where

$$\Delta M_v=\Delta d(P_0+20\Delta d) \quad \text{and} \quad \Delta d=d(\mathrm{Star})-d(\mathrm{Std}).$$

The difference between the two luminosity determinations, involving Strömgren with Hβ photometry and Geneva photometry, shows a mean dispersion of only $\sigma=\pm0.17$ mag.

The potential sample is 2000 A0 to F2 stars in the Bright Star Catalogue. A0/1 stars are discussed in Eggen (1984b). The stars of type A2 or later include the rejected stars, listed in Table 2, that are either probable spectroscopic binaries without orbit determination or have photometrically unresolved companions between 0.2 and 3.0 mag fainter. Also rejected are a dozen stars with poorly determined proper motion, a half-dozen without available photometry, and the few supergiants and bright giants (luminosity class II or I) in the sample. The spectral luminosity classifications conflicts with the photometric luminosity in several cases, as illustrated in Table 3. The spectral classifications are from the Bright Star Catalogue (Hoffleit 1982), the Michigan Catalogues (Houk & Cowley 1975; Houk 1978, 1982; and Houk & Smith-Moore 1988) and Gray & Garrison (1987,1989). The finally adopted "Bright A-Star Sample" consists of 1400 objects with β between 2.910 and 2.680 mag and fainter than $M_v=-1$ mag.

2. HYADES SUPERCLUSTER

The 1400 objects in the bright A-star sample contain the 74 members of the Hyades supercluster, listed in Table 4. These include 30 members of the Hyades cluster. The supercluster parameters are, from Eggen (1984a, 1992a)),

$$A=6^h.4, \quad \pi=4.74\nu/V_{\mathrm{TOT}}\sin\lambda,$$

$$V_{\mathrm{TOT}}=4.35+0.045X(\mathrm{pc})\mathrm{km/s},$$

$$D=6^\circ.5, \quad \Delta T=4.74\tau D(\mathrm{pc}),$$

where X is the distance of the member from the Sun, in the direction away from the galactic center. ν is the proper motion in the direction of (A,D), the convergent point of the proper motion, and τ is the motion perpendicular to that direction. ΔT represents the peculiar motion, τ, in km/s. The 30 Hyades cluster members are listed at the beginning of Table 4 and give a mean $\Delta T=+0.9\pm1.9(\sigma)$km/s, whereas the noncluster supercluster members give $+0.8\pm3.4(\sigma)$km/s. The computed radial velocities, $V_{\mathrm{TOT}}\cos\lambda$, compared with the observed values for the Hyades cluster stars give a mean of computed-observed=$+0.1\pm2.2(\sigma)$km/s, omitting two probably variable velocity stars, whereas the noncluster, supercluster members give $+0.2\pm2.3(\sigma)$km/s, omitting five variable velocity objects. The differences between the mean of the photometric luminosities, derived from the Strömgren and Geneva photometry, and that computed from supercluster membership gives a mean of cluster-photometric=0.00 $\pm0.18(\sigma)$ mag.

The resulting color–luminosity array is shown in Fig. 1 where Hyades cluster stars are represented by closed circles and noncluster supercluster members by clear circles. As discussed elsewhere (e.g., Eggen 1962, 1992a) the Praesepe cluster is moving with the supercluster and in many details is similar to the Hyades in stellar content and has a modulus of 6.33 mag. The cluster members that lie in the temperature domain discussed here are included in Eggen (1992a) Table 9) and, except for two stars (HD 73574 and 73712) with companions more than 0.2 mag and less than 3.0 mag difference and HD 73346 (BV Cnc), which does not share the cluster velocity, are represented by crosses in Fig. 1. Mason *et al.* (1993a,b) have examined the Hyades and Praesepe cluster stars, discussed here, for duplicity in a speckle survey.

TABLE 2. Stars of type A 2 or later that either are probable spectroscopic binaries ($Q=A$) or have photometrically unresolved comparisons that are between 0.2 and 3.0 mag fainter ($Q=B$).

HR	Q	HR	Q	HR	Q	HR	Q
9	A	884	B	1466	B	2257	B
12	B	887/8	AB	1470	B	2265	A
32	A	895	A	1478	B	2280	B
118	A	897/8	B	1480	B	2285	A
146	A	932	A	1483	A	2291	AB
232	A	961	A	1505	AB	2304	B
245	B	967	B	1530	A	2320	A
277	B	986	A	1561	A	2324	A
282/3	AB	997	B	1563	A	2326	AB
289	B	1041	A	1566	A	2408	A
293	A	1043	B	1569	A	2417	A
309	A	1053	B	1575	A	2466	A
325	A	1065	B	1611	A	2471	A
328	A	1073	A	1613	A	2488	A
331	B	1077	B	1616	A	2499	AB
349	A	1091	A	1645	A	2532	AB
359	A	1104	A	1658	A	2539	A
362	B	1118	B	1664	B	2543	A
379	AB	1138	B	1678	A	2585	A
460	A	1158	A	1701	B	2592	A
462	B	1185	B	1711	A	2606	A
499	B	1211	B	1738	A	2607	B
515	A	1223	A	1760	A	2705	A
526	AB	1296	B	1774	A	2706	A
558	A	1309	A	1832	A	2707	A
575	B	1314	A	1853	B	2714	A
580	A	1329	AB	1854	A	2751	A
581	A	1331	A	1872	A	2753	A
622	B	1342	A	1901	A	2777	B
634	A	1353	A	1992	A	2780	A
691	A	1359	B	1999	A	2820	A
714	A	1367	A	2020	A	2837	A
724	A	1374	B	2107	A	2842/3	A
773	A	1376	B	2108	B	2891	B
782	A	1383	A	2124	B	2898	B
789	A	1392	B	2143	B	2958	A
804	B	1394	B	2150	A	2992	A
813	B	1403	B	2171	A	3015	A
816	A	1410	B	2175/6	B	3040	A
820	B	1422	B	2214	AB	3067	AB
827	A	1434	A	2228	A	3077	A
875	A	1458	B	2253	A	3083	A
3173	A	4369	B	5532	A	6457	A
3197	A	4388	A	5556	A	6493	B
3224	AB	4410	A	5577	B	6503	B
3335	B	4422	A	5591	A	6509	A
3455	B	4464	A	5633	A	6611	B
3469	A	4465	AB	5656	A	6723	B
3519	A	4527	B	5672	A	6730	B
3523	AB	4531	B	5682	A	6734	B
3526	A	4560	AB	5702	B	6792	A
3551	A	4589	B	5715	A	6795	B

TABLE 2. (continued)

HR	Q	HR	Q	HR	Q	HR	Q
3553	AB	4624	AB	5746	A	6813	A
3561	A	4633	AB	5747	B	6814	AB
3565	A	4686	A	5754	A	6844	A
3592	A	4719	B	5756	AB	6876	B
3608	A	4756	A	5765	AB	6890	A
3644	A	4791	B	5780	B	6898	B
3646	A	4794	A	5788/9	B	6903	A
3655	B	4847	B	5851/2	B	6904	AB
3686	A	4859	A	5903	A	6962	A
3689	A	4868	A	5905	A	6795	A
3690	AB	4900	A	5972	A	6986	A
3746	A	4917	B	6032	B	6987	A
3756	A	4936	A	6033	A	6988	A
3760	A	4937	B	6034	A	7003	A
3778	AB	4950	B	6071	B	7051/2	AB
3787	A	4963	B	6074	A	7059	A
3829	A	4972	A	6099	A	7214	AB
3848	A	5003	A	6110	A	7288	A
3909	B	5038	AB	6123	A	7340	B
3945	A	5084	A	6129	B	7357	A
4000	A	5088	A	6169	B	7366	A
4020	B	5112	A	6170	A	7369	B
4028	B	5142	A	6232	AB	7411	A
4055	B	5162	A	6236	AB	7423	A
4060	A	5170	A	6237	B	7489	A
4083	A	5182	B	6240	B	7499	B
4113	A	5216	A	6255	B	7533	A
4137	A	5278	A	6317	A	7544	B
4148	B	5303	B	6329	B	7546	B
4167	B	5328/9	AB	6335	A	7577	A
4197	A	5364	A	6351	AB	7588	B
4227	A	5368	A	6361	A	7619	B
4229	B	5392	A	6378	AB	7630	A
4282	B	5476	B	6379	A	7638	B
4344	A	5497	B	6412	A	7641	A
4350	A	5505	AB	6435	B	7740	A
4366	A	5530/1	AB	6455	A	7755	AB
7764	A	8130	AB	8373	A	8798	B
7774	AB	8140	B	8417	B	8826	A
7781	AB	8187	A	8444	A	8840	A
7787	B	8198	A	8450	AB	8851	A
7818	AB	8202	B	8484	A	8864	B
7849	B	8237	A	8566	B	8877	AB
7858	A	8257	B	8595	B	8890	B
7958	B	8258	AB	8599	A	8932	A
7990	B	8264	B	8600	A	8959	A
8012	A	8291	A	8616	AB	8966	B
8018	A	8302	A	8627	AB	8968	A
8025	A	8337	AB	8645	B	8791	A
8038	AB	8344	B	8708	B	9002	B
8058	B	8361	A B	8739	B	9039	A
8060	B	8366	A	8766	A	9044	B
8074	AB	8370	A	8769	A	9092	A

TABLE 3. Conflict of spectroscopic and photometric luminosities.

HR	HD	β	E(b−y)	V_0	M_V 4C	M_V GNV	Sp.T.
287	6028	—	0^{m}040	6^{m}38	—	−1^{m}0	A3 V
1550	30823	2^{m}826	0.064	5.40	−1^{m}2	−2.0	A2 III
1615	32188	2.757	0.15:	5.5:	<−2.0	—	A2 III
1968	38090	2.809	0.030	5.76	−1.2	−1.9	A2/3 V
2025	39182	2.821	0.025	6.28	−0.6	−1.3	A2 V
2045	39551	2.804	0.030	6.48	−0.55	−1.3	A5 V
2629	52479	2.804	0.040	6.44	−2.6	—	A2 V
3113	65456	2.783	0.025	4.68	−2.5	−4.5	A3 III
3190	67751	2.804	0.050	6.15	−2.5	−4.5	A3 III
3514	75630	2.812	0.035	5.34	−1.0	—	A2/3 IV
3520	75710	2.796	0.035	4.77	−2.2	—	A2 III
3622	78293	2.775	0.050	6.22	−0.5	−1.9	A8 III
3989	88195	2.788	0.047	5.70	−1.4	—	A1 V
5431	127716	2.845	0.075	6.47	−1.0	−2.4	A2 IV
5498	129932	2.805	0.060	5.80	−2.5	—	A1 III/IV
6235	151527	2.793	0.205	5.15	−0.95	—	A0 V
6562	159877	2.804	0.030	5.78	−1.3	−3.0	F0 IV
6572	160263	2.824	0.028	5.65	−0.9	—	A0 V
6593	160839	2.756	0.040	6.21	−1.2	<−3	F0 III/IV
7060	173664	2.842	0.025	6.00	−0.9	—	A2 IV
7502	1786377	2.812	0.055	5.70	−2.3	−4.5	A4 III
8120	202240	2.774	0.050	5.88	−2.6	−5.0	F0 III
8155	203096	2.752	0.045	5.96	−2.6	—	A5 IV
8755	217491	2.807	0.110	6.03	−2.2	−5.0	A3 V
8822	218753	2.774	0.078	5.36	−4.0	—	A5 III

Notes to Table 3.

[a] Gray and Garrison (1987) find "Fe II and Tr II lines have strength similar to those of the A2 Ib standard except that λ 4481 is very weak.

HD 73666 (40 Cnc) is double but the magnitude difference between the components is large.

There are no isochrones from published stellar models that can match the stellar distribution in Fig. 1 with a single age. Also, most aspects of the distribution in Fig. 1 are shown by both cluster and noncluster supercluster members, except that the two bluest object are noncluster supercluster stars. Four isochrones, with ages of 6.3×10^8, 10^9, 1.5×10^9, and 2×10^9 yr, from models with convective overshoot at the core (Maeder & Meynet 1991), are also represented in the figure. These isochrones, with perhaps some fine tuning of the ages, could give a satisfactory representation of the supercluster content.

(1) The youngest stars are represented in the Hyades by HR 1389 (68 Tau) which has often been called a blue straggler amongst cluster members. Babcock (1957) noted the presence of a magnetic field and Catalano & Leone (1989) found a small-amplitude light variation with a period of 21.3 days. Variable radial velocity in a period near 50 days has been suggested but not confirmed. Stars similar to 68 Tau in Fig. 1 are

HR	$(B-V)_0$	M_v	$v \sin i$
1389	0^{m}05	+1.^{m}23	18 km/sec
3449	0.02	+1.26	79
520	0.03	+0.87	56
4869	0.01	+0.80	...

At least three of these stars are relatively sharp lined but little else is known of them. A direct comparison between HR 1389 (68 Tau) and 3449 (γ Cnc) would be of interest.

(2) The two bluest stars in Fig. 1 are noncluster supercluster members and are rare Ap(Si) stars with temperature in the domain discussed here. Most of these Ap, Bp stars have temperature greater than 10.000 K and are excluded from the present discussion,

TABLE 4. Sample stars in the Hyades supercluster.

HR	HD	μ_α/μ_δ 0".001	υ/τ 0".001	ΔT km/sec	X pc	V_{TOT} km/sec	MOD	E(b-y)	V_0	M_V CLU	M_V PHOT	β	$(B-V)_0$	ρ COMP	ρ OBS	Sp.T	Note
HYADES CLUSTER																	
1201	24357	142/-30	145/-2	-0.5	36.3	45.1	$3\overset{m}{.}07$	$0\overset{m}{.}000$	$5\overset{m}{.}96$	$+2\overset{m}{.}89$	$+3\overset{m}{.}02$	$2\overset{m}{.}712$	$0\overset{m}{.}34$	+35.1	+35.4	F4 V	X
1254	25570	163/26	136/26	+3.7	25.8	44.8	2.65	0.000	5.44	+2.89	+3.10	2.687	0.37	+36.6	+35.6	F2 V	
1292	26462	148/3	148/-6	-1.0	29.9	44.8	2.74	0.000	5.70	+2.96	+3.04	2.701	0.37	+37.3	+36.6	F2 V	
1319	26911	124/-14	126/1	+0.4	38.3	45.2	3.17	0.000	6.31	+3.14	+3.38	2.690	0.40	+37.9	+36.9	F5 V	
1351	27397	122/-18	123/4	+1.3	37.1	45.2	3.06	0.000	5.58	+2.52	+2.21	2.767	0.28	+38.4	+42.0	F0 IV	X
1356	27459	109/-20	126/-4	-1.2	41.9	45.4	3.31	0.000	5.27	+1.96	+1.79	2.812	6.22	+38.3	+36.2	F0 V	X
1368	27628	114/-24	116/-3	-1.1	39.3	45.3	3.20	0.000	5.71	+2.51	+2.42	2.757	0.32	+38.5	+41.2	Am	X
1380	27819	113/-32	117/1	+0.4	39.7	45.3	3.17	0.000	4.79	+1.62	+1.48	2.857	0.15	+38.4	+37.5	A7 V	
1385	27901	112/-34	117/4	+1.4	40.2	45.3	3.16	0.000	5.97	+2.81	+2.91	2.705	0.37	+38.5	+36.6	F4 V	
1387	27934	114/-41	121/9	+3.1	40.7	45.3	3.17	0.000	4.21	+1.04	+0.96	2.867	0.13	+38.0	+40.1	A7 IV-V	
1398	27946	111/-44	119/-6	-2.2	41.2	45.4	3.19	0.000	5.27	+2.08	+1.83	2.782	0.25	+39.0	+35.V	A7 V	X
1389	27962	116/-36	122/0	0.0	38.1	45.2	3.06	0.000	4.29	+1.23	+1.03	2.889	0.05	+38.6	+40.2	A2 IV	X
1408	28294	106/-24	109/-1		41.2	45.3	3.25	0.000	5.90	+2.65	+2.48	2.747	0.32	+39.1	+42:	F0 IV	
1412	28319	112/-26	115/2	+0.7	39.3	45.3	3.14	0.000	3.75	+0.01	+0.80	2.830	0.11	+38.9	+39.0	A7 III	X
1414	28355	107/-16	108/2	+1.0	38.9	45.3	3.20	0.000	5.02	+1.82	+1.64	2.830	0.23	+39.4	+39.4	A7m	
1430	28556	114/-19	116/3	+1.0	37.4	45.2	3.05	0.000	5.40	+2.35	+2.36	2.797	0.26	+39.3	+38.8	F0 V	
1432	28677	108/-30	112/-1	-0.4	39.0	45.2	3.11	0.000	6.01	+2.90	+2.68	2.725	0.34	+39.4	+36.0	F4 V	
1459	29169	114/-49	124/9	+3.0	38.6	45.2	3.03	0.000	6.01	+2.98	+3.20	2.709	0.38	+38.5	+43.2	F5 IV	
1472	29375	93/-29	98/-2	-1.0	43.3	45.4	3.32	0.000	5.80	+2.48	+2.32	2.754	0.31	+40.0	+38.4	F0 V	
1473	29388	106/-13	107/5	+2.1	37.8	45.2	3.06	0.000	4.27	+1.21	+1.14	2.870	0.12	+40.2	+45.0	A6 V	
1479	29488	84/-18	86/6	+3.9	49.7	45.7	3.62	0.000	4.69	+1.07	+1.11	2.852	0.16	+10.3	+38:	A5 V	
1507	30034	98/-12	99/2	+0.8	38.5	45.2	3.10	0.000	5.38	+2.28	+2.12	2.741	0.25	+40.8	+39.4	F0 V	
1519	30210	69/-5	69/6	+5.3	56.4	46.0	3.93	0.000	5.35	+1.42	+1.54	2.846	0.19	+41.4	+40.8	Am	X
1547	30780	80/-34	87/3	+1.7	46.6	45.6	3.43	0.000	5.10	+1.67	+1.52	2.813	0.21	+40.9	+38.5	A7 IV-V	X
1620	32301	71/-41	78/2	+4.8	51.9	45.8	3.62	0.000	4.63	+1.01	+1.00	2.847	0.16	+41.3	+42.2	A7 V	
1670	33204	55/-60	81/-3	-2.1	56.4	46.0	37.8	0.000	5.93	+2.15	+2.26	2.796	0.27	40.4	39.4	Am	
1672	33254	64/-7	64/2	+1.6	47.0	45.6	3.51	0.000	5.42	+1.91	+2.05	2.817	0.24	43.0	42.2	Am	X
1905	37147	46/-35	55/0	-0.4	47.6	45.6	3.44	0.000	5.52	+2.08	+1.94	2.807	0.22	43.8	41.1	F0 V	
HYADES SUPERCLUSTER																	
238	4818	140/1	140/2	+1.0	35.7	45.1	4.14	0.000	6.38	+2.24	+22.3	2.780	0.28	+6.9	+4.3	F2 IV	X
343	6961	228/-28	230/-6	-1.1	23.3	44.4	3.01	0.000	4.34	+1.33	+1.21	2.845	0.17	+9.3	+9.4	A7m	
403	8538	297/-50	302/1	+0.1	18.3	44.3	2.40	0.000	2.67	+0.27	+0.45	2.830	0.13	+10.0	+6.7	A5 III	X
520	10939	127/56	138/8	+4.2	44.5	45.5	4.19	0.010	5.00	+0.81	+0.91	2.900	0.03	+5.1	+9.5	A1 V	
733AB	15634	80/33	86/3	+3.5	31.3	44.9	5.00	0.004	(7.22)	+2.22	+1.92	2.758	0.29	+18.4	+24.0	A9	X
1083A	22001	380/376	535/-4	0.0	-1.9	43.4	1.11	0.000	4.72	+3.61	+3.59	2.671	0.40	+9.6	+12.0	F5 IV-V	X
1083B									10.72	+9.61	+9.55	--	1.445			M	X
1554	30912	45/-33	56/2	+3.7	91.3	47.6	4.84	0.010	5.92	+1.08	+0.80	2.702	0.36	+41.4	+38.0	F2 IV	
2132	41074	-42/-150	155/-15	-3.5	35.6	45.1	2.83	0.008	5.84	+3.01	+2.81	2.731	0.335	+36.1	+34.1	F3 V	
2550	50241	-72/268	274/41	+4.6	-1.0	43.5	2.46	0.000	3.26	+0.80	+0.55	2.788	0.21	+15.9	+20.6	A5/7 III	
2556	50643	-10/41	42/-1	-2.4	65.2	46.4	5.06	0.018	6.05	+0.99	+1.26	2.856	0.13	+41.6	+40.9	Am	
2672	53811	-54/129	137/7	+5.0	9.4	43.9	3.76	0.020	4.84	+1.08	+0.96	2.868	0.11	+24.1	+25.1	A4 IV	

TABLE 4. (continued)

HR	HD	μ_α/μ_δ 0".001	υ/τ 0".001	ΔT km/sec	X pc	V_{TOT} km/sec	MOD	E(b-y)	V_0	M_V CLU	M_V PHOT	β	$(B-V)_0$	ρ COMP	ρ OBS	Sp.T	Note
3136	65900	-52/7	52/-3	+3.9	44.5	46.0	4.31	0.000	5.65	+1.34	+1.00	2.895	0.00	+42.3	+46.1	A0 V	
3449	74198	-106/-40	113/2	+0.8	37.6	45.2	3.47	0.000	4.73	+1.26	+1.52	2.914	0.02	+36.6	+36.0	A1 IV	
3495	75171	-62/101	118/-8	-5.0	-13.7	42.9	4.36	0.014	5.97	+1.61	+1.92	2.811	0.175	+10.0	+9.0	A4 V	
3798	82610	-86/49	99/2	+1.2	15.0	44.2	4.48	0.010	(7.05)	+2.57	+2.71:	2.709	0.30	+24.5	+24:	A9 V	X
3828	83261	-124/58	137/6	+2.4	12.7	44.1	3.78	0.020	(7.20)	+3.42	+3.55	2.691	0.40	+25.0	+24.5	F3 IV-V	
3936	86358	-119/-31	123/3	+0.2	36.3	45.1	3.98	0.015	(7.00)	+3.02	+3.24	2.701	0.345	+26.5	2 Sp	F3 V	
4024	88960	-70/-18	72/4	+5.8	61.1	46.2	5.30	0.020	5.40	+0.10	+0.33	2.882	-0.015	+24.3	+23:	A0 V	
4082	90044	-50/5	50/3	+9.0	45.2	45.5	6.10	0.020	5.87	-0.23	--	2.835	-0.11	+22.7	+23.0	A0p	
4191A	92787	-269/-67	279/-5	-0.6	16.0	44.2	2.46	0.000	5.17	+2.71	+2.50	2.718	0.33	+17.0	Note	F0 V	X
4191B	92855								7.26	+4.80	+4.90	2.613	0.545		Note	G0	X
4033	89021	-164/-38	168/-16	-4.7	28.4	44.8	3.49	0.000	3.44	-0.05	+0.04	2.873	0.01	+20.8	+18.3	A2.5 IV	
4599	104671	-157/28	159/-5	-1.8	-25.8	42.3	3.74	0.015	(4.54)	+0.80	+0.60	2.718	0.245	-2.3	-2.4	Am:	X
4662	106625	-161/23	162/-3	-1.1	-14.2	42.9	3.73	0.000	2.59	-1.18	-1.24	2.717	-0.11	+0.7	-3.0	HgMn	X
4694	107326	-141/24	143/-11	-5.0	6.0	43.8	4.05	0.000	6.15	+2.10	+2.10	2.743	0.28	+3.2	+3.0	F0 IV	X
4869	111469	-100/14	101/0	0.0	1.5	43.6	4.79	0.016	5.69	+0.90	+0.95	2.896	0.01	-1.2	+1.4	A2 V	
4914	112412	-234/57	240/-16	-2.6	43.5	43.7	2.92	0.000	5.62	+2.70	+3.00	2.721	0.34	-1.3	-3.1	F0 V	X
4915	112413								2.89	-0.04	--	2.778	-0.12			Ap	X
5059	116831	-111/4	111/8	+6.0	-30.4	42.2	4.47	0.022	5.88	+1.41	+1.20	2.843	0.165	-19.4	-20.5	A7 III	
5107	118098	-285/43	288/-9	-0.9	-12.3	42.9	2.39	0.000	3.37	+0.98	+1.16	2.875	0.11	-12.7	-13.2	A3 V	
5229	121164	-133/28	135/11	+5.4	-11.2	43.0	4.05	0.085	5.84	+1.74	+1.45	2.838	0.18	-11.5	-11.9	A7 V	
5491	129723	-98/-68	119/-8	-5.2	-37.0	41.8	4.33	0.020	6.40	+2.07	+2.48	2.774	0.275	-5.7	-5.4	Am	X
6871	168740	3/-102	102/5	+3.4	-57.9	40.9	4.24	0.019	6.04	+1.80	+1.53	2.798	0.175	-22.6	-21.1	A3 V	
7020	172748	9/0	180° from (A, D)			43.7	--	0.000	4.66	(+1.34)	+1.34	2.743	0.35	-43.3	-45.3	F2 IV	
7362	182369	52/-52	73/6	+3.6	-45.5	41.4	3.35	0.010	(5.71)	+2.36	+1.76	2.810	0.20	-38.2	-41.8	A3 IV/V	X
7974	198391	31/12	33/0	+0.1	-84.1	39.7	5.99	0.019	6.25	+0.26	+0.39	2.878	-0.005	-31.0	-30.2	A1 V	X
7984	198639	126/133	183/-3	-0.8	-4.3	43.3	3.18	0.015	4.98	+1.80	+1.88	2.844	0.18	-22.0	-24.0	Am	
8293	206546	78/-10	79/2	+2.1	-49.2	41.3	4.62	0.020	(6.87)	+2.25	+2.07	2.824	0.245	-27.2	-25.0	Am	X
8351	207958	313/12	312/27	+1.9	-12.1	43.0	1.78	0.000	5.06	+3.28	+3.35	2.693	0.385	-26.8	-22V	F3 IV	
8435	210074	120/38	126/-5	-2.3	-11.2	43.0	3.99	0.010	5.70	+1.71	+1.68	2.714	0.325	-21.2	-17V	F2 V	
8518	212061	132/7	131/-8	-0.4	-19.0	42.6	3.83	0.000	3.83	0.00	+0.17	2.851	-0.005	-22.2	-21.0	A0 V	
8547	212728	149/-73	166/-1	-0.2	-28.7	42.2	3.55	0.000	5.55	+2.00	+1.75	2.813	0.18	-12.4	-16 V	A4 V	
8586	213617	169/33	171/18	+5.1	-4.4	43.3	3.44	0.000	6.42	+2.98	+2.88	2.700	0.34	-17.6	-18.9	F1 V	
8782AB	218060	128/9	128/0	+0.1	-14.2	42.8	4.10	0.010	(6.18)	+2.08	+2.25	2.748	0.275	-15.2	-15:	F0 V	
8947	222451	263/20	235/28	-5.0	10.9	44.0	2.97	0.000	6.23	+3.26	+3.50	2.683	0.39	-3.9	-0.2	F1 V	

Notes to Table 4.

238 V 256 Cas, USPC

403 δ Cas, unconfirmed eclipsing binary

733 TY For, USPC. Equal components.

TABLE 4. (continued)

1083	60 arcsec separation. The brighter star is just outside the temperature range considered here and is not included in the discussion. The luminosity of the B component is based on R-I = 0.803 (Eggen 1993b).
1351	V 483 Tau, USPC.
1356	V 969 Tau, USPC.
1368	V 775 Tau, USPC. SpB, P = 2.14d.
1388	κ^2 Tau, USPC.
1389	V 776 Tau, light and magnetic field variable, 57.25d.
1412	γ^2 Tau, USPC. SpB, P = 140.73d.
1519	Possible SpB, P = 18d.
1547	V 480 Tau, USPC.
1672	SpB, P = 155.5d.
2566	Equal components.
3798	S. Ant, contact binary with P = 0.65d. Assumed equal components, as in the case for most contact binaries and the mean photometric luminosity confirms this. However, the two photometric luminosities differ by nearly a magnitude.
3936	Equal components.
4082	SS Sex, spectrum var., P = 4.37d. Ap star and photometric luminositiy unavailable.
4191	282 arcsec separation. Both stars may be SpB.
4599	SpB, P = 24.48d. The secondary spectrum appears to be 1.0 mag fainter than the primary.
4662	A HgMn star.
4694	Possibly a SpB.
4914/5	19 arcsec separation. 4915 is α^2 CVn, a magnetic var. with P = 5.47d.
5491	BP Oct, USPC
7020	δ Sct, USPC. The star is at the convergent point of the supercluster proper motions and the photometric parallax has been adopted. Shown in parenthesis in Figure 1.
7362	Equal components. P = 11.62y and a = 0.119 arcsec (Hartkopf 1994). The cluster parallax of 0.0204 arcsec lead to a mean mass of 0.7⊙.
7974	Like 40 Cnc (see text). SpB, P = 10.88d.
8293	SpB, P = 6.37d. Equal components.
8595	No photometry. The components differ by 0.7 mag and are not further discussed here.
8782	Equal components. P = 21.84 and a = 0.195 arcsec (Hartkopf 1994). The cluster parallax of 0.016 arcsec leads to a mean mass of 1.9$M_\odot$. The star lies on the 2×10^9 y isochrone which predicts a mass of 1.7$M_\odot$.

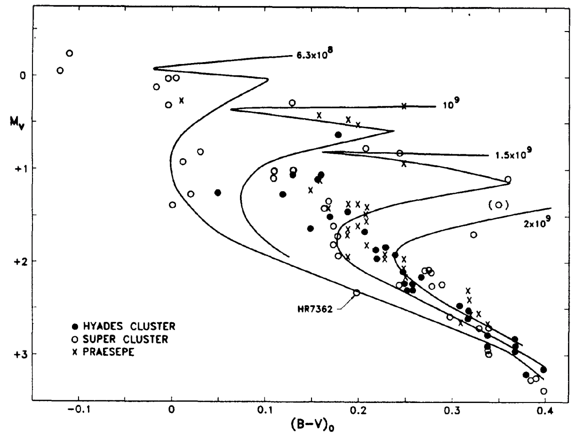

FIG. 1. Color–luminosity array for the Hyades supercluster.

HR	M_v	$(B-V)$	$v \sin i$ (km/s)	
4082	-0^m23	-0^m11	≤75	SS Sex, P=4.37d
4915	−0.03	−0.12	8	α^2CVn,P=5.47d.

Both of these objects are excessively blue because of back warming from the strong, rare earth lines and they probably lie at the point of core hydrogen exhaustion on the 6.3×10^8 yr isochrone in Fig. 1 (e.g., Hubrig & Schwan 1991). α^2 CVn is a magnetic variable but SS Sex is not known as such.

(3) The equivalent blue straggler to HR 1389 in the Hyades cluster is HD 73661 (40 Cnc) in Praesepe which was recognized as an Ap(Si) star by Abt (1985) and the overabundance of Si, as well as Hg, has been confirmed by detailed comparison with α Lyr on *IUE* spectra (Gerbaldi & Freire-Ferrero 1986). The star is nearly identical to HR 7974 (14 Del) and HR 4024.

Star	M_v	$B-V$	$cv \sin i$ (km/s)	
40 Cnc	$+0^m25$	$+0^m01$	5	Praesepe
HR 7974	+0.26	−0.005	39	SpB,P=10.88d.
HR 4024	+0.10	−0.015	139	

Shayn (1933) noted strong lines of Si and Hg in HR 7974 and a direct comparison with 40 Cnc would be of some interest. A similar star, HR 8518 (γ Aql) with $(M_v, B-V)$ $=0.00, -0.005$ mag, is often considered to be a γ Boo object, mainly on the basis of its apparent sub-main sequence position from the trigonometric parallax, but was found to be normal by Bascheck & Searle (1969) and by Fraggiani *et al.* (1990). HR 4024 is very similar to, but slightly bluer than, 40 Cnc and Lambert *et al.* (1986) find it to have a very low carbon abundance. This is characteristic of some Ap(Si) stars and it is possible that the relatively large rotational velocity of 139 km/s is both obscuring the fact that it is an Ap star and making it appear somewhat bluer.

(4) A cooler Ap star, β CrB, has a companion about 1.6 mag fainter, visually, and is therefore not included in Table 1. The period of the system, from spectroscopic and speckle observations (Kamper *et al.* 1990), is 10.5 yr. The FK5 proper motion leads to

$$\nu=0.198 \text{ arcsec } X=-14.9 \text{ pc } \rho(\text{Comp})=-23.8 \text{ km/s}$$

$$\tau=0.022 \text{ arcsec } \Delta T=+4.1 \text{ km/s } \rho(\text{Obs})=-22.4 \text{ km/s}$$

$$V_{\text{TOT}}=42.8 \text{ km/s Mod}=2.89 \text{ mag}$$

$$\pi(\text{Clus})=0.0264 \text{ arcsec.}$$

The mean trigonometric parallax is also 0.026 arcsec. A total mass of 4.08 $\mathcal{M}_\odot$ is derived from the orbital elements and the cluster parallax or 2.02$\mathcal{M}_\odot$ for the primary and 1.7$\mathcal{M}_\odot$ for the secondary, on the basis of $B=m_2/m_1+m_2=0.41$, derived from the astrometric orbit (Kamper *et al.* 1990). The secondary is probably an early F-type dwarf and $B-V$ for the primary may be near +0.15 mag which, with $M_v=+0.9$ mag, places it near the hydrogen exhaustion stages of the 1.5×10^9 yr isochrone in Fig. 1. The models upon which the isochrone are based indicate a mass of 2$\mathcal{M}_\odot$ for the primary.

(5) The binary, and USPC (δSct) variable, θ^2 Tau is the brightest and one of the most interesting stars in the Hyades cluster. Key references to this object are Peterson *et al.* (1993) and Krolikowski (1992). The period of the binary is 140.73 days and a combination of the speckle and spectrographic orbits gives a distance modulus of 3.14 mag, identical to that in Table 1, derived from the proper motion and the supercluster parameters. The individual components have

	V	$B-V$	M_v
A	3^m75	0^m17	$+0^m61$
B	4.85	0.16	+1.71.

Both stars lie near the 1.5×10^9 yr isochrone in Fig. 1 and the models upon which this isochrone is based would predict masses of 2.0 and 1.9$\mathcal{M}_\odot$. The values of $m \sin i$ from the spectrographic orbit then give an inclination of 43°.2 from the A component and 43°.0 from the B component. A preliminary, speckle orbit (Pan *et al.* 1992) gives $i=46°.1\pm0°.1$. The A component is very similar to three Praesepe cluster stars

	M_v	$B-V$	$v \sin i$	
HR 1412A	$+0^m61$	0^m17	78	θ^2 Tau, Hyades
HD 73819	+0.40	0.16	152	Praesepe
HD 73210	+0.40	0.19	80	Praesepe
HD 73785	+0.50	0.21	85	Praesepe.

Two noncluster, supercluster members are only slightly brighter and hotter,

	M_V	B−V	$v \sin i$
HR 403	$+0^m26$	$+0^m13$	113
HR 607	+0.17	0.14	

HR 403 (δ Cas) has for many years been considered to be an eclipsing variable with a period of 759 days and a visual light amplitude near 0.1 mag but this has never been confirmed. Both stars are classified as A5III. These stars are best represented by the post-hydrogen exhaustion phase of the

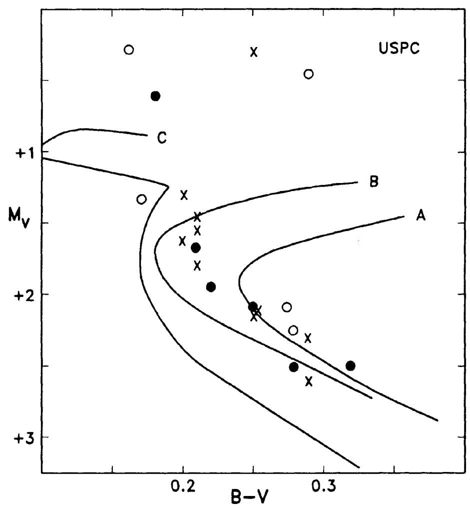

FIG. 2. USPC(δ Sct) variables in the Hyades supercluster. Hyades cluster—closed circles, noncluster supercluster members—clear circles and Praesepe cluster—crosses.

10^9 yr isochrone in Fig. 1. The reddest star near this isochrone is the Praesepe cluster member 38 Cnc (HD 73575) which is also BT Cnc, an USPC (δ Sct) variable with a period of 0.10*d* and is an Fo III star with $v \sin i$ of only 15 km/s. The 10^9yr old models in this temperature range have masses near $2.3_\odot$. The system of θ^1 Cru (HR 4594) is very similar to θ^2 Tau with the A component at $M_v = +0.8$ mag. The magnitude difference is near 1 mag and accurate determinations of the color dependence of this difference are important. The combined color is $B-V=0.245$ and the mass ratio is $m_2/m_1=0.82$. The binary period is 24.5 days and the spectral type may be Am, but this is very uncertain; the spectral lines are very sharp. Speckle observations are necessary to search for the companion and possibly construct an astrometric orbit.

(6) The USPC(δ Sct) variables in the Hyades cluster (closed circles), Praesepe cluster (crosses), and noncluster, supercluster members (open circles) are shown in the (M_v, $B-V$) plane of Fig. 2 and listed in Table 5. Figure 2 also contains three isochrones: A and B are for 2 and 1.5×10^9 yr, respectively, with $Z=0.02$ and convective overshoot (Maeder & Meynet 1991), and C is also from models with $Z=0.02$ and convective overshoot, for 8×10^8 yr (Castellani *et al.* 1992). Castellani *et al.* fitted the Hyades cluster, color-luminosity array with this 8×10^8 yr isochrone, but to obtain this fit they assumed a distance modulus of 3.00 mag and a reddening of $E(B-V)=0.04$ mag. No documentation exists for any reddening of the Hyades cluster (45 pc) and their adopted modulus is almost 0.5 mag smaller than that derived from accurate proper motions and radial velocities (e.g., Eggen 1984a, Schwan 1991). It is troubling that a number so fundamental to our concept of the universal metric does not enjoy a wider consensus. It may be a commentary on the current state of model building that if we permit a systematic offset in luminosity, the isochrone labeled C in Fig. 2 would quite accurately fit the distribution of all of the variables,

TABLE 5. USPC (δ Sct) variables in the Hyades supercluster.

HR	HD	Name	M_V	B–V	v sin i km/sec	Sp.T.	β	Log Te
	73729	BQ Cnc	$+2^m\!.62$	$+0^m\!.29$	160	A9 V	$2^m\!.742$	3.850
1368	27628	V 775 Tau	+2.51	+0.32	59	Am	2.757	3.858
1351	27397	V 483 Tau	+2.51	+0.28	109	F0 IV	2.767	3.864
238	4818	V 256 Cas	+2.26	+0.28	—	F2 IV	2.780	3.870
733AB	15634	TY For	+2.22	+0.29	—	A9	2.758	2.859
	73450	BS Cnc	+2.15	+0.25	138	A9 V	2.770	3.865
	73798	BW Cnc	+2.14	+0.25	175	F0 V	2.764	3.862
1388	27946	κ^2 Tau	+2.08	+0.25	18	A7 V	2.782	3.871
5491	129723	BP Oct	+2.07	+0.275	89	Am	2.774	3.867
1356	27459	V 696 Tau	+1.96	+0.22	65	F0 V	2.812	3.887
	73175	BR Cnc	+1.91	+0.23	180	A9 V	2.790	3.876
	73345	CY Cnc	+1.82	+0.21	98	A8 V	2.815	3.889
1547	30780	V 480 Tau	+1.67	+0.21	141	A7 IV	2.813	3.888
	74028	BX Cnc	+1.62	+0.20	160	A8 V	2.812	3.887
	74050	BY Cnc	+1.57	+0.21	150	A7 V	2.812	3.887
	73763	BN Cnc	+1.47	+0.21	—	A8 V	2.812	3.887
	73756	Bu Cnc	+1.32	+0.20	200	A8 V	2.812	3.887
1412	28319	θ^2 Tau	+0.61	+0.17	78	A7 III	2.830	3.897
	73375	BT Cnc	+0.33	+0.25	150	A8 IV	2.778	3.869

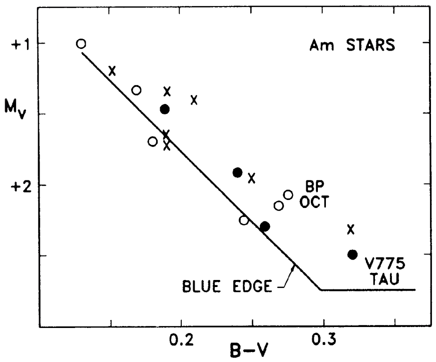

FIG. 3. The Am stars in the Hyades supercluster. Hyades cluster—closed circles, noncluster supercluster members—clear circles, and Praesepe cluster—crosses.

with a systematic decrease of 0.6 mag in M_v. A comparison of Figs. 1 and 2 indicates that the variables in Fig. 2 may define a relatively tight color–luminosity relation. The mixture of radial and nonradial; modes and the small light-amplitudes of most of these stars prevent accurate mode separation and the scatter in this relation may reflect this. It should be noted that Castellani *et al.* (1992) caution that their models should be regarded as a test of theory rather than as a tight determination of cluster parameters.

The variable in Fig. 1 (δ Sct) that appears, together with the nonvariable HR 8435 (Table 4), to fix the upper age limit near 2×10^9 yr, probably represents the most controversial, and the most vulnerable, aspect of this discussion,

HR	M_v	$B-V$	
7020	$+1^m34$	$+0^m35$	δ Sct
8435	+1.71	+0.325	Variable?

In some respects the prototype variable δ Sct presents both the strongest and the weakest arguments for supercluster membership. The star lies on the antapex of cluster motion so the proper motion is negligibly small and the convergent point test of membership is inapplicable. However, the radial velocity faithfully represents the total space motion. The photometric luminosity adopted in Table 4 is near that derived from the high weight trigonometric parallax (0.025 arcsec). All of the other supercluster variables have very small, and sometimes chaotic, light variations from a mixture of nonradial pulsation modes. However, δ Sct has the relatively large amplitude of 0.2 mag and extensive observations have identified the primary period as 0.193*d*, which implies a radius near $4R_\odot$ (Cuzier & Monier 1993). The period–luminosity relation for fundamental periods (Eggen 1994) then gives $M_v=2.18\log P-0.60=+1.40$ mag, in excellent agreement with the photometric value adopted in Table 4. The 2×10^9 yr isochrone (Maeder & Meynet 1991) yields $R=3.5_\odot$ and a mass of $1.9\mathscr{M}_\odot$. A quite different radius of $1.9\pm0.1R_\odot$ is obtained by Berdnikov *et al.* (1993) from a Baade–Wesselink analysis of simultaneous radial velocity and light variations. Finally, the large-amplitude variable VZ Cnc may be important in the consideration of the reality of 2×10^9 yr old stars in the supercluster. This variable shares the motion and distance of the Praesepe cluster, within the uncertainties of the available data. It is a cluster outlier, some 10° from the cluster center. The period–luminosity relation (Eggen 1994) gives a modulus of 6.15 mag and the luminosity calibration gives the same result, compared with a modulus of 6.33 mag for the cluster (Eggen 1992a). The proper motion on the FK5 system is $(\mu_\alpha, \mu_\delta)=-0.033, -0.014)$ arcsec, compared with the mean for the cluster of $(-0.038, -0.011)$ arcsec. The median luminosity and color, from cluster membership are $(M_v, B-V)=(+1.32, 0.33)$ mag and it is nearly identical to the supercluster member δ Sct.

It is useful to consider the possibility of *accidental* supercluster membership. That is, the proper motion, radial velocity, and luminosity parameters mimic those of supercluster members. The constraints placed on ΔT and $\Delta\rho$ eliminate most nonmembers and the comparison of photometric and cluster parallaxes imposes a bar that should expose most kinematic accidents. Consider the equal component, visual binary HR 7362. This object is listed in Table 4 and labeled in Fig. 1, although it may not be a member. The value of $\Delta T=+3.6$ km/s is certainly acceptable for a supercluster member and the observed radial velocity of -41.8 km/s from five plates may represent the velocity of the system near apastron because double lines were not noted. The computed velocity, $V_{\rm TOT}\cos\lambda=-38.2$ km/s is, again, no basis to reject the system from the supercluster. The Strömgren and Geneva photometries give $M_v=+1.72$ and $+1.80$ mag, respectively for the luminosity and these values, although closely agreeing with each other, show a half-magnitude displacement from that derived from the cluster parallax. When compared with other stars in Table 4 this discrepancy casts doubt on membership and this doubt is confirmed by the orbital elements, $P=11.62$ yr and $a=0.119$ arcsec from speckle observations (Hartkopf 1994). The cluster parallax leads to a mass of $0.64\mathscr{M}_\odot$ whereas the 6.3×10^8 yr isochrone, on which the stars lie in Fig. 1, predicts a mass of $1.4\mathscr{M}_\odot$. A luminosity of +1.6 mag, well within the uncertainty of the photometric calibrations, would place the stars on the 1.5×10^9 yr isochrone with the expected mass of $1.9\mathscr{M}_\odot$, compared with $1.7\mathscr{M}_\odot$ obtained from the orbital parameters and the photometric parallax 0.0154 arcsec.

In summary, there appears to be little doubt that an age spread of 5×10^8 yr exists in the supercluster because it is present in the Hyades and Praesepe clusters. There is some indication that an even larger spread may exist in the supercluster and confirmation of this, such as the orbit for HR 8782 (see notes to Table 4) is available. With this situation the designation of "blue straggler" is more complicated than sketched in the Introduction.

3. Am STARS

The color–luminosity relations formed by the supercluster USPC (Fig. 2) is represented by the continuous line in Fig. 3. No supercluster USPC has $M_v>+2.5$ mag. The known

TABLE 6. Am Stars in the Hyades supercluster.

HR	HD	M_V	B−V	v sin i km/sec	β	log Te	Note
1368	27628	$+2^m.51$	$0^m.32$	59	$2^m.757$	3.858	V 775 Tau
1428	28546	+2.28	0.26	21	2.808	3.885	
8293	206546	+2.25	0.245	47	2.824	3.894	Sp.B, Δm=0.0
1670	33204	+2.15	0.27	27	2.796	3.879	
5491	129723	+2.07	0.275	189	2.789	3.875	BP Oct
	73619	+1.96	0.25	135	2.824	3.894	Sp.B., Δm=0.0
1672	33254	+1.91	0.24	15	2.817	3.890	
1414	28355	+1.82	0.23	104	2.830	3.897	
	73618	+1.73	0.19	—	2.845	3.905	
7984	198639	+1.70	0.18	90	2.844	3.904	
	73730	+1.67	0.19	30	2.838	3.901	
1519	30210	+1.42	0.19	47	2.846	3.905	
	73174	+1.41	0.21	<20	2.844	3.904	
	73709	+1.36	0.19	—	2.843	3.904	
343	6961	+1.33	0.17	102	2.845	3.904	
	73711	+1.20	0.15	60	2.858	3.912	
2666	53704	+1.00	0.175	62	2.851	3.908	
2566	50463	+0.99	0.13	—	2.856	3.911	
3429	73731	+0.71	0.17	82	2.834	3.902	ε Cnc, Δm=0.00

metallic-line A stars (Am) in the Hyades cluster (closed circles), Praesepe cluster (crosses) or amongst the noncluster, supercluster members (open circles) are listed in Table 6 and represented in Fig. 3. The two USPC that are also Am stars are labeled in the figure. The Am stars crowd, and slightly overlap, the color–luminosity relation for the USPC.

In addition to HR 403 and HR 8435, already discussed, there are nine supercluster members that are not named variables but are very similar to known USPC, and seven stars not known as Am stars but are very similar to known members of that class. The potential variables and their known counterparts are

NOT KNOWN TO BE VARIABLE

	M_v	$B-V$	Sp.T	$v \sin i$
HD 73819	$+0^m.43$	$0^m.16$	A6 V	152
HD 73785	+0.50	0.20	A9 IV	85
HR 8435	+1.71	0.325	F2 V	49
HR 1414	+1.82	0.23	A7 V	104
HD 73430	+1.97	0.23	A8 V	82
HR 8782AB	+2.08	0.235	F0 V	101
HR 1905	+2.08	0.22	F0 V	114
HR 4694	+2.10	0.28	F0 IV	109
HR 1507	+2.12	0.25	F0 V	85
HD 73893	+2.20	0.29	A9 V	200.

KNOWN VARIABLES

	M_v	$B-V$	Sp.T	$v \sin i$	Var
HD 73575	$+0^m.33$	$0^m.25$	A8 IV	150	BT Cnc
HR 1412	+0.61	0.17	A3 III	78	θ^2 Tau
HD 73175	+1.91	0.23	A9 V	180	BR Cnc
HR 1356	+1.96	0.22	F0 V	65	V696 Tau
HR 5491	+2.7	0.275	Am	89	BP Oct

Breger (1970) suspected a small-amplitude variation in HR 1507 but found no variation in the Praesepe stars 73430, 73785, 73919, and 73993. Another possible variable, HR 5059 lies on the USPC, color–luminosity relation and is not known to be an Am star. Jerzykiewicz (1975) suspects this object to be a small-amplitude variable.

The possible Am stars in the supercluster and their identified counterparts are

	M_v	$B-V$	Sp.T	$v \sin i$
HR 1620	$+1^{\mathrm{m}}.01$	$0^{\mathrm{m}}.16$	A7 V	126
HR 1387	+1.04	0.13	A7 V	81
HR 5059	+1.41	0.165	A7 III	112
HR 1427	+1.51	0.17	A6 IV	71
HR 3495	+1.61	0.175	A4 V	-
HR 6871	+1.80	0.175	A3 V	123

	M_v	$B-V$	Sp.T	$v \sin i$
HR 2566	$+0^{\mathrm{m}}.99$	$0^{\mathrm{m}}.13$	Am	-
HD 73711	+1.20	0.15	Am	60
HD 73709	+1.36	0.19	Am	-
HD 73174	+1.41	0.21	Am	<20
HR 1519	+1.42	0.19	Am	47
HD 73730	+1.67	0.19	Am	30
HR 7984	+1.70	0.18	Am	90.

It is arguable that the apparently higher rotational velocities, taken from the Bright Star Catalogue (Hoffleit 1982) and, for Praesepe, from Abt (1986), for the prospective Am stars prevents their detection or their formation. Figure 4 contains the correlation between the metallicity index, $[m_1]$, of the Strömgren photometric system, and $B-V$ for known USPC (open circles), Am stars (closed circles), and normal stars (crosses).The USPC known to be Am stars, HR 5491 (BP Oct) and HR 1368 (V 775 Tau), are labeled as well as HR 7020 (δ Sct) which is sometimes classified as Fm. The half-dozen potential Am stars listed above are not distinguishable from the normal stars in the figure.

The results that the Am stars have larger values of $B-V$ than the USPC at a given temperature and also are ultraviolet deficient (Fig. 4) are hallmarks of line blanketing (e.g., Sandage & Eggen 1959) from increased heavy element abundance. If the Hyades have [Fe/H]~0.1 dex, the Am stars have ~0.3 dex. The normal nomenclature for Am stars is to give the spectral types based on CaK/H/ and metal lines. The values of ΔS used in classifying USPC (RR Lyr) variables represent the difference between the type from the hydrogen and from the metal line and for the Am stars in the Hyades supercluster this would translate into values of $\Delta S=-2$ to -4. Because the overabundance of the Am stars is a surface phenomenon, whose source is connected with the evolutionary state, the degree of metallicity of an Am star is therefore, in part, dependent upon the metallicity of the stellar system in which it is found. This situation will be discussed in more detail with respect to other superclusters, but it is obviously of some interest in the basic question discussed here, of the origin of blue stragglers. If such a blue straggler represents a new generation of stars within a stellar system, Am stars will be seen in their subsequent evolution, whereas alternative explanations of stragglers, such as the coalescence of binary components, seem unlikely to produce the conditions conducive to forming Am stars. In this regard the presence of Am stars amongst the faintest USPC (BP Oct and V775 Tau) is interesting. SX Phe is one of the lowest luminosity USPC known and has [Fe/H]~-0.6 dex from spectroscopic analysis (Bessell 1969), compared with -1.7 dex as a member of the Kapteyn's star group [or -1.5 dex from calibration of the hydrogen lines (Eggen 1994)]. The observed value of $\Delta S=6$ (Bessell 1969) gives [Fe/H]~-0.9 dex from calibrations of that index, so *if* all assumptions made here about SX Phe are correct, the star is a metallic line, USPC.

The separation of the Am and USPC stars in Fig. 2 is exaggerated in Fig. 5 where the values of β are correlated with B2−V1 and with $B-V$. Hauck & North (1993) believe that B2−V1 represents Te for the Am stars but Fig. 5 demonstrates that B2−V1, as well as $B-V$, is a blanketed index for these objects. The separation of the Am and USPC stars in Fig. 5 is also shown in the (M_v, log T_e) plane of Fig. 6. Smalley & Dworetsky (1993) have derived values of T_e for several supercluster stars from spectrophotometry. Adopting their results for [M/H]+0.1 dex for USPC and normal stars, and 0.4 dex for the Am stars, leads to the results listed in Table 7, together with the predicted values from the relation

$$\log T_e=3.881+0.53(\beta-2.800). \qquad (1)$$

Two "fundamental" values of T_e, derived from the eclipsing binaries PV Pup (HR 3009) and MY Cyg (Andersen 1991), have been added to Table 7. The relation (1) is valid for the bright A star sample with T_e<9000 K. The spectrophotometric values and those from Eq. (1) give $\sigma=\pm0.007$ dex, or a mean dispersion of about 100 K. The isochrones in Fig. 6 are from Castellani *et al.* (1992) and it is apparent that the difficulty with the equivalent isochrone in Fig. 2 is mainly in the

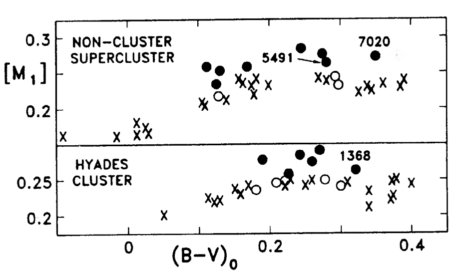

FIG. 4. The known USPC (open circles), Am stars (closed circles), and normal stars (crosses) of the Hyades supercluster in the $B-V$, $[m_1]$ plane. The labeled stars in the upper panel are both Am stars and USPC.

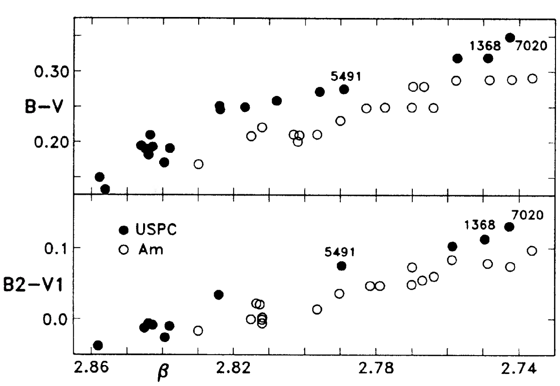

FIG. 5. Correlation of β with $B-V$ (upper) and B2−V1 (lower) for supercluster members. The labeled stars are both USPC and Am.

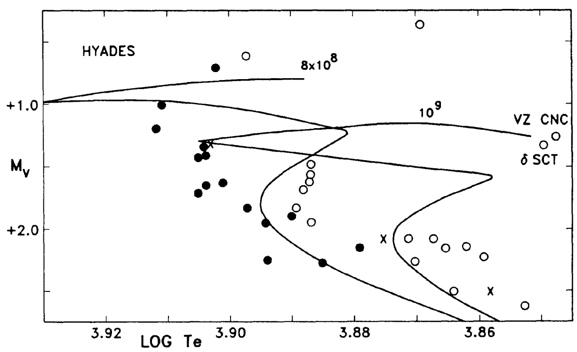

FIG. 6. The USPC and Am stars of the Hyades supercluster in the (M_v, log T_e) plane. The isochrones are from Castellani *et al.* (1992).

adopted ($B-V$, log T_e) relation. This is demonstrated in Fig. 7 where the relation from both the Maeder & Meynet (1991) and Castellani *et al.* (1992) models is shown. The relation adopted by Castellani *et al.* is obviously in error and accounts for their need to introduce a modulus of only 3.0 mag and a reddening of 0.04 mag for the Hyades cluster. The three faintest Am stars in Fig. 6, $M_v > +2.3$ mag, contain two USPC, BP Oct and V 775 Tau, that are also Am objects. The two possible supercluster USPC, VZ Cnc, and δ Sct, are labeled in Fig. 6.

The possibility that Am stars, because of their nature, would not survive the merger or the coalescence of binary components poses the question "Are there Am stars in the old disk population?" The Am stars in the bright star sample, but not in the Hyades supercluster, are listed in Table 8. The values of M_v from Geneva (GNV) and Strömgren (STR) photometry are listed separately and the mean value is used to derive the modulus (MOD). These stars are shown in the (U, V) plane of Fig. 8 and, indeed, there are old disk Am stars, representing a third of such objects in the bright sample. Most of these OD objects proceed in the Sun in galactic rotation ($V > 0$ km/s). The stars in Table 8 are shown in the (M_v, log T_e) plane of Fig. 9 where the OD population is represented by closed circles and the YD by open circles. There is little difference in the apparent age distributions and all appear to be older than about 2×10^8 yr (Castellani *et al.* 1992.

4. USPC (δ SCT VARIABLES)

The known USPC (δ Sct) variables in the bright A-star sample, but not in the Hyades supercluster, are listed in Table 9. The mean luminosities, from the Strömgren (STR) and Geneva (GNV) photometries, are used to plot the stars in the (M_v, log T_e) plane of Fig. 10, where Eq. (1) is used to derive the values of log T_e and the values of (U, V) are in Fig. 11. The OD population is represented with closed circles, the YD with open circles, and the USPC in the Hyades supercluster (Table 5) are represented by crosses. The 8×10^8 yr isochrone is from Castellani *et al.* (1992). Four variables, HR 2238 (UZ Lyn), 6581 (κ Ser), 7711 (18 Vul), and 8569, lie blueward of the apparent "blue edge" for the remaining stars in Fig. 10. It would appear that these four stars represent a different process. UZ Lyn has large-amplitude and very short period radial velocity variations that differ from Balmer line to Balmer line (Antonello *et al.* 1978). Valtier (1972) believes that the USPC nature of HR 6581 is not proven. Although Breger (1969) found no variation in HR 7711 larger

TABLE 7. Effective temperature of USPC, Am, and normal stars.

HR	Te °K	Log Te SPH	log Te Comp	Δ	Type
1351	7354	3.866	3.864	+0.002	V 483 Tau
1356	7624	3.882	3.887	−0.005	V 696 Tau
1389	8696	3.939	3.928	+0.011	V 776 Tau
1412	7716	3.888	3.897	−0.009	θ^2 Tau
1368	7380	3.868	3.858	+0.010	Am
1428	7692	3.886	3.885	+0.001	Am
1672	7598	3.880	3.890	−0.010	Am
MY CYG	7023	3.846	3.851	−0.006	Fm
1380	8120	3.910	3.911	−0.001	A7 V
1387	8126	3.910	3.917	−0.007	A7 IV–V
1408	7220	3.859	3.853	+0.006	F0 IV
1427	7982	3.902	3.911	−0.009	A6 IV
1473	8176	3.919	3.917	+0.002	A6 V
3009	6918	3.840	3.840	0.000	A8 V
			mean	−0.001	
			σ	±0.007	

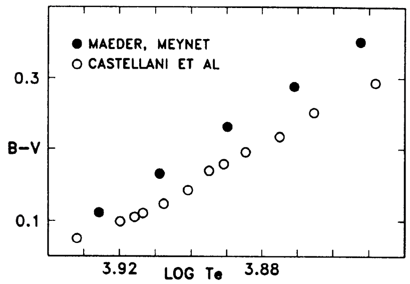

FIG. 7. The correlation between $B-V$ and $\log T_e$ from the models of Maeder & Meynet (1991) and Castellani *et al.* (1992).

than 0.002 mag in two 4.5 h observing runs, Belmonte & Cortes (1989) found a variation of 0.002 mag in three such runs. Schutt (1991) announced the USPC nature of HR 8569 on the basis of two, three hour observing runs which showed a variation of 0.0015 mag in a period near 0.057*d*. It is obvious that all of these stars need further study and it is suggestive that they lie near the point of core hydrogen exhaustion on the 8×10^8 yr isochrone in Fig. 10, which may identify them with the magnetic Ap stars, such as α^2 CVn (Fig. 1). The Ap stars are artificially blue because of back-warming from the strong earth lines, but no such peculiarities have been detected in the stars discussed here. Light variations similar to those found in USPC have been also found in some of the Ap stars.

The only post-main-sequence USPC younger than those in the Hyades would be found in clusters such as those connected with the Pleiades supercluster ($1-2\times10^8$ yr). The Pleiades and α Per clusters, which are part of this supercluster (Eggen 1992b,c), have moduli of 5.45 and 6.28 mag, respectively, derived from the supercluster motion. Six known variables in these clusters are

Name	Var	V_0	β	M_v	$\log T_e$
α Per cluster					
+47°842	V465 Per	$8^{\rm m}40$	$2^{\rm m}782$	$+2^{\rm m}12$	3.866
+48 894	V459 Per	8.90	2.770	+2.62	3.865
+49 905	V961 Per	8.80	2.775	+2.52	3.868
Pleiades cluster					
HD 23156	V624 Tau	8.05	2.839	+2.60	3.902
23567	V534 Tau	7.96	2.788	+2.54	3.875
23607	V647 Tau	8.04	2.841	+2.59	3.903.

These stars are represented in Fig. 10 by plus signs. The very young cluster NGC contains the variable V588 Mon, which is almost certainly a pre-main-sequence star (Breger 1972).

Although there are at least 30 Am stars in the direction of the much younger Orion Association (Levato & Malroda 1994), only the 11 in Table 10 are possible members. The photometry of Warren & Hesser (1978) and of Rufener (1988) was used to derive the luminosities from the Strömgren (STR) and Geneva (GNV) systems. The mean photometric moduli are compared with those of the various subsections of the association in which the stars occur (Warren and Hesser 1978). The spectral types are from Levato &Malroda (1994). The only "certain" member appears to be WH 497 and the Am nature of this object is obviously marginal. If this is truly an Am star and member of the association, the Am phenomenon exists in pre-main-sequence objects. Five additional stars in Table 10 have MOD(PHOT)-MOD(WH)<0.75 mag so *if* all Am stars are binary these could also be members.

The mean rotational velocities (Hoffleit 1982), for fixed temperature intervals, of the USPC and Am stars in the sample are

USPC			Am		
$\log T_e$	$v \sin i$ km/s	σ	$\log T_e$	$v \sin i$ km/s	σ
3.930	(50)	(±55)	3.920	41	±27
3.890	110	±60	3.897	41	±30
3.868	110	±52	3.871	43	±20.
3.843	70	±50			

The value of 50±55 km/s represents the four bluest USPC which, as discussed above, may be the result of a separate process. The reddest USPC also show a reduced rotational velocity. The Am stars of all temperatures have a mean rotational velocity of only 42 km/s and, in the mean, the rotational velocity of the Am stars is only one-half that of the USPC. The Am stars outnumber the USPC in the sample by three to two. Fifty percent of the Am stars are binary whereas only 20% of the USPC are in this category. Abt & Levy (1985) suggest that possibly every Am star is in a binary of some sort. One half the binary Am stars are double-lined whereas only three such systems are found among the USPC. Seven Am stars are also USPC,

HR	$\log T_e$	M_v	Var
114	3.857	$+1^{\rm m}30$	GN And
139	3.890	+0.96	θ Tuc
1368	3.858	+2.51	V 775 Tau
3321	3.896	+2.09	LM Hya
4594	3.865	+2.30	DP UMa
4684	3.900	+1.91	FM Com
5491	3.687	+2.07	BP Oct.

Figure 6 suggests that some 2×10^8 yr separate the bulk of the Am and USPC stars of the Hyades supercluster if (Table 7) β gives the same temperature scale for both types of object. Despite the fact that a half-dozen stars belong to both categories, the supposition that Am stars evolve into USPC is faced with several difficulties. The apparent age difference does not seem great enough to allow one-half the Am binaries to merge and produce single objects with twice the rotational velocity. The effect of such mergers on the pulsation process, as the stars enter the instability region, is uncertain. The Am phenomenon is often traced to diffusion, due to gravity and radiation pressure or magnetic forces. Böhm-Vitense (1976) suggests that the Am stars have an active hydrogen convection zone, whereas the more rapidly rotating USPC do not. The implication is that the borderline effective temperature, separating the two domains in Fig. 6, is strongly gravity sensitive.

5. THE λ BOO AND RELATED STARS

The λ Boo stars are "anti-Am" stars in the sense that the metallic lines are too weak for their spectral type, when that

TABLE 8. Am Stars in the sample but not in the Hyades or Sirius supercluster.

HR	β	E(b-y)	V_o	M_V STR	M_V GNV	MOD	μ_α/μ_δ 0".001	ρ km/sec	U	V km/sec	W	$(B-V)_o$	Sp.T.	Note
169	2.882	0.000	6.85	+1.60	+1.58	5.26	-15/0	+21.2	-15.4	-8.5	-14.3	0.11	A1m	
178	2.812	0.010	6.00	+1.32	+1.36	4.66	107/-16	-14.6	+28.5	-35.9	+2.3	0.25	A7m	
192Aa	2.892		5.60	+0.35	--							0.05	A1m	X
192Ab	--	0.000	8.25	+3.10	--	5.15	-18/-26	+8.1	-2.2	+13.9	-10.7	0.375	F2	X
192B	--		11.23	+6.08	--							0.94	K	X
250	2.861	0.010	6.21	+2.14	+1.84	4.22	76/-22	-1.1	+19.7	-15.7	-6.8	0.175	A5m	
323	2.885	0.005	(7.32)	+1.35	+1.33	5.98	70/-25	+17.9	+31.8	-47.5	-12.1	0.13	A5m	X
324	2.865	0.000	5.02	+1.14	+1.48	3.71	166/-70	+8.5	+38.2	-24.2	-12.3	0.11	A3m	
395	2.816	0.033	(6.20)	+2.66	+2.48	3.63	83/-15	+13.3	+24.4	-5.3	-6.4	0.215	A8m	X
418	2.768	0.000	6.46	+2.90	+2.86	3.58	8/19	+1.0	+2.8	+4.3	+4.1	0.27	A7m	
540	2.856	0.015	6.37	+2.20	+2.11	5.21	47/-11	+7.9	+23.9	-10.8	-0.6	0.16	A5m	
553	2.879	0.003	2.65	+1.58	+1.65	1.03	96/-111	-1.9	+1.9	-11.0	-3.3	0.125	A5m	X
613	2.902	0.010	(5.75)	+2.25	+1.98	3.63	19/-41	+11.5	+8.3	-4.2	-13.3	0.10	A2m	X
839	2.899	0.010	6.42	+1.86	+1.86	4.56	-39/3	-4.8	-13.1	+7.3	-5.6	0.085	A1m	X
883	2.823	0.000	5.42	+1.91	+2.09	3.42	111/-44	+28.8	+13.3	-31.6	-0.9	0.24	A7m	
905	2.884	0.000	5.91	+1.91	+1.88	4.01	-17/6	-4.0	-6.1	+3.4	+0.6	0.14	A3m	
976	2.812	0.010	6.21	+2.41	+2.40	3.81	49/-43	+24.6	+27.8	-5.8	-10.6	0.27	A1m	X
984	2.797	0.000	4.79	+1.82	+1.80	2.98	-2/46	-4.5	+2.1	+7.1	+6.3	0.23	A5m	X
1068A	2.872	0.024	6.33	+1.57	+1.68	4.75	1/-41	+6.9	+12.1	-3.6	-13.8	0.13	A5m	X
1068B	--		7.79	--	+2.90							0.38	F	X
1078	2.876	0.010	5.76	+1.90	+1.96	3.83	9/-34	+3.7	+5.4	-6.0	+6.9	0.11	A5m	X
1138	2.882	0.020	(6.05)	+1.14	--	4.91	13/-69	+17.0	+32.1	-3.4	-16.3	0.065	A1m	X
1139	2.822	0.005	5.57	+2.11	+2.12	3.45	-3/-26	+16.2	+6.6	-7.5	-14.1	0.21	A5m	
1196	--	0.010	6.27	--	+2.95	3.32	54/-7	-1.9	+4.4	-9.6	+5.9	0.305	F0m	
1248	2.851	0.012	6.08	+0.97	+1.00	5.10	17/-28	-6.5	+5.2	-15.6	-5.8	0.12	A3m	
1300	2.864	0.010	(6.50)	+2.08	+1.94	4.49	41/50	+32.8	+33.8	-11.0	-12.2	0.165	A2m	X
1308	2.864	0.015	6.45	+1.87	+1.95	4.54	4/-34	+7.5	+2.4	-11.3	-9.7	0.14	A2m	
1401	--	0.010	5.90	--	+1.88	4.02	37/-83	+9.9	+25.8	-10.5	-6.1	0.285	A8m	X
1511	2.819	0.010	5.18	+1.75	+1.98	3.31	51/-148	+18.6	+33.0	-18.3	-10.0	0.235	A3m	
1528	2.791	0.010	5.80	+1.58	+1.84	4.10	24/-38	+20.3	+22.0	-10.2	-4.7	0.225	A8m	X
1627	2.770	0.009	6.56	+1.84	+2.10	4.59	-10/-82	-8.0	-6.9	-24.3	-21.0	0.26	A4m	
1689	2.846	0.000	4.82	+1.93	+1.95	2.88	-18/-75	+27.6	+29.0	-3.2	-10.6	0.18	A4m	
1827	2.823	0.010	5.77	+1.45	+1.52	4.29	11/96	+36.4	+43.4	-19.4	-12.3	0.225	A7m	
1850	2.886	0.005	6.46	+1.57	+1.66	4.84	-4/-62	+34.0	+35.6	-19.0	-16.6	0.08	A2m	
2079	2.751	0.009	6.36	+2.16	+1.92	4.32	-6/-93	+45.0	+54.7	-7.9	-4.1	0.21	A5m	
2138	2.848	0.005	5.63	+1.51	+1.55	4.10	-26/87	+5.0	-25.4	-3.4	-13.4	0.19	Am	
2172	2.884	0.039	(6.86)	+2.00	+1.72	5.00	2/-62	+13.5	+24.0	-20.4	-7.8	0.09	A5m	X
2262	2.862	0.013	5.94	+1.33	+1.15	4.70	-17/-22	-4.5	-8.9	+4.5	-6.7	0.14	A2m	
2372	2.862	0.020	(6.50)	+1.82	+2.00	4.59	-19/-8	-9.4	-7.7	+0.7	-9.7	0.165	Am	X
2772	--	0.010	6.32	--	+2.40	3.92	-8/20	+7.0	+3.5	+7.9	+2.9	--	A8m	
2914	2.840	0.015	5.85	+1.65	+1.76	4.15	-50/-30	+10.3	+18.1	-3.1	+0.4	0.20	A5m	
3320	2.846	0.020	5.87	+0.78	+1.10	4.93	-10/40	+8.8	+18.8	+3.5	+8.2	0.145	A5m	
3352	--	0.000	6.30	--	+2.38	3.92	-22/-23	-6.4	+2.8	-8.2	-6.8	--	A2m	
3354	2.842	0.005	5.44	+1.85	+2.00	3.52	-56/-60	-15.5	+2.4	-17.7	-17.5	0.17	A2m	
3572	2.865	0.000	4.26	+1.19	+0.74	3.30	34/-31	-13.8	-16.5	+0.7	-4.3	0.14	A5m	
3588	2.811	0.005	5.14	+1.31	+1.34	3.82	-74/48	+18.0	+14.0	-16.9	-6.9	0.24	Am	X
3619	2.797	0.000	4.46	+2.37	+2.38	2.08	-139/-28	+1.0	+12.9	-3.0	-11.6	0.27	A5m	X
3624	2.763	0.000	4.56	+2.60	+2.24	2.14	97/-56	-9.0	-12.5	-10.1	+5.1	0.35	Am	X
3855	2.879	0.025	6.37	+1.36	--	5.01	-36/-34	+20.6	+27.9	-12.6	+7.1	0.095	A5m	
3988	2.846	0.010	6.14	+1.50	+1.88	4.45	1/-17	-14.3	-7.1	+7.8	-11.4	0.165	A5m	
4021A	2.769	0.015	6.62	+1.91	+2.20	4.56	-35/-49	+12.2	+22.0	-14.0	+10.3	0.30	A8m	X
4021B	2.820		7.32	+2.32	+2.49	4.91						0.28	A7m	X
4025	2.810	0.015	5.10	+0.56	+0.37	4.64	-24/22	-15.2	+12.0	+10.0	+3.9	0.19	Am	
4237	2.841	0.010	5.75	+0.91	+1.00	4.79	-4/-15	-5.9	-2.2	-0.4	-8.6	0.145	A3m	X
4300	2.917	0.000	4.42	+1.57	--	2.85	-14/42	-10.2	+1.9	+9.1	-9.0	0.05	A1m	
4322	2.870	0.005	6.45	+1.86	+2.00	4.52	-10/3	-2.9	+2.5	+0.6	-3.9	0.15	A5m	X
4385	2.790	0.010	6.32	+2.19	+2.17	4.14	54/-32	-4.0	-14.9	+13.7	-2.0	0.245	Am	
4429	--	0.010	6.08	--	+2.30	3.78	-144/32	+3.2	+35.8	-6.9	-16.8	0.25	Am	
4454	2.834	0.015	6.49	+1.85	+2.01	4.56	41/-24	-5.0	-18.7	+0.3	-2.5	0.16	A2m	
4535	2.795	0.010	6.06	+2.26	+2.35	3.76	40/-53	-24.2	-19.2	-0.8	-23.1	0.26	A3m	
4543	2.774	0.005	6.35	+2.50	+2.46	3.87	-145/38	+6.9	+41.5	-10.7	-0.3	0.26	A5m	
4629	2.765	0.000	5.71	+2.81	+2.76	2.93	-158/16	-9.1	+26.9	-7.4	-12.1	0.35	Am	
4646	--	0.000	5.15	--	+2.34	2.81	10/22	+0.3	-0.4	+2.7	-1.9	0.33	A5m	
4650	2.793	0.000	5.85	+2.25	+2.26	3.60	-91/-8	+2.3	+18.8	-13.1	-1.9	0.27	A2m	
4673	2.873	0.000	5.69	+1.69	+1.92	3.75	-33/35	-6.7	+11.3	+4.2	-8.1	0.15	A4m	
4685	2.868	0.000	6.24	+2.21	+1.90	4.19	-8/0	+1.4	+2.2	-1.4	+1.1	0.17	Am	X
4750	2.846	0.000	6.51	+1.63	+1.80	4.70	-17/-9	+1.8	+4.6	-7.3	+1.1	0.17	A2m	
4794	2.822	0.000	5.12	+2.18	+2.11	2.77	-106/0	-11.0	+22.2	-2.5	-5.3	0.22	Am	
4852	2.806	0.010	6.26	--	+1.10	5.16	29/-42	-28.0	-30.9	-21.8	+0.5	0.15	A5m	
4866	2.842	0.010	6.22	+0.83	+0.88	5.36	-60/19	-1.9	+33.6	-10.5	-6.2	0.165	A6m	

TABLE 8. (continued)

HR	β	E(b-y)	V_o	M_V STR	M_V GNV	MOD	μ_α/μ_δ 0".001	ρ km/sec	U	V km/sec	W	$(B-V)_o$	Sp.T.	Note
5008	2.864	0.000	5.78	+2.13	+1.83	3.80	-3/-8	-12.0	+7.4	+7.7	-5.9	0.19	Am	
5040	2.893	0.000	5.87	+1.76	+1.79	4.09	-67/-22	-10.2	+11.3	-15.1	-9.6	0.12	A2m	
5045	2.770	0.000	6.35	+1.39	+1.76	4.78	-62/4	-1.1	+22.5	-15.9	+1.5	0.24	A7m	
5175	2.793	0.005	5.89	+2.51	+2.33	3.47	89/13	+16.1	-20.6	-2.6	+3.3	0.27	A3m	
5349	2.830	0.000	5.20	+2.35	+2.33	2.86	-168/-82	+21.2	+9.9	-38.4	-3.0	0.29	Am	
5359	2.880	0.002	(5.26)	+1.54	+1.59	3.70	-15/30	-5.4	+9.0	+4.5	+2.6	0.125	A2m	X
5401	2.789	0.005	5.79	+2.56	+2.37	3.30	-156/-78	-25.6	+43.7	-14.0	-7.8	0.38	Am	
5405	2.817	0.014	5.34	+1.03	+1.00	4.32	-71/26	-28.3	+32.6	-12.7	-15.8	0.21	F0m	
5599	2.880	0.046	6.39	+1.64	+1.51	4.82	-45/-27	-22.4	+21.3	-20.5	-12.6	0.14	A5m	
5752	2.860	0.020	6.05	+0.42	+0.69	5.50	-18/9	-16.0	+12.3	-14.1	-7.6	0.07	Am	X
5759	2.891	0.015	6.37	+1.55	--	4.82	-7/36	-9.2	+15.3	-2.4	-10.7		A3m	
5762	2.875	0.000	5.50	+1.91	+1.55	3.77	-20/-36	-33.2	+28.8	-4.1	-19.4	0.18	A2m	
5807	2.851	0.030	5.91	+1.03	+1.15	4.82	15/3	+14.0	-15.5	-0.6	+0.2	0.17	A3m	
5845	2.860	0.018	5.72	+2.34	+2.16	3.47	-68/59	-29.5	+33.3	-10.6	-9.9	0.175	A2m	
5892	2.886	0.000	3.70	+1.94	+1.84	1.81	129/62	-9.4	+4.6	+12.6	-12.2	0.15	A2m	
5980	2.854	0.000	4.71	+2.15	+2.02	2.63	3/28	-15.5	+12.9	+9.8	+1.6	0.23	Am	
5992	2.873	0.025	6.17	+0.50	--	5.67	28/5	-21.5	+10.6	+8.7	-24.9	0.045	Am	
6250	2.898	0.005	5.45	+1.55	+1.65	3.95	54/4	-3.6	+0.7	+9.1	-13.4	0.09	A3m	
6350	2.889	0.030	6.15	+1.63	+1.62	4.53	-13/-75	-45.2	+41.3	-26.3	-21.2	0.09	A3m	
6377	2.748	0.000	(6.16)	+2.45	+2.45	3.71	-28/-16	-29.9	+9.6	-26.9	-12.2	0.31	A5m	X
6385	2.885	0.020	6.48	+1.27	--	5.21	34/-4	+4.5	-7.0	+11.1	-13.0	0.055	A1m	X
6554	2.777	0.000	4.87	+2.21	+2.20	2.67	148/55	-16.7	+9.7	0.0	-2.90	0.26	A6 V	X
6555	2.772		4.85	+2.47	+2.44	(2.40)						0.28	A4m	X
6784	2.864	0.030	6.21	+1.27	+0.95	5.10	4/-6	-9.1	+4.7	-6.6	-5.4	0.115	A5 V	
6811	--	0.000	5.74	--	+2.04	3.70	50/18	+1.2	+4.9	+5.7	-11.4	0.25	Am	
6910	2.889	0.025	5.51	+1.52	+1.33	4.09	0/-40	-21.3	+22.7	-9.7	-0.1	0.095	A1m	
6911	2.876	0.015	6.31	+1.66	+1.36	4.80	28/-4	-3.7	+0.6	+1.9	-12.4	0.155	A3m	
6979	2.765	0.020	(7.25)	+2.37	--	4.88	-16/72	-9.3	+29.6	-16.3	+6.1	0.285	A8m	X
7011	2.830	0.015	6.15	+2.18	+2.10	4.01	32/-24	+0.9	+0.6	-2.2	-12.0	0.205	Am	
7019	2.814	0.017	6.43	+1.15	+1.16	5.28	15/4	+17.0	-1.8	+19.0	-1.5	0.185	A6m	
7056	2.853	0.000	4.33	+1.14	+1.22	3.15	24/20	-26.0	+14.5	-19.8	-10.7	0.19	Am	X
7077	2.879	0.035	(7.35)	+2.32	+2.11	5.14	-6/2	-42.8	+40.4	-11.5	+8.8	0.155	A1m	X
7219	2.863	0.021	6.62	+0.88	+0.67	5.84	25/25	-13.0	+24.6	+10.7	-7.1	0.10	A5m	
7327	2.791	0.010	5.54	+2.03	+2.07	3.49	-6/25	-6.4	+6.3	+3.5	+5.3	0.255	A8m	
7532	2.872	0.020	6.00	+2.50	+2.19	3.65	29/-29	-7.7	+8.1	-6.8	-6.3	0.175	A6m	
7562	2.882	0.021	6.16	+1.32	+1.46	4.77	10/-16	+20.9	-16.0	+12.1	-10.2	0.07	A1m	
7579	2.845	0.010	5.68	+1.73	+1.52	4.06	63/-98	+12.7	+33.8	-15.5	-7.6	0.22	Am	
7723	2.793	0.000	6.61	+2.79	+2.56	3.93	52/36	-37.0	+31.7	-26.2	-2.9	0.28	A2m	
7833	2.837	0.025	6.45	+0.60	+2.30									X
7839	2.890	0.019	6.13	+1.78	+1.70	4.39	98/53	-40.2	+50.8	-22.0	-10.2	0.115	A1m	
7930	--	0.020	6.11	--	+1.61	4.50	16/-12	+10.0	+4.5	+11.2	-2.4	--	A3m	
8177	2.835	0.018	6.21	+1.22	+1.33	4.93	46/-16	-23.9	+32.0	-5.7	+3.9	0.175	A7m	
8253	2.821	0.000	5.71	+1.99	+2.13	3.65	112/-24	-19.0	+31.6	-12.7	-6.1	0.22	A3m	
8410	2.820	0.000	5.28	+1.51	+1.40	3.82	-16/-63	+20.4	-19.5	+0.5	-18.9	0.23	A5m	X
8722	2.840	0.005	5.68	+1.54	+1.68	4.07	-20/-3	+6.4	-8.4	-0.1	-2.7	0.20	Am	
8944	2.781	0.000	5.88	+2.18	+2.23	3.68	108/-13	-2.8	+22.6	-14.5	-7.3	0.29	A7m	
8970	2.843	0.000	5.96	+1.90	+1.91	4.06	78/-12	-6.0	+18.7	-15.6	-4.2	0.185	A2m	
9025	2.840	0.010	5.96	+1.28	+1.51	4.56	61/24	-4.3	+23.3	-9.6	+4.4	0.15	A2m	

Notes to Table 8.

192 YZ Cas. The spectroscopic and photometric orbits of Aab are discussed by Lacy (1981). They lead to the adopted distance (107 pc), radii of 2.50 and 1.35 times the solar value and masses of 2.30 and 1.35 times the sun, for the brighter and fainter components, respectively. The stars lie on a 10^9 y isochrone (Maeder and Meynet 1991) which predicts masses of 2.1 and 1.5$M_\odot$. The Aa component is near the commencement of shell hydrogen burning.

323 Sp.B, P = 10,62d.

395 Sp.B, P = 35.27d. Components are of equal magnitude.

553 Sp.B, P = 107.0d. Tomkin and Tran (1987) have detected the secondary spectrum, nearly 3 mag fainter than the primary. The photometric parallax is 0.0623 arcsec, compared with the mean trigonometric value of 0.074 arcsec.

613 Sp.B, P = 15.29d. The components are of equal magnitude.

839 Sp.B, P = 8.25d.

976 Sp.B, P = 5.35d.

TABLE 8. (continued)

984	Sp.B, P = 17.93d.
1068	20 arcsec separation.
1078	Sp.B, P = 0.92d. IW Per, ellipsoidal variable.
1138	Sp.B, P = 15.51d. Δm = 0.2 mag.
1300	Sp.B, P = 3.66d. Components of equal magnitude.
1401	Sp.B, P = 7.05d.
2172	Sp.B, P = 106d. Δm = 0.2 mag.
2372	Sp.B, P = 2.5d. WW Aur, eclipsing binary with equal components. The masses and radii are both 1.9 times the solar values (e.g. Andersen 1991). The mean component lines on the 10^9 y isochrone (Maeder and Meynet 1991) which predicts a mass of $1.8M_{\odot}$.
3588	FZ Vul, USPC.
3619	Sp.B, P = 4.89d.
3624	Sp.B, P = 1062.4d.
4021	CPM 16.5 arcsec separation.
4237	Sp.B, P = 6.16d.
4322	Sp.B, P = 40.45d.
4685	In Coma Ber cluster.
4750	Sp.B, P = 11.78d.
5359	Sp.B, P = 1.93d. Δm = 0.14 mag.
5752	Sp.B, P = 105.95d.
5892	Photometric parallax is 0.0434 arcsec, compared with the mean trigonometric value of 0.041 arcsec.
5992	Sp.B, P = 8.86d.
6377	This close pair of equal components has P = 8.129y and a = 0.1118 arcsec, based on speckle observations (Hartkopf et al. 1989). The photometric parallax of 0.0181 arcsec leads to a mean mass of $1.8M_{\odot}$. The mean component lies on an isochrone for $2x10^9$ y with a predicted mass of $1.7M_{\odot}$.
6385	Sp.B, P = 23.24d.
6554/5	Separated by 62 arcsec. The Am star (HR 6855) is Sp.B, P = 38.13d and this probably accounts for the slight modulus discrepancy. The faint spectroscopic companion apparently contributes significant light to the system.
6979	Sp.B, P = 14.34d. Equal magnitude components.
7056	Sp.B, P = 4.30d.
7077	Equal components separated by 0.2 arcsec.
7083	The large difference is derived luminosities probably indicates a peculiarity, a companion or incorrect colors.
8410	Sp.B, P = 7.83d.

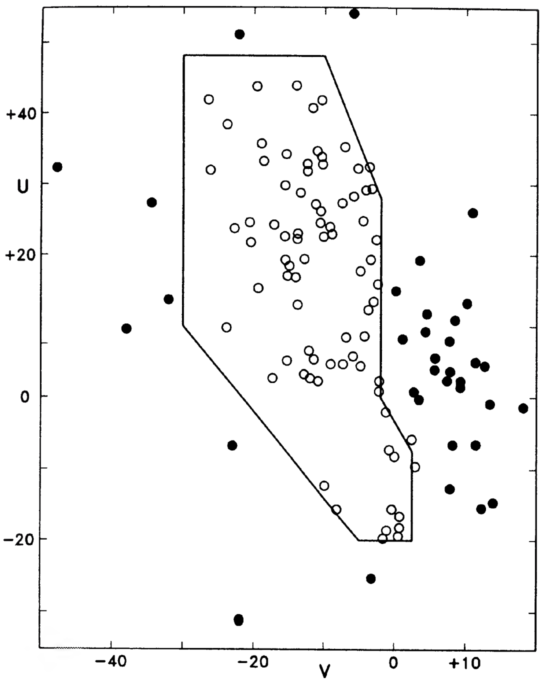

FIG. 8. The Am stars (Table 8) in the $(U-V)$ velocity plane.

type is determined from the K-line and Balmer-line strengths. An accretion/diffusion model for these objects, described by Turcotte & Charbonneau (1993), requires a modest amount of mass loss. Fifteen λ Boo stars (Gray 1988) are listed in Table 11. The temperatures for four λ stars, from Eq. (1), compare well with the results from an extensive investigation by Gerbaldi and Fraggiani (1993):

Name	HR	T_e		
		Eq. (1)	GF	Δ
π^1 Ori	1570	8548	8560	−12 K
ρ Vir	4828	8644	8630	+14
λ Boo	5351	8527	8490	+37
29 Cyg	7736	7916	7940	−4
				+3±24(σ).

The stars are shown in the $(M_v, \log T_e)$ plane of Fig. 12 which also contains isochrones for 6 and 10×10^8 yr (Castellani *et al.* 1992). HR 7764, a wide binary in which both components are λ Boo stars, and HR 4881 are labeled in the figure. The stars appear to be between 6 and 10×10^8 yr old. HR 4881 has peculiar hydrogen-line profiles (Iliev & Barzova 1993). The star is a radial velocity variable with $\rho=-18.1\pm2.4$ km/s from two observations (Nordström & Andersen 1985) and -5 ± 3 km/s (Iliev & Barzova 1993). The temperature (7355 K) derived from Eq. (1) is the lowest of all the stars in the table, except for HR 8437, and is in fair agreement with 7500 K derived by Iliev and Barzova from the central part of the hydrogen lines. The λ Boo nature of HR 4881 needs to be confirmed. The two components of HR 7764 are incompatible with a single isochrone and possible contamination of the colors of one or both components of this important system needs to be investigated. Both stars are radial velocity variables (Nordström & Andersen 1985) and, like HR 4881, the population assignment is consequently uncertain. At least three of these λ Boo stars are members of the OD population and, therefore, blue stragglers.

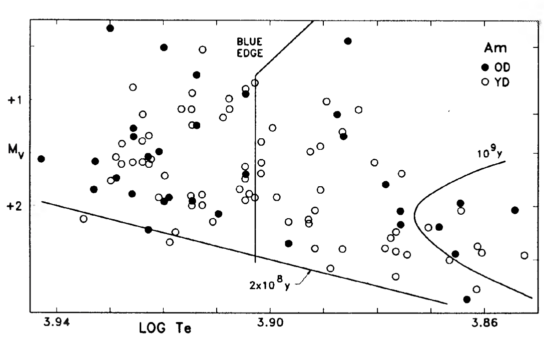

FIG. 9. The Am stars in the $(M_v, \log T_e)$ plane. The isochrones are from Castellani *et al.* (1992).

Abt (1994, also Rao *et al.* 1994) suggests that stars classified as A2 IV could represent a hitherto unnoticed class of peculiar A stars with sharp lines of Mg II 4481, and Sr II 4077 and 4215 that are too weak for the spectral luminosity class. The 16 objects of this type discussed by Abt and Rao *et al.*, and in the bright A star sample (except for HR 4825, 4881, and 7764), are listed in Table 12 and are shown in the $\log T_e, M_v$ plane of Fig. 13. Three of these objects are members of the Sirius supercluster and three of the Hyades supercluster. Also at least three of these stars are members of the OD population and therefore, blue stragglers. The luminosity range is 2.0 mag and the mean temperature, Eq. (1), is 8220 ±200 K. These stars fall into three groups for which the mean parameters are

(N)	M_v	$\log T_e$	$v \sin i$ (km/s)	τ ($\times10^8$ yr)	Mass (⊙)	Mg II 4481
9 Stars	+0.07	3.915	116	5	2.6	682(2)
	±0.21	±0.010	±63			±201
4 Stars	+0.96	3.925	103	8	2.15	606(2)
	±0.19	+0.003	±64			±61
3 Stars	+1.78	3.919	52	6	1.95	416(1)
	±0.23	±0.20	±18.			

The values of W(mA) for Mg II are available for very few of the stars (Rao *et al.* 1994) as indicated in the final column by (N). The ages (τ) and the masses are from the models with convective overshoot by Castellani *et al.* (1992). The luminosities of the three groups agree with normal luminosity calibrations for luminosity class V(+1.7 mag), IV (+0.9 mag), and III(0.0 mag) by Keenan (1963). It may be important that these stars lie on the blue border of the instability region (Fig. 10). Also, HR 3863, a low luminosity and low rotational velocity star, consists of equal components in a very close binary with $P=10.72$ yr and $a=0.142$ arcsec. The elements are uncertain because of the closeness of the components but, with photometric parallax of 0.015 arcsec, they give a mean mass of $3.5\mathscr{M}_\odot$, which is substantially larger than expected. Obviously speckle observations are needed to define the orbit more precisely.

TABLE 9. USPC(δ Sct) variables in the bright A-star sample but not in the Hyades supercluster.

HR	VAR	β	E(b-y)	V_0	M_V STR	M_V GNV	MOD	μ_α/μ_δ 0".000	ρ km/sec	U	V	W	$(B-V)_0$	Sp.T.	Note
21	β Cas	$2^{m}.709$	$0^{m}.000$	2.65	$+1^{m}.49$	$+1^{m}.35$	$1^{m}.23$	525/-187	+11.8	+40.9	-9.4	-23.3	0.34	F2 III/IV	X
114	GN And	2.755	0.016	5.15	+1.14	+1.46	3.85	37/-57	-10.2	-0.5	-19.6	-8.6	0.22	Am	
119	BB Phe	2.749	0.006	6.14	+1.12	+0.96	5.10	4/16	-5.1	+6.4	+6.6	+2.9	0.32	F2 III	
139	θ Tuc	2.817	0.030	5.98	+0.96	+0.96	5.02	66/-12	+2.3	+24.3	-21.2	0.0	0.19	A7m	
214	XX Psc	2.773	0.007	6.08	+0.96	+1.14	5.03	98/5	0.0	+40.7	-24.0	+1.0	0.26	F0 V	
239	AZ Phe	2.765	0.000	6.47	+1.76	+2.06	4.56	12/7	+15.1	+2.8	-3.8	-15.3	0.29	F0 III	
242	ρ Phe	2.719	0.000	5.22	+1.47	+1.58	3.70	67/39	+22.0	+14.6	-9.0	-24.3	0.36	F2 III	
401	AV Cet	2.797	0.000	6.20	+1.99	+1.97	4.22	187/-20	+5.7	+38.6	-53.7	-5.3	0.23	F0 V	
431	WZ Scl	2.717	0.005	6.56	+1.66	+1.48	5.00	-32/-36	-4.5	-20.0	-3.3	+4.0	0.29	F0 IV	
432	VX Psc	2.817	0.020	5.93	+0.12	+0.12	5.81	63/-5	+4.2	+33.8	-27.1	+2.5	0.115	A4 IV	
547	BK Cet	2.759	0.005	5.76	+0.83	+0.68	5.00	49/-59	-4.3	-0.9	-36.3	+4.3	0.26	F0 III	
729	UU Ari	2.777	0.005	6.11	+1.68	+1.82	4.36	79/-33	+19.0	+28.8	-19.0	-9.4	0.24	A9 V	
812	UV Ari	2.804	0.005	5.16	+1.88	+1.93	3.26	117/-93	-1.5	+7.6	-30.9	-0.7	0.23	A7 III	
1170	V 376 Per	2.743	0.020	5.92	+1.45	+1.52	4.44	-12/37	-15.0	-17.6	+4.5	+9.8	0.265	A9 IV	
1225	DL Eri	2.762	0.020	6.08	(+1.24)	(+1.82)		37/5	+14.5				0.265	F1 V	X
1287	IM Tau	2.708	0.000	5.40	+1.69	+1.69	3.71	-33/-37	+19.0	+13.8	+2.0	-18.3	0.34	F0 IV-V	
1298	κ Eri	2.730	0.000	4.04	+1.69	+1.66	2.36	10/82	+11.0	+15.3	+4.5	-1.4	0.33	F2 III	
1338	γ Dor	2.742	0.002	4.23	+2.50	+2.76	1.60	104/183	+26.6	+23.4	-19.5	-14.3	0.295	F4 III	X
1653	X Cae	2.715	0.015	6.24	+1.28	+1.44	4.90	23/39	+9.7	+21.4	-5.3	+5.0	0.28	F1 III	
1706	KW Aur	2.799	0.020	4.93	+0.78	+0.78	4.15	34/11	-10.0	-11.4	+7.9	-6.1	0.20	A9 IV	
1974	- Aur	2.746	0.000	6.50	+1.97	+2.15	4.44	-28/-4	-4.0	-3.6	+3.5	-9.8	0.25	A5 IV	
2100	1004 Ori	2.799	0.010	5.89	+0.95	+1.25	4.79	-11/-10	+45.3	+38.5	-22.7	-11.3	0.195	A5 IV	
2238	UZ Lyn	2.913	0.010	4.42	+1.05	--	3.47	-8/26	-3.6	-5.9	+4.3	-0.7	0.00	A2 V	
2557	V 532 Aur	2.743	0.020	6.12	-0.01	+0.29	6.02	0/-7	-7.0	-5.4	-5.6	-4.0	0.295	A9 III	
2720	-C Ma	2.763	0.000	6.09	+2.30	+2.41	3.74	-44/25	+6.5	+12.2	+0.6	-8.5	0.27	A8 V	
2724	HN CMa	2.784	0.030	6.54	-0.20	0.00	6.64	-17/-12	-8.2	-8.0	+8.2	-20.0	0.15	A5 IV/V	
3365	HQ Hga	2.755	0.012	6.25	+1.95	+2.04	4.25	-40/38	+31.6	+33.7	-14.2	+2.9	0.315	F3 III	
3321	LM Hya	2.829	0.000	5.60	+2.02	+2.16	3.51	-57/-63	+27.3	+17.0	-27.8	-9.4	0.22	A8m	
3329	CX Cnc	2.788	0.010	6.01	+0.97	+1.24	4.91	-36/-51	+9.5	+13.0	-22.6	-14.6	0.225	F0 V	
3350	GU Vel	2.781	0.000	5.09	+1.26	+1.50	3.71	-67/15	+24.7	+17.1	-22.4	-16.0	0.25	A9 IV	
3517	HZ Vel	2.753	0.005	6.38	+1.62	+1.71	4.72	-58/38	+8.6	+28.8	-4.3	-8.2	0.22	A5 III	
3254	RS Cha	2.792	0.000	(6.77)	+1.64	+1.71	5.10	-25/29	+15.9	+12.2	-20.0	-8.3	0.12	A7 V	
3662	DD UMa	2.833	0.000	4.81	+1.65	+1.84	3.06	48/61	-15.1	-18.9	+8.4	-5.3	0.19	A5 V	
4017	LW Vel	2.778	0.000	5.26	+1.57	+1.85	3.55	-29/-15	+48.1	-4.3	-48.4	-3.3	0.25	A7 V	
4047	EN UMa		0.020	5.85	(+0.55)	--	5.30	-53/-28	+3.9	+27.4	-17.3	-5.5	0.255	A7 V	
4274	IW Vel	2.836	0.025	5.79	+0.61	+0.80	5.09	-27/14	+16.3	+10.2	-19.4	+2.8	0.15	A4 V	
4594	DP UMa	2.770	0.000	5.22	+2.20	+2.39	2.92	-323/68	+5.5	+57.8	-14.8	-9.1	0.26	Am	
4684	FM Com	2.836	0.000	6.43	+1.93	+1.89	1.73	-16/-7	0.0	+4.0	-5.0	-0.8	0.18	Am	
4715	AI CVm	2.707	0.000	6.05	+0.96	+0.93	5.12	-78/15	+5.0	+3.81	-11.9	-1.4	0.33	F3 III/IV	
4797	TU Crv	2.716	0.012	6.19	+2.10	+1.94	4.17	35/-53	-2.0	-15.8	-2.2	-13.3	0.315	F0 III	
5005	DK Vir	2.725	0.020	6.60	+1.33	+1.57	5.15	-46/-29	-12.3	+16.1	-20.2	-15.7	0.28	F1 IV	
5343	CN Boo	2.771	0.000	5.96	+2.34	+2.51	3.54	52/-30	+4.0	-14.7	+3.0	-1.4	0.26	A8 III	
5435	γ Boo	2.817	0.000	(3.81)	+0.75	+0.85	3.01	-113/154	-37.0	+41.4	-9.0	-29.8	0.19	A7 III	
5437	- Dra	2.790	0.010	6.22	+0.91	+1.35	(5.09)	-49/21	-18.8	+21.0	-22.1	-10.7	0.24	F0 III	
5919	FP Ser	2.834	0.010	6.26	+1.08	+1.38	5.03	4/3	-25.0	+17.5	-3.7	-17.6	0.165	A7 V	
5960	CL Dra	2.761	0.000	4.95	+2.06	--	2.89	-149/111	-18.0	+30.2	-23.3	-0.5	0.26	F0 IV	
6290	V 644 Her	2.709	0.000	6.29	+1.95	+2.24	4.19	32/-34	-5.0	-5.8	-3.3	-14.6	0.34	F3 V	
6391	V 620 Her	2.798	0.000	6.20	+1.41	+1.70	4.64	-15/37	-2.2	+13.9	+3.3	+7.5	0.22	A8 V	
6434	V 2112 Oph	2.724	0.030	6.37	+0.64	--	5.73	13/7	-25.2	+22.2	-2.5	-15.1	0.36	F1 IV	
6522	V 949 Sco	2.724	0.024	6.02	+1.40	+1.50	4.57	-6/-34	-50.2	+51.3	-7.2	-4.6	0.32	F2 V	
6581	κ Ser	2.878	0.015	4.13	+0.35	+0.65	3.63	-72/-55	-30.0	+25.4	-27.6	+3.2	0.07	A2 V	
6754	V 831 Her	2.728	0.010	6.30	+2.16	--	4.14	11/-73	-33.0	+1.6	-33.6	-22.7	0.285	F0 IV	

TABLE 9. (continued)

HR	VAR	β	E(b-y)	V_o	M_V STR	M_V GNV	MOD	μ_α/μ_δ 0.″000	ρ km/sec	U	V	W	$(B-V)_o$	Sp.T.	Note
6969	V 4190 Sgr	2.767	0.010	6.41	+1.70	+1.90	4.61	32/-4	-10.2	+12.1	+1.7	-10.8	0.265	F0 IV	
7197	V 701 CrA	2.730	0.010	5.69	+1.85	+1.82	3.86	10/4	+4.0	-3.1	+2.0	-3.4	0.325	F2 III/IV	
7222	LT Vul	2.749	0.031	6.49	+1.04	+1.34	5.30	15/2	+5.0	+0.4	+7.6	-6.5	0.30	F2 III	
7228	- Oct	2.752	0.010	5.51	+0.96	+1.26	4.40	23/0	+11.9	-1.3	-7.4	-12.5	0.255	F0 III	
7331	V 1208 Aql	2.796	0.034	5.37	+0.75	+0.98	4.50	-3/17	+3.2	+1.6	+5.8	+4.0	0.215	F0 III	
7439	- Sgr	2.775	0.010	6.05	+1.70	+2.05	4.18	26/-17	-42.1	+39.7	-16.7	+3.7	0.245	F0 III	
7461	QQ Tel	2.780	0.015	6.17	+1.59	+1.86	4.45	-20/4	+7.8	-10.2	-1.3	+3.0	0.26	F2 IV	
7501	V 1276 Cyg	2.728	0.012	6.44	+1.86	--	4.58	58/50	-25.2	+36.0	-10.0	-11.3	0.315	F1 III	
7524	NZ Pav	2.745	0.000	6.02	+1.82	+2.10	4.06	101/-160	-40.9	+68.4	-18.1	-5.6	0.30	F2 IV	
7563	CN Dra		0.017	6.26	--	+1.24	5.02	5/-5	-12.0	-3.0	-9.7	-7.2	0.26	F0 III	
7711	- Vul	2.896	0.038	(6.21)	+0.50	--	4.86	20/-1	-12.0	+11.1	-8.9	-10.4	0.03	A3 III	X
7731	NU Vul	2.791	0.025	5.08	-0.60	-0.40	5.58	8/-21	+7.0	-9.9	+2.8	-11.7	0.145	A7 IV	
7736	V 1644 Cyg	2.833	0.000	4.94	+1.40	--	3.54	62/64	-17.3	+25.1	-10.8	-4.3	0.14	A2 V	
7928	δ Del	2.738	0.000	(5.18)	+1.17	+1.25	3.97	-19/-43	+9.3	-15.9	+0.3	-5.2	0.32	A7 III	X
8006	EM Aqr	2.754	0.010	6.48	+1.66	+1.82	4.74	21/27	-9.4	+16.7	+3.0	+2.8	0.225	A9 V	
8102	EW Aqr	2.754	0.005	6.38	+0.94	+1.23	5.30	41/0	-39.2	+40.8	-17.8	+6.0	0.27	F0 III	
8210	IK Peg	2.806	0.000	6.07	+2.33	+2.41	3.69	84/18	-11.4	+22.0	-8.6	-7.8	0.22	A8 V	X
8294	CG Oct	2.751	0.010	6.50	+1.40	+1.94	(4.83)	13/-41	+14.9	+2.6	-23.7	+2.6	0.265	F0 IV	
8367	BZ Gru	2.728	0.015	6.11	+1.06	+1.08	5.04	11/11	+0.9	+4.3	+4.6	-4.2	0.31	F1 III/IV	
8494	ϵ Cep	2.757	0.000	4.18	+1.91	+2.15	2.15	450/53	-0.6	+50.0	-11.6	-26.7	0.28	F0 IV	
8569	- Peg	2.888	0.020	6.47	+0.93	--	5.54	-16/-36	-2.0	-30.6	-9.4	-26.1	0.035	A2 V	
8584	- Peg	2.821	0.018	6.26	+1.13	+1.37	5.01	-27/-38	+1.0	-21.1	-4.2	-7.4	0.185	H8 V	X
8611	- Gru	2.740	0.010	6.01	+1.68	+1.29	4.98	5/-4	+11.2	-4.1	-4.9	-9.7	0.1335	F1 III	
8676	FM Aqr	2.773	0.009	6.13	+1.00	+1.30	4.98	35/7	-5.8	+17.3	-4.3	-1.7	0.265	A9 III/IV	
8880	τ Peg	2.808	0.000	4.59	+0.62	+0.77	3.89	33/-8	+13.0	+8.5	+5.9	+2.6	0.17	A5 V	
8895A	- Phe	2.774	0.010	6.08	+0.66	+0.86	5.32	81/-34	+6.7	+33.7	-36.4	-13.5	0.235	A4 III	
8895B		2.784		6.88	+1.32	--	5.56						0.24	A3 III	

Notes to Table 9.

1225 The conflicting luminosity estimates may indicate a companion or flawed observations.

1338 Possibly not USPC (Cousins 1992).

3524 RS Cha is also an eclipsing binary with equal components. The mean mass is $1.85M_\odot$ and the mean radius $2.25R_\odot$ (Clausen and Nordstrom 1980). Clausen and Nordstrom find a distance of 100pc, the same as found here, and a mean T_e = 7875°K, compared with 7530°K from Eq.(1). The age appears to be near 1.25×10^9 y (Castellani et al. 1992).

5435 Possibly a close binary. One speckle observation out of 17 spread over 10 years gives a separation of 0.10 arcsec.

6290 Sp.B, P = 11.85d.

7711 Sp.B, P = 9.32d and near equal components.

7928 Sp.B, P = 42.5d with equal components.

8210 Sp.B, P = 21.79d.

8584 Sp.B, P = 2.34d.

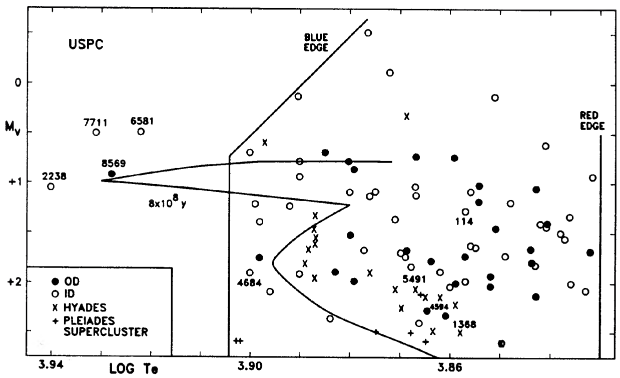

FIG. 10. The USPC (Table 9) in the (M_v, log T_e) plane. The isochrones are from Castellani *et al.* (1992).

6. SIRIUS SUPERCLUSTER

The nine members of the sparse UMa cluster that are in the bright A star sample are listed in Table 13 together with 11 members of the Sirius supercluster. The noncluster supercluster members are limited to those with FK5 or other highly weighted proper motions, to avoid contamination with nonmembers in this low-velocity supercluster. With the exception of HR 3031 these stars are all within 50 pc of the sun, compared with 36 stars, including Hyades cluster members, of the Hyades supercluster in the same volume. The star density of the Sirius supercluster is roughly one-half that of the Hyades supercluster.

The A stars are shown in the (Log T_e, M_v) plane of Fig. 14 where the cluster members are represented by closed circles and the noncluster supercluster members by open circles. The values of T_e are from Eq. (1) except, as noted in Table 13, for (1) "fundamental" values for HR 2491 (α CMa), from angular diameter measure, and HR 5793 (α CrB), from a combination of photometric and spectroscopic orbits (see Moon & Dworetsky 1985); (2) two A0 stars (HR 4295 and 4554) outside the calibrated domain of Eq. (1), from Napiwotzki *et al.* 1993); and (3) two Ap stars (HR 4905 and 5054) from Hauck & North 1993). The isochrones from Castellani *et al.* (1992) for 2, 4, and 6×10^8 yr are also represented in the figure. Like the Hyades supercluster (Fig. 1), the main age spread is shared by both cluster and noncluster members. The obvious exception is HR 2491 (α CMa) with M_v, log T_e) =(+1.48, 3.996). As discussed in Eggen & Iben

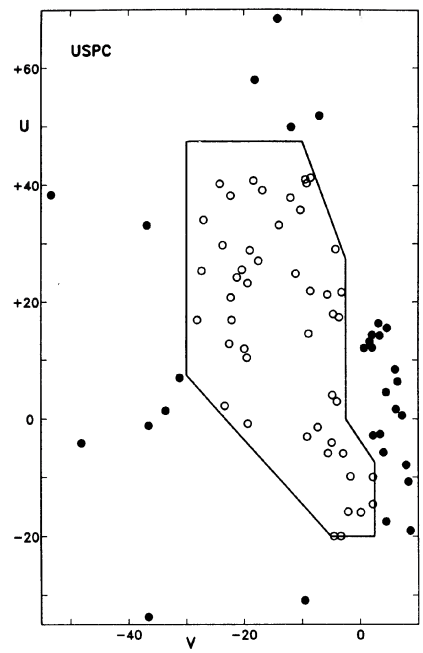

FIG. 11. The USPC (Table 9) in the (U,V) velocity plane.

TABLE 10. Possible Am stars in the Orion association.

WH*	V_o	β	M_V STR	M_V GNV	PHOT	MOD WH	σ	Sp.T.	HD (BD)
82	$8\overset{m}{.}96$	$2\overset{m}{.}788$	$+2\overset{m}{.}19$	$+2\overset{m}{.}35$	$6\overset{m}{.}70$	$8\overset{m}{.}16$	± $0\overset{m}{.}49$	A4/F1/F2	36016
157	8.69	2.832	+1.96	—	6.73	8.16	± 0.49	A0/A1/A4	36559
182	8.84	2.891	+1.05	—	7.79	8.16	± 0.49	A3/A5/F1	36670
187	8.34	2.868	+0.89	—	7.55	8.16	± 0.49	A1/A1/A5	36697
194	8.56	2.992	+1.65	—	6.91	8.04	± 0.55	A1/A1/A5	36726
205	9.86	2.746	+2.36	+2.11	7.58	8.16	± 0.49	A3/?/?	(−5.1296)
228	10.08	2.810	+1.50	+1.25	8.70	8.20	± 0.36	A2/A8/A9	(−5.1302)
323	8.85	2.895	+1.45	—	7.40	8.04	± 0.55	A1/A1/A4	37111
464	8.77	2.892	+1.28	—	7.49	8.50	± 0.53	A1/?/A3	37789
497	8.77	2.841	+0.60	—	8.17	8.16	± 0.49	A5/?/A7	(−5.1377)
499	8.48	2.886	+1.13	—	7.35	8.03	± 0.46	A0/?/A2	38371

* Warren and Hesser 1978.

TABLE 11. λ Boo stars.

HR	β	E(b−y)	V_0	M_V (STRM)	M_V GNV	μ_α/μ_δ 0″000	ρ km/sec	U	V km/sec	W	v sin i km/sec	Sp.T.[a]
541	2ᵐ829	0ᵐ000	5ᵐ92	+1ᵐ12	+1ᵐ01	−41/−3	+6.6	−11.9	+5.1	−8.6	125	A1 V a
1525	2.832	0.005	6.10	+1.81	+1.92	13/16	+19.0	+15.2	−11.0	−7.4	157	A3 V b
1570	2.896	0.031	4.51	+1.32	—	30/−124	+13.0	+4.8	−25.6	−13.4	104	A0 V a
1989	2.852	0.012	5.67	+0.29	+0.46	0/−35	+21.0	+15.4	−20.8	−12.5	200	A2 V a
4828	2.908	0.000	4.95	+1.55	—	84/−91	+2V	(−27)	(−7)	(−4)	173	A0 V a
4875	2.798	0.005	5.86	+0.48	+0.48	−88/25	−14.0	+47.7	−17.3	−16.5	183	A3 V
4881	2.773	0.059	5.92	+1.96	+2.07	−101/43	−4V	(+30)	(−9)	(+7)	130	A15 V a
5381	2.894	0.005	4.13	+1.40	+1.52	−186/162	−8.1	+40.0	−6.5	−4.8	110	A0 V a
7400	2.891	0.040	5.55	+1.17	—	−3/−30	+13.1	−16.2	−0.3	−5.8	73	A0 V b
7736	2.833	V 1644	Cyg	Table 9	+1.40	62/64	−17.3	+25.1	−10.8	−4.3	37	A05 V a
7764A	2.846	0.025	6.52	0.00	—	9/1	+4V	(+2)	(+3)	(−9)	80	A2 V a
7764C	2.817		7.63	+0.98	—						55	A2 V a
8203	2.846	0.018	6.37	+1.42	+1.79	54/13	−9.0	+23.7	−2.8	−8.4	68	A1 V b
8432	2.774	0.005	6.34	+1.22	+1.19	14/16	−3.6	+9.2	+6.3	−0.8	—	Am
8947	2.878	0.035	5.45	+0.70	—	−17/−46	+11.5	−10.6	+8.7	−19.3	109	A1 V a

[a] Gray (1988). HR 5930 is A2 II/II in Houk and Smith-Moore (1988). The type for HR 4875 is from Gerboldi and Faraggiana (1993). HR 4881 weak and narrow absorption are in Ca II K probably indicates circumstellar material.

(1988), the mass of the bright component in this wide binary (P=50 yr) is 2.15$\mathcal{M}_\odot$, whereas the models that make up the 2×10^8 yr isochrone in Fig. 14 indicate 2.2$\mathcal{M}_\odot$. Another supercluster member with a well-determined mass is the bright component of α CrB, with 2.6$\mathcal{M}_\odot$ (Tomkin & Popper 1986). This star lies on the 4×10^8 yr isochrone in Fig. 14, near the point of core hydrogen exhaustion, and the models predict a mass of 2.8 $\mathcal{M}_\odot$. Also, HR 5054 in the UMa cluster is a spectroscopic and interferrometric binary (P=20.5d) with equal components and the mean mass is 2.45$\mathcal{M}_\odot$. In Fig. 14 the components lie on the 4×10^8 yr isochrone and the models indicate a mass of 2.35$\mathcal{M}_\odot$. It should be noted that in many ways the bright star HR 3136, in the Hyades supercluster (Table 4), is very similar to HR 2491 (Sirius) in the Sirius supercluster (Table 13):

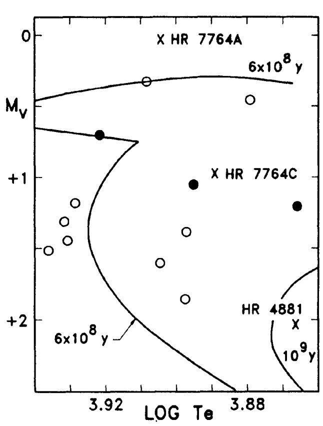

FIG. 12. The λ Boo stars in the (M_v, log T_e) plane. The isochrones are from Castellani *et al.* (1992). The OD stars are represented by closed circles and the YD by open circles. The crosses indicate variability velocity stars for which population assignment is uncertain.

HR	log T_e	M_v	v sin i (km/s)	[C/H]	[Si/H]	[Fe/H]	[Ba/H]
2491	3996	+1ᵐ48	16	−0.76	+0.38	+0.33	+1.4
3136	3.984	+1.34	35	−0.77	+0.17	+0.55	+1.4.

The element abundance are from Holweger & Stürenburg (1993) and Lemke (1990). Hr 2491 (Sirius) is the prototype of the "hot" or "mild" Am stars (Conti 1965). HR 3136 is not known to be a hot Am star but 68 Tau (HR 1389), the bluest star in the Hyades cluster in Fig. 1, is (Conti 1965) and this object is also overabundant in Fe and Ba and underabundant in C.

7. NORMAL STARS

In addition to the peculiar stars, already discussed, there are 1200 apparently normal stars in the bright A-star sample. The OD stars amongst these are listed in Table 14 and represented by closed circles in Fig. 15. The YD stars are not discussed here individually but are represented in Fig. 15 by open circles. The distribution of the YD stars in Fig. 15 from the first 12 h of right ascension is nearly identical to that in the last 12 h so, to avoid crowding in the figure, only the former are included. The OD stars of Table 14 are shown in the (M_v log T_e) plane of Fig. 16 where log T_e is from Eq. (1), except for a dozen stars outside the calibrated region of the equation, β>2.890, where the temperature is from Moon & Dwaretsky (1985). The 4×10^8 and 1.5×10^9 yr isochrones in the figure are from Castellani *et al.* (1992) and the stars apparently lie in this age range, despite the fact that the space motions indicate stars $>2\times10^9$ yr old.

The constituents of the bright A-star sample are then

TABLE 12. A2 IV stars.

HR	β	E(b−y)	V_o	M_V PHOT	μ_α/μ_δ 0^{m}001	ρ km/sec	U	V km/sec	W	v sin i km/sec	Sp.T.	LogTe
63	2^{m}879	0^{m}006	4^{m}58	+0^{m}82	−50/−16	0.0	−12.6	+5.0	−2.1	107	A2 IV	3.923
383	2.872	0.011	4.70	+0.05	25/−13	+4.0	+8.8	−6.1	−5.6	93	A2 IV	3.919
1389	2.889	0.000	4.29	+1.23	116/−36	+40.2	HYADES, Table 4			18	A2 IV	3.928
2496	2.831	0.010	4.91	0.00	−37/−51	+4.2	+20.0	−15.4	−14.3	183	A3 IV	3.897
3131	2.836	0.000	4.61	−0.07	−2/−39	−12.0	SIRIUS, Table			198	A2 IV	3.900
3615	2.877	0.030	(4.75)	+1.76	0/−96	−3.8	SIRIUS, Table			45	A2 IV	3.922
3863[a]	2.832	0.015	(6.00)	+1.87	−30/9	+7.0	−7.9	−8.2	−4.7	39	A3 IV	3.898
3894	2.862	0.010	4.53	+0.07	−8/−28	−11.9	−8.9	+7.1	−13.2	30	A2 IV	3.914
4033	2.873	0.000	3.44	−0.05	−164/−38	+18.3	HYADES, Table 4			48	A2 IV	3.920
4192	2.871	0.024	5.00	+0.17	−116/9	+19.0	+52.2	−14.5	−7.4	154	A2 IV	3.919
4343[a]	2.869	0.020	4.37	−0.28	3/−400	+6.4	−20.4	−24.0	−26.0	58	A2 IV	3.918
5107	2.875	0.000	3.37	+0.98	−285/4	−0.04	HYADES, Table 4			173	A2 IV	3.921
5867A[a]	2.866	0.000	3.65	+0.35						170	A2 IV	3.916
5867B			9.95	+6.59	67/−45	+2.0	SIRIUS, Table			—	K3 V	—
5867C			8.07	+4.64						—	—	—
6446	2.888	0.005	4.28	+0.43	48/3	+4.8	−5.6	+9.0	−9.2	115	A15 IV	3.928
7194	2.905	0.006	(3.34)	+1.52	−20/10	+25.0	−24.6	+2.0	−4.1	72	A2 IV-V	3.937
7254	2.886	0.000	4.08	+0.83	84/−99	−18.4	+25.4	−13.5	−16.1	201	A2 IV-V	3.927

[a] 3863 Visual binary, Δm = 0 mag.
4343 White dwarf companion (Fleming et al. 1991).
5867 AB, 30.6 arcsec. AC 200 arcsec.

Type	YD	OD	A11	%OD
Normal	975	221	1196	18
Am	99	36	135	27
USPC	57	31	88	35
λ Boo	8	4	12	33
Total	1133	292	1424	20.

The seven USPC that are also Am stars are counted twice. The Am, USPC, and λ Boo stars represent 10%, 6%, and 1%, respectively, of the total. In the case of the Am stars, the large percentage of spectroscopic binaries leads to an underestimate of both the incidence of Am stars and the binary frequency of Am stars because the stars in Table 2, that are rejected from the sample on the basis of variable radial velocity but no available orbit, include a large number of Am stars. About 80% of the spectroscopic binaries among the Am stars have periods less than 40 days and 10% with periods both between 40 and 60 and more than 60 days.

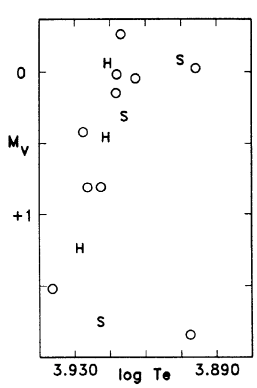

FIG. 13. The "A2 IV" stars in the ($\log T_e$, M_V) plane. "H" and "S" represent members of the Hyades and Sirius supercluster, respectively.

The distribution of the known rotational velocities, $v \sin i$, among the normal OD and YD stars, in fixed temperature limits, is as follows:

	$\overline{\log T_e}$	$\overline{v \sin i}$ (km/s)	σ	N
YD	3.832	76	±43	49
OD	3.834	71	50	31
YD	3.859	105	63	59
OD	3.864	105	60	17
YD	3.892	118	65	71
OD	3.893	133	57	25
YD	3.916	106	64	93
OD	3.919	94	53	43
YD	3.910	102	58	43
OD	3.910	115	±70	12.

These velocities are identical to those found for the USPC (δ Sct) variables and are two to three times the rotational velocities of the Am stars.

Less than 5% of the normal, YD and OD stars are spectroscopic binaries and all but 1 YD and 1 OD system have periods less than 20 days. However, accurate statistics will not be available until more data is obtained for the large number of probable binaries in Table 2.

8. OLD DISK CLUSTERS

The old disk, HR 1614 supercluster (Eggen 1992d) has three notable features, at least two of which it shares with the populous, old disk cluster NGC 6791. Both are near 5×10^9 yr old and markedly overabundant in heavy elements. The third notable feature of the supercluster, which strengthens its reality, is that its members are among the 5% of the nearer stars that have the strongest known CN strengths and the cluster may share this feature. Kinman (1965) has presented

TABLE 13. Members of the Sirius supercluster.

HR	HD	μ_α/μ_δ 0".001	υ/τ 0".001	ΔT	X pc	V_{TOT} km/sec	MOD	E(b-y)	V_o	M_V CLUST	M_V PHOTO	β	$(B-V)_o$	ρ (km/sec) COMP	ρ (km/sec) OBS	Sp.T.	Note
UMa CLUSTER																	
4141	91480	67/39	78/-2	-0.5	13.0	18.7	1ᵐ85	0ᵐ000	5ᵐ15	+3ᵐ30	+3ᵐ25	2ᵐ716	0ᵐ33	-16.0	-15.0	F1 V	
4295	95418	82/34	89/0	0.0	10.9	18.7	1.73	0.006	2.30	+0.57	+0.30	2.880	-0.025	-16.2	-13.0	A0 V	x
4554	103287	95/12	96/4	+1.0	9.2	18.6	1.96	0.000	2.44	+0.48	+0.31	2.885	0.00	-14.9	-14.0	A0 V	
4660	106591	104/9	104/1	+0.3	8.5	18.6	1.94	0.010	3.24	+1.30	+1.16	2.883	0.06	-14.2	-14.0	A3 V	x
4905	112185	111/-6	111/4	+0.1	6.5	18.6	2.01	0.000	1.76	-0.25		2.866	-0.02	-13.0	-11:	Ap	x
4931	113139	122/-2	121/10	+0.3	5.9	18.6	1.85	0.000	4.93	+3.08	+3.17	2.708	0.36	-12.8	-12.0	F2 V	x
5054	116656	121/-20	123/-5	-0.9	4.6	18.6	1.94	0.000	(2.92)	+0.98	+1.10	2.907	0.02	-12.0	-10.0	A1 V (Si)	x
5055	116657								3.95	+2.01	+2.30	2.886	0.13			Am	x
5062	116842	115/-9	114/15	+3.5	4.8	18.6	2.11	0.000	4.01	+1.90	+1.65	2.847	0.16	-11.9	-15V	A5 V	
SUPERCLUSTER																	
531A	11171	-146/-93	173/13	+1.6	7.8	18.6	1.71	0.000	4.67	+2.96	+2.89	2.735	+0.33	0.0V	+4.9	F1 V	x
531B	11131								5.76	+5.05	+4.85	2.593	+0.63			G0 V	x
1666	33111	-94/-81	123/-13	+3.1	23.6	18.7	2.30	0.000	2.79	+0.49	+0.46	2.846	0.13	-8.0	-9.0	A3 III	
2491	48915	-546/-208	1326/12	+0.1	1.7	18.6	-2.94	0.000	-1.46	+1.48	+1.27	2.906	-0.01	-9.1	-7.6	A0 V	x
3131	65810	-2/-39	39/4	+6.2	46.7	18.8	4.68	0.000	4.61	-0.07	+0.14	2.836	0.08	-10.3	-12.0	A2 IV	
3615	78045	0/-96	96/-9	-3.8	-8.4	18.6	2.99	0.000	(4.75)	+1.76	+1.60	2.877	0.11	+4.6	+4.9	A5m	x
4803	109799	80/-90	120/-4	-0.9	-12.9	18.5	2.55	0.000	5.38	+2.83	+2.72	2.720	0.33	-1.2	-0.9	F2 V	
5193	139006	121/-89	150/10	+1.7	-11.4	18.5	2.07	0.000	2.14	+0.07	+0.25	2.871	-0.03	-1.8	-1.5	A0 IV	x
5867A	141003								3.65	+0.22	+0.41	2.866	0.06			A2 IV	x
B		67/-45	80/10	+6.0	-2.90	18.5	3.43	0.000	9.95	+6.52			1.01	+1.1	+2.0	K2 V	x
C									8.07	+4.64			0.65				x
7312	180777	47/-123	131/8	+1.6	7.6	18.6	2.16	0.000	5.11	+2.95	+2.65	--	0.31	-8.0	-7.0	A9 V	
8709	216627	-40/-25	47/-8	-6.2	-16.0	18.5	3.56	0.010	3.26	-0.30	+0.10	2.897	0.04	+14.6	+15.0	A3 IV-V	

Notes to TABLE 13.

531AB 184 arcsec separation.

2491 Sirius. WD companion. P = 50.09yr, a = 7.56 arcsec. See discussion by Eggen and Iben (1988). Fundamental log T_e = 3.996 See Moon and Dworetsky 1985).

3615 Equal components.

4295 Log T_e = 3.962 (Napiwotzky et al. 1993).

4554 Log T_e = 3.971 (Napiwotzky et al. 1993).

4660 Microvariable (Ruffener 1988).

4905 ϵ UMa. Magnetic variable, P = 5.09d. LogT_e = 3.950 (Hauck and North 1993).

4931 P = 115.7yr, a = 1.252 arcsec. Δm = 3 mag.

5054 Mildly peculiar spectrum. Sp.B, P = 20.54d with equal components. The interferometric orbit (see discussion in Eggen and Iben 1988) gives a mean mass of 2.45$M_\odot$ and logT_e = 3.963 (Hauck and North 1993).

5055 Sp.B, P = 755.55d. Cpm with 5054, 14 arcsec distant.

5793 α CrB eclipsing binary with P = 17.36d. Both components seen in the spectrum (Tompkin and Popper 1986). Combining the photometric and spectroscopic orbits give logT_e = 3.987 and a mass for the bright component of 2.6$M_\odot$. The star lies on the 4×10^8yr isochrone near the point of core hydrogen exhaustian and the models that form that isochrone predict a mass of 2.8$M_\odot$.

8867 B is 30 arcsec and C 200 arcsec distant.

the main-sequence and red giant sequence of NGC 6791 shown as clear circles in Fig. 17. Kinman found E$(B-V)$ $=0.22$ mag and $(M_v-V)_0=13.5$ mag. From DDO and $(B-V)$ photometry of a half-dozen of the proper motion and radial velocity, red giant cluster members Janes (1984) found a reddening of 0.10 mag. This low value of the reddening is confirmed by Montgomery *et al.* (1994), Harris & Canterna (1981), and Liebert *et al.* (1994). On the other hand, Kinman's value of E$(B-V)$ near 0.20 mag is confirmed by Anthony-Twarog & Twarog (1985) who find 0.02 mag, and by Garnavich *et al.* (1994) with 0.19 mag and Kaluzny & Udalski (1992). A value of 0.20 mag has been adopted here. Kinman's modulus determination of 13.5 mag is confirmed by Harris and Canterna but most other determinations are 0.5 mag or more smaller with 12.66 mag by Montgomery *et al.*, 12.9 mag by Anthony-Twarog and Twarog, and 13.0 mag by Garnavich *et al.* R,I photometry is available for three of the stars with DDO photometry and a previous calibration (Eggen 1993a) give

Kinman	V_0	$(R-I)_0$	$(45-45)_0$	$(42-45)_0$	$(C_m)_0$	M_v	Mod
2051	14,12	$0^m.423$	$1^m.323$	$1^m.151$	$0^m.253$	$+0^m36$	$13^m.76$
3009	14.13	0.380	1.266	1.115	0.358	+0.88	13,25
3016	13.97	0.350	1.297	1.042	0.274	+0.36	13,61
							Mean 13.54 ±0.26.

7

A modulus of 13.5 mag, has been adopted in Fig. 17. The mean main and red giant sequences of the old disk cluster M67 (Sandage & Eggen 1969), on the basis of E$(B-V)$ $=0.0.5$ mag and $(M_v-V)_0=9.65$ mag, is represented in the figure by crosses and the individual members of the HR 1614 supercluster (Eggen 1992d) by closed circles. The blue stragglers in M67 (e.g., Eggen 1981) are also shown and at least two of these are Am stars, and two are USPC (Gilliland & Brown (1992);

Eggen & Sandage (1964)	V_0	$(B-V)_0$	M_v	Spectral Type (Sargent 1968)
I-17	$11^m.17$	$0^m.245$	$+1^m.52$	Am
153	11.16	0.08	+1.51	Am
190	10.83	0.18	+1.18	A8 IV–V
III=12	12.12	0.18	+2.47	···

The bright A-star sample, discussed above, yields one blue straggler in the HR 1614 supercluster. The convergent point of the proper motion of supercluster members is $A=8^m.38$ and $D=-58°.1$ with $V_{TOT}=59$ km/s. HR 8195 (HD 203875) has $(\mu_\alpha,\ \mu_\delta)=(0.016,\ -0.168)$ arcsec so, as a supercluster member, $\nu=0.170$ arcsec and $\tau=0.009$ arcsec and the modulus is 4.19 mag. The reddening is 0.010 mag so $(M_v, B-V)_0$ $=(+1.50, +0.21)$ mag and the star is represented by a closed circle in Fig. 17. The predicted radial velocity is -20.4 km/s, compared with the observed value of -20.6 km/s. The calibration of four-color and Geneva photometries gives $M_v=+1.39$ and $+1.56$ mag, respectively. The spectral type is F0 IV and the star is bracketed in Fig. 17 by the two Am stragglers in M67.

Much more data is needed for the blue stragglers in NGC 6791 but there is one known proper motion and radial velocity member, Kinman No. 15, with $V_0=15.40$ mag, $(B-V)_0=0.45$ mag, spectral type F2 IV, and $M_v=+1.90$ mag. This star is represented by a clear circle in Fig. 17. The 4×10^9 yr isochrone in the figure is from Castellani *et al.* (1992) with $Z=0.02$ and shifted 0.05 mag in $B-V$ (see Figs. 2 and 7). Perhaps the most stable results in the figure are those for the individual members of the HR 1614 supercluster and the M67 stars. The adopted modulus of 9.65 mag and reddening of 0.05 mag for M67 agree with most results of recent years. The determination of ages for old disk clusters is obviously critically dependent upon the reddening and distance determinations. The low value of the reddening for NGC 6791, near 0.10 mag, can probably be excluded and changing the distance modulus to 13.0 mag, as found in several recent determinations, would present a serious problem in Fig. 17. Figure 18 shows an enlargement of the region near the He burning clump in the $(M_v, B-V)_0$ plane. Three certain members of NGC 6791 lie in that clump,

Kinman	$(B-V)_0$	M_v
3016	$+1^m.11$	$+0^m.45$
3026	+1.13	+0.45
3035	+1.06	+0.75,

and are represented in Fig. 18 by clear circles. The cluster NGC 6791 may be related to the HR 1614 supercluster. The mean radial velocity of the cluster stars is near -50 km/s compared with -54 km/s predicted from the supercluster motion. The observed proper motion of (μ_a, μ_δ) $=(-0.01, -0.07)\pm(0.09,0.08)$ arcsec cen^{-1} (Cudworth & Anthony-Twarog 1994) is directed toward the convergent point of the

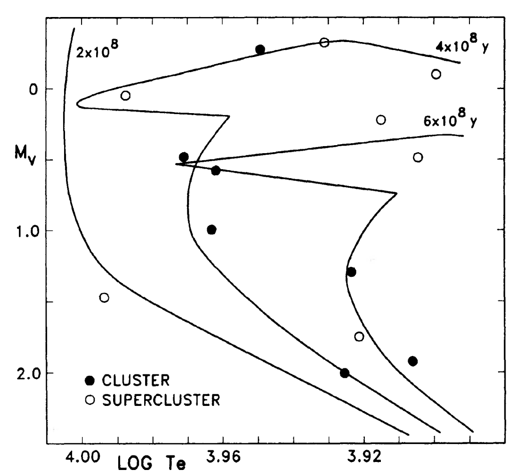

FIG. 14. The Sirius supercluster members in the $(M_v, \log T_e)$ plane. The isochrones are from Castellani *et al.* (1992).

TABLE 14. Normal old disk stars in the bright A-star sample.

HR	HD	β	E(b-y)	V_o	M_V	μ_α/μ_δ 0.001	ρ km/sec	U	V km/sec	W	Sp.T.	v sin i km/sec	Note
41	905	$2^{m}.717$	$0^{m}.000$	$5^{m}.71$	$+2^{m}.86$	-123/-148	-28.8	-38.1	-20.7	-10.3	FV IV	25	
184	4058	2.857	0.000	(5.69)	+1.83	-24/32	+13.4	-0.5	+12.5	-12.1	A5 V	58	X
197	4247	2.701	0.000	5.21	+3.21	-60/-83	+12.0	-0.4	+13.2	-10.2	F0 V	32	
290	6116	2.844	0.000	5.55	+1.50	-25/-13	+4.4	-6.0	+6.9	-6.4	A2 V	39	
330	6736	2.708	0.000	5.50	+2.50	-263/-183	+7.1	-53.6	+6.8	-27.9	F0 IV		
421	8829	2.731	0.000	5.49	+2.65	16/9	+10.4	+5.7	+0.9	-9.2	F0 III		
463	9919	2.700	0.000	5.54	+2.79	-66/43	-0.5	-7.5	+11.4	+3.0	F0 V	96	
473	10148	2.718	0.000	5.56	+1.18	133/-36	+14.0	+31.7	-39.5	-6.5	F0 V		
534	11257	2.718	0.000	5.93	+2.70	-71/-32	+11.1	-12.7	+8.7	-15.4	F2 V		
538	11335	2.876	0.015	6.20	+0.14	6/-15	+12.6	+12.6	+2.9	-12.2	A3 V	135	
550	11604	2.725	0.000	6.04	+2.18	-74/-58	+30.1	-36.3	-13.6	-10.2	F0 IV		
569A	11973A	2.762	0.000	4.78	+1.83	-98/-16	-1.4	-14.8	+8.9	-5.8	F0 V	99	
599	12471	2.877	0.000	5.50	+0.34	-21/-1	+3.3	-5.8	+8.7	-5.0	A2 V	92	
670	14212	2.895	0.004	5.28	+0.90	-59/-8	-29.6	-35.7	-6.8	-2.8	A1 V	74	
687	14622	2.764	0.016	5.75	+2.14	-79/-104	-34.5	-38.8	-20.0	-18.8	F0 III-IV		
701	14943	2.846	0.013	5.83	+1.78	18/63	+4.7	+18.6	+5.5	-9.1	A5 V		
717	15257	2.762	0.005	5.27	+2.20	-15/-87	-24.8	-22.5	-20.0	-2.7	F0 III		
732	15633	2.852	0.000	5.98	+1.29	-58/-50	-2.3	-27.0	0.00	-16.4	A7 III-IV		
815	17138	2.882	0.010	6.20	+2.00	4/35	-40.0	-30.8	-27.6	-4.5	A3 V	82	X
852	17848	2.882	0.005	5.22	+1.36	90/21	+30.9	+15.6	-34.2	-15.1	A2 V	167	
859	17943	2.825	0.018	6.22	+1.17	68/55	+34.7	+64.4	-25.2	+3.0	A7 IV	120	
892	18543	2.874	0.005	5.20	-0.07	-24/-69	-6.8	-30.9	-19.0	-16.3	A2 IV	63	
919	18978	2.850	0.000	3.95	+1.40	-144/-54	-9.8	-22.6	+11.7	-3.1	A4 IV	144	
945	19600	2.878	0.030	6.28	+0.42	11/-57	-6.2	-5.5	-33.4	-23.6	A0 V	62	
975	20193	2.678	0.000	6.31	+3.08	-9/18	+13.5	+10.6	+8.9	-2.8	F4 V	19	
993	20606	2.738	0.000	5.91	+2.05	167/-18	+41.6	+36.3	-49.9	-10.9	F3 V		
1002	20677	2.903	0.006	4.93	+1.26	-61/-4	-11.0	-17.3	+4.5	-7.1	A3 V	228	
1128	23055	2.888	0.012	6.45	+1.19	-11/0	-7.8	-7.0	+6.6	+2.4	A3 V		
1177	23848	2.884	0.017	5.07	+0.15	-21/10	-11.9	-15.0	+5.8	+0.7	A3 V	82	
1197	24167	2.832	0.020	6.13	+1.42	-10/-40	-38.0	-36.6	-19.7	-3.1	A5 V	151	
1227	24863	2.810	0.020	6.37	+0.08	31/-41	+21.4	-19.3	-43.3	+8.1	A4 V		
1269	25867	2.720	0.006	5.20	+3.19	-92/10	+9.0	+4.3	+10.1	-9.1	F1 V	68	
1275	25945	2.723	0.000	5.57	+2.14	204/95	+60.7	+63.7	-46.9	-10.5	F1 IV	98	
1302	26612	2.713	0.000	4.92	+1.46	195/63	+38.5	+39.4	-47.0	+2.2	A9 V	193	
1330	27084	2.788	0.000	5.45	+0.86	52/-80	-16.5	+1.7	-40.1	+8.3	A7 V	120	
1334	27236	3.884	0.050	6.32	+0.28	-1/-27	+28.0	-23.4	-17.7	+18.8	A4 III		
1438	28763	2.898	0.017	6.17	+0.50	-15/-46	-15.0	-27.8	-4.9	-3.8	A3 V		
1448	28978	2.887	0.035	5.53	+0.08	-18/2	-7.2	-8.7	-8.7	-3.8	A2 V	36	
1485	29598	2.812	0.008	6.73	+1.45	-18/3	-5.1	+0.6	+9.8	-5.1	A7 IV-V		
1502	29875	2.736	0.000	4.43	+3.00	-144/-80	0.0	-10.1	+5.4	-10.0	F2 V	52	
1596	31739	2.868	0.015	6.28	+0.72	0/25	+37.0	+39.0	-0.8	-9.2	A2 V		
1714	34109	2.880	0.005	6.67	+0.61	-18/19	-14.0	-20.0	+3.6	-12.9	A2 V		
1724	34317	2.876	0.000	6.40	+0.10	-22/-11	-7.5	-12.9	+6.1	-17.4	A0 V	65	
1766	35046	2.737	0.010	6.30	+1.45	-15/0	-9.9	-5.0	+10.7	+0.1	F2 IV-V		
1955	37788	2.734	0.000	5.90	+2.15	10/19	-13.0	-8.9	+7.6	+8.1	F0 IV	52	
1984	38458	2.758	0.000	6.37	+1.70	29/94	+11.0	+41.6	-6.6	+10.5	A9 V		
2015	39014	2.790	0.000	4.32	+0.75	-31/8	-3.0	+2.3	+6.4	-5.0	A7 V	206	
2029	39283	2.891	0.015	4.91	+0.42	-13/-20	-12.0	-13.9	+3.9	-4.1	A2 V	72	
2039	39421	2.862	0.015	5.89	+0.55	-12/32	+38.7	-41.6	-5.5	-9.9	A2 V		
2046	39586	2.855	0.010	5.86	+1.25	-50/-178	-20.8	-16.7	-51.2	-53.7	A5 IV	105	
2085	40136	2.722	0.000	3.70	+2.84	-42/139	-1.6	+5.6	+8.4	+1.9	F2 V	0	
2110	40588	2.874	0.026	6.07	+0.97	-19/-1	-9.0	-8.3	+5.5	-11.1	A2 V	100	
2180	42301	2.872	0.018	5.40	+0.45	3/-39	+44.0	+13.1	-41.2	-19.9	A0 V		
2210	42824	2.897	0.013	6.57	+0.90	-51/-3	-4.5	-1.5	+16.5	-28.9	A2 V		
2330	45394	2.867	0.020	6.13	-0.25	-24/4	+39.3	+42.3	+4.6	-14.8	A2 V		
2375	46089	2.832	0.010	5.20	+0.92	12/18	-3.0	-1.7	+4.4	+6.3	A3 V	124	
2386	46304	2.768	0.000	5.60	+1.93	-6/-44	-20.8	-22.8	+5.0	-4.0	F0 V		
2402	46590	2.881	0.030	5.74	+0.31	-19/11	+0.4	-0.5	+10.0	-7.4	A2 V		
2498	49048	2.837	0.020	5.21	-0.38	-19/-19	-18.8	-18.5	+11.2	-13.2	A2 V	205	
2514	49434	2.751	0.000	5.74	+2.50	-36/-24	-14.2	-12.6	+7.1	-8.7	F1 V	82	
2572	50747	2.831	0.025	5.33	0.00	-4/-3	-8.8	-7.4	+4.8	-3.2	A4 IV	70	
2588	51055	2.865	0.020	5.70	-0.19	0/-13	-15.1	-16.0	+7.1	-1.8	A3 IV		

TABLE 14. (continued)

HR	HD	β	E(b-y)	V_o	M_V	μ_α/μ_δ 0".001	ρ km/sec	U	V km/sec	W	Sp.T.	v sin i km/sec	Note
2638	52622	2.707	0.010	6.45	+2.08	-17/-42	-3.4	-12.5	+6.2	-8.4	F2 II		
2647	52913	2.884	0.020	5.87	+1.61	-21/4	-12.0	-8.0	+8.9	-7.2	A3 V	85	
2661	53349	2.735	0.000	6.02	+1.98	-58/144	+10.0	+47.2	-7.2	-7.3	A8 III		
2740	55892	2.705	0.000	4.48	+2.72	-132/102	-0.8	+14.5	+6.3	-8.0	F0 IV	54	
2776	56963	2.713	0.000	5.77	+3.00	-45/7	+25.1	+25.2	+6.4	+3.6	A7 V		
2788	57167	2.736	0.000	5.90	+2.55	167/-139	-32.7	-55.0	-3.2	+19.0	F1 V	98	X
2836	58552	2.899	0.025	6.26	+1.41	-32/1	-10.5	-3.7	+9.3	-14.4	A2 IV	20	
2852	58946	2.713	0.000	4.17	+2.92	154/176	-5.7	-0.4	+18.5	-8.9	F0 V	68	
2853	58954	2.734	0.010	5.56	+1.00	3/3	-29.2	-17.3	+23.5	+1.8	A5 V	157	
2987	60111	2.751	0.000	5.58	+2.38	-28/32	+0.8	+5.8	+6.4	-1.9	F2 V	101	
2926	61035	2.723	0.000	6.20	+2.72	11/23	+7.3	+6.2	+2.5	+6.6	F0	112	
3132	65856	2.875	0.013	6.25	+0.40	-31/12	-9.2	+3.6	+14.8	-19.7	A1 V	115	
3140	65925	2.687	0.000	5.22	+2.08	-86/-31	-8.2	+1.1	+10.4	-17.2	F5 III	125	
3154	66358	2.844	0.013	5.85	+0.52	-4/2	+1.7	+1.0	-0.9	-0.4	A3 IV		
3171	66920	2.866	0.030	6.19	+1.02	2/-17	+23.8	-13.7	-18.1	-11.3	A3 III		
3214	68332	5.848	0.020	6.47	+0.35	-20/-1	-9.4	+0.3	+6.2	-17.0	A7 III	71	
3270	70060	2.806	0.000	4.43	+1.82	-107/97	+5.1	+22.7	+1.0	-5.4	A7 III	129	
3310/1	71150/1	2.810	0.020	6.76	+0.82	-4/3	-27.0	-20.3	+8.6	-15.9	A5 V	130	X
3344	71815	2.898	0.020	6.41	+0.81	-28/5	+53.5	+34.6	-44.3	-3.6	A1/2 V		
3380	72716	2.716	0.000	6.03	+1.84	-1/-22	+15.6	+8.6	+15.5	+3.8	F3 IV	67	
3473	74706	2.820	0.012	6.05	+1.32	-20/1	-15.0	-1.2	+14.0	-9.0	A5 V	170	
3507	75495	2.787	0.005	6.45	+2.20	7/-58	-17.1	-21.1	+6.0	-14.0	A6 IV		
3556	76483	2.865	0.008	4.85	+0.81	74/-106	+5.4	-35.7	-17.5	-1.8	1A IV	73	
3647	79025	2.829	0.020	6.39	+0.40	11/-35	-1.3	-24.4	+1.8	-12.2	A2 III		
3702	80447	2.874	0.030	6.49	+0.39	-52/23	+28.6	+50.6	-12.8	-5.8	A7 V		
3719	80930	--	0.025	6.09	+0.86	-14/15	+1.2	+2.4	+7.0	-7.9	A5 V	55	
3840	83520	2.851	0.010	(6.15)	+1.20	-34/-26	-13.3	-15.3	+13.1	-19.2	A2/3 V		X
3865	84179	2.705	0.000	6.34	+2.61	-20/53	-27.0	-10.3	-23.6	-17.1	F2 V	101	
3880	84722	2.786	0.025	(7.08)	+2.30	-47/3	-3.7	+13.9	+0.9	-15.0	A7 V		X
3900	85376	2.788	0.000	5.29	+2.02	-3/-177	-1.8	-10.6	-35.5	-7.7	A5 IV	126	
3906	85504	2.836	0.000	6.02	+0.42	-192/91	+97.7	+161.2	-30.8	+13.8	A0 V	<40	X
3917	85795	3.922	0.015	5.22	+1.30	-11/26	-5.9	-1.4	+6.1	-7.8	A3 III	147	
3933	86301	2.814	0.030	6.19	+0.42	-79/18	+14.9	-51.0	-15.3	-19.2	A4 V		
3947	86629	2.740	0.000	5.22	+2.30	-112/-20	+30.0	+14.6	-32.5	-7.2	F1 IV		
3985	88024	2.885	0.032	6.39	+0.30	7/-6	-0.8	-9.0	+4.8	-4.7	A2 V		
4102	90859	2.698	0.000	3.99	+3.28	-21/-26	-4.0	+2.0	+4.0	-1.2	F2 IV	26	
4152	91790	2.829	0.024	6.38	+1.75	9/10	-7.3	-1.4	+8.9	+0.3	A5 IV/V		
4155	91854	2.757	0.000	6.57	+2.24	15/-34	-22.3	-14.3	+10.5	-18.7	F0 V	112	
4214	93397	2.892	0.014	5.37	+1.56	-4/-23	-13.7	-3.3	+7.4	+2.8	A3 V		
4248	94334	2.869	0.000	4.71	+0.24	45/-21	-18.7	-24.3	-4.1	-7.5	A1 V	35	X
4293	95370	2.865	0.005	4.35	+0.45	28/-3	-5.1	-6.2	+7.0	+1.1	A3 IV	111	
4294	95382	2.854	0.000	4.95	+1.34	-46/-27	-12.1	+5.6	+2.5	-16.6	A5 III	71	
4302	95698	2.747	0.008	(6.93)	+2.34	59/-125	+0.7	-44.7	-13.2	-27.7	F1 V	X	
4303	95771	2.775	0.011	6.10	+2.16	-14/-119	+4.5	-12.6	-29.4	-14.5	F0 V		
4311	96113	2.768	0.010	5.62	+0.63	-112/37	-16.0	+57.4	-6.3	-8.4	A8 III/IV	202	
4378	98286	2.914	0.022	6.56	+1.31	13/-46	-34.9	-24.0	-4.5	-35.6	A2 V		
4391	98772	2.862	0.018	5.95	+0.62	-5/34	0.0	+4.6	+14.7	-11.0	A3 V	160	
4551	103107	2.906	0.022	5.47	+0.65	-96/14	+23.4	+29.0	-39.2	-0.7	A2 V		
4564	103578	2.870	0.036	5.38	+0.65	9/2	-21.4	-4.7	+8.3	-19.5	A3 V	54	X
4584	104179	2.801	0.014	6.44	+1.23	-38/32	-8.3	+22.6	+6.1	-13.8	A9 III	101	
4631	105776	2.858	0.020	5.97	+1.84	52/-38	-7.1	-15.6	+10.1	-11.2	A5 V		
4677	106975	2.691	0.000	6.96	+3.60	-6/20	0.0	+3.4	+2.4	+2.8	F3 V		X
4678	106976	2.731		6.55	+2.91						F2 V		X
4680	107054	2.717	0.000	6.23	+1.96	76/-116	-18.0	-43.6	-21.8	-12.5	A9.5 III	140	
4681	107070	2.819	0.000	5.90	+0.25	30/-12	-14.0	-18.5	+10.1	-13.3	A5 V	195	
4703	107566	2.831	0.000	5.15	+0.10	-31/-3	-17.0	+21.1	+7.8	-1.7	A5 V	86	
4713	107833	2.769	0.025	6.27	+1.05	-4/1	-13.2	+7.1	+10.1	-4.9	F2 V		
4760	108844	2.830	0.020	5.26	+1.13	-62/92	+6.8	+30.6	+15.1	-10.9	A5 IV	87	
4836	110575	2.788	0.015	6.37	+1.85	34/-13	-4.6	-10.1	+9.0	-5.8	A8 V		
4889	111968	2.814	0.000	4.25	+0.80	63/-22	-2.5	-12.0	+8.2	-5.8	A7 III	81	
4947	113852	2.912	0.000	5.65	+1.25	38/-89	+16.6	-27.0	-17.0	-21.7	A0 V	<50	
5076	117242	2.787	0.020	6.25	+1.35	-98/-17	-7.0	+29.4	-35.0	+3.5	F0	101	
5079	117281	2.771	0.015	6.89	+1.60	-103/56	-15.8	+60.3	-18.8	-17.9	F1 IV		

TABLE 14. (continued)

HR	HD	β	E(b-y)	V_0	M_V	μ_α/μ_δ 0.001	ρ km/sec	U	V km/sec	W	Sp.T.	v sin i km/sec	Note
5108	118156	2.850	0.020	6.28	+2.03	24/33	-12.0	-1.5	+7.8	-14.5	F0 IV	97	
5129	118660	2.778	0.010	6.45	+2.18	46/-20	-1.7	-15.5	+4.4	-6.0	A9 V	90	
5179	120047	2.839	0.000	5.87	+1.90	-111/-42	-13.0	+16.9	-33.5	-2.5	A5 V	199	
2514	120818	2.890	0.020	6.55	+1.62	31/-5	-12.3	-11.0	+4.3	-14.9	A5 IV	108	
5244	121607	2.816	0.010	5.85	+0.96	-27/19	-23.0	+23.8	+3.4	-13.0	A8 V	181	
5262	122365	2.890	0.014	5.92	+1.10	36/-2	-17.0	-5.0	+10.7	-19.8	A2 V	100	
5333	124713	2.825	0.017	6.31	+2.01	39/-6	-4.0	-9.4	+6.6	-8.2	A7 V	67	
5337	124780	2.757	0.002	6.54	+1.95	25/7	+2.7	-8.5	+6.4	+0.4	F0 V		
5382	125990	2.837	0.031	6.23	+0.36	-39/-12	+17.5	+9.6	-32.4	+0.1	A3 V		
5418	127167	2.851	0.015	5.90	+1.35	24/22	-9.2	+3.3	+13.4	-7.1	A5 IV	125	
5438	127964	2.866	0.038	6.32	-0.12	17/6	-0.4	-9.7	+10.4	-6.3	A4 V		
5447	128167	2.681	0.000	4.46	+3.45	189/132	+0.2	-1.9	+16.2	-5.3	F2 V	3	
5473	129153	2.816	0.000	5.93	+2.17	60/-16	-7.9	-9.0	+6.8	-14.6	F0 V	94	
5482	129422	2.752	0.000	5.31	+1.75	77/-20	-1.0	-5.4	+8.6	-23.4	A9 V	213	
5529	130817	2.680	0.000	6.16	+3.34	-253/112	-34.6	+48.5	-31.1	-13.6	F2 V	12	
5570	132052	2.726	0.000	4.46	+2.17	-94/-153	+21.6	-16.3	-26.1	+10.8	F0 V	117	
5588	132772	2.713	0.010	5.60	+2.06	-32/43	+12.3	+10.3	+6.5	+13.2	F2 IV	67	
5664	135263	2.910	0.038	6.14	+1.20	48/93	-4.8	+21.1	+42.6	-9.5	A2 V		
5721	137006	2.787	0.011	6.06	+2.18	76/-30	-2.5	-13.1	+8.0	-17.5	F0 V	105	
5748	137928	2.888	0.022	6.34	+0.76	20/0	-4.9	-6.0	+5.1	-10.6	A2 IV	30	
5804	139225	2.724	0.000	5.93	+2.52	43/-3	-2.0	-7.1	+10.0	-11.4	F3 V		
5830	135758	--	0.000	5.76	+2.93	90/-126	-1.8	-26.1	-0.7	-1.9	F2 V		
5870	141187	2.883	0.010	5.66	+1.27	-58/58	-34.2	+43.8	-8.9	-6.2	A3 V		
5876	141413	2.832	0.018	6.45	+1.05	38/10	+15.2	-23.5	+7.0	-11.6	A5 IV		
5936	142908	2.714	0.000	5.43	+2.60	31/83	-11.6	+14.0	+4.4	-12.6	F0 IV	74	
5991	144415	2.732	0.000	5.70	+2.68	50/-50	+26.1	-26.9	-8.7	-8.1	F1 IV		
6019	145361	2.696	0.020	5.70	+1.74	-88/-46	-45.6	+53.2	-0.7	+10.2	F2 III		
6032	145589	2.789	0.020	(7.18)	+1.29	27/-4	-27.3	+11.0	+2.2	-31.4	F0 IV		X
6109	147787	2.726	0.000	5.28	+3.05	53/34	-5.1	-2.4	+12.9	-2.0	F4 IV	0	X
6153	148898	2.889	0.005	4.41	+1.27	25/37	+2.5	-2.6	+8.8	+1.6	A7	41	X
6156	149081	2.899	0.000	6.45	+1.30	-48/-45	-7.9	-13.1	-28.3	+14.3	A1 V	59	
6207	150451	2.743	0.000	6.24	+2.47	20/6	-12.3	+9.9	+1.6	-9.0	A7 III	64	
6205	150557	2.725	0.005	5.68	+1.96	-91/53	-45.4	+50.4	-16.7	+2.0	F3 IV	45	
6273	152431	2.830	0.040	6.14	+0.85	36/-2	+0.8	-4.6	+10.9	-15.7	A7 III		
6355	154494	2.878	0.005	4.85	+1.60	51/-10	-4.2	+0.1	+2.9	-11.3	A4 IV	111	
6376	155102	2.875	0.014	6.22	+0.18	-38/-32	-7.4	-16.2	-31.1	+16.4	A2 IV	45	
6410	156164	2.858	0.000	3.13	+0.75	-21/-157	-40.7	+5.8	-38.4	-24.3	A3 IV	290	
6449	156971	2.730	0.005	6.42	+2.98	57/-19	+11.8	-13.8	+6.4	-10.1	F1 III	28	
6503	158156	2.912	0.011	(7.09)	+1.71	37/6	+7.7	-9.3	+12.7	-15.6	A2 V		X
6534	159170	2.827	0.010	5.56	+1.66	-39/-91	-26.0	+14.1	-34.3	-10.0	A5 V	255	
6597	160928	2.824	0.015	(6.53)	+1.41	7/6	-8.8	+7.8	+6.0	-0.2	A2 IV/V	184	X
6614	161420	2.761	0.020	5.99	+2.17	-18/36	-20.9	+14.2	+12.8	+13.9	A9 IV		
6655	162570	2.773	0.020	5.89	+0.73	24/-14	+4.1	-7.9	+5.1	-10.9	A9 V	212	
6656	162579	2.899	0.002	5.02	+1.33	-48/211	-54.8	+63.3	-44.6	-10.9	A2 V	140	
6917	169981	2.878	0.020	5.76	+0.17	26/-22	+8.5	-13.3	+8.5	-16.4	A2 IV		X
6955	170878	2.833	0.025	5.64	-0.23	-32/-21	-9.4	-8.0	-24.7	+11.5	A2 V		
7094	173417	2.706	0.000	5.70	+2.22	-39/-124	-2.3	-26.0	-15.9	-3.4	F1 IV		
7080	174177	2.827	0.025	6.40	-0.37	21/-12	-1.0	-6.6	+6.2	-24.0	A2 IV		
7136	175529	2.833	0.037	6.12	+1.90	6/28	+5.2	-5.9	-9.1	-0.2	A5 IV/V		
7152	175813	2.689	0.000	4.87	+2.58	-132/-105	+61.9	-62.3	-20.6	-4.4	F2 V	132	X
7159	175892	2.906	0.020	6.03	+1.35	6/19	-6.6	+7.9	+6.4	+2.5	A2 V		
7215	177196	2.845	0.000	5.02	+1.78	28/-79	+7.6	-15.5	+7.5	-8.5	A7 V	121	
7266	178596	2.721	0.000	5.21	+2.60	-7/-78	-46.7	+28.3	-38.9	-3.9	F0 IV	104	
7399	183312	2.700	0.000	6.53	+3.50	116/-26	+8.3	+0.5	+2.6	-26.4	F3 V		
7453	184977	--	0.025	6.67	+2.22	-17/-74	-0.5	-26.1	-9.4	+2.4	A9 V		
7545	187340	2.886	0.030	5.79	+0.27	15/-13	0.0	-2.8	+4.7	-10.6	A2 III		
7549	187421	2.882	0.052	6.30	+0.45	10/2	-21.5	+20.5	+8.5	+4.7	A11 IV		
7553	187532	2.698	0.000	5.36	+3.51	-30/33	+6.0	-5.2	+5.2	+2.5	F0 V	67	
7614	188899	2.892	0.010	4.95	+0.44	16/-101	0.0	-7.3	-32.4	-19.6	A3 IV	102	
7646	189684	2.832	0.040	5.79	+0.46	12/-20	+6.4	-7.5	+6.8	-9.9	A5 III		
7649	189741	2.889	0.022	5.58	+0.59	39/18	-42.2	+46.0	-7.4	+3.5	A1 IV		
7702	191329	2.822	0.050	6.34	-0.33	13/-14	+3.0	-5.7	+5.6	-17.9	A3 V		
7707	191603	2.739	0.005	6.06	+1.49	-41/34	+18.8	-27.7	+2.1	+2.0	F0 IV		

TABLE 14. (continued)

HR	HD	β	E(b-y)	V_0	M_V	μ_α/μ_δ 0″.001	ρ km/sec	U	V km/sec	W	Sp.T.	v sin i km/sec	Note
7729	192486	2.687	0.000	6.53	+3.52	4/56	-8.0	+7.2	+9.7	+5.5	F2 V		
7826	195050	2.864	0.015	5.57	+0.57	-23/-72	0.0	-33.4	-7.6	-10.8	A3 V	133	
7829	195093	2.830	0.028	6.61	+2.14	30/-84	-13.9	+9.6	-33.6	-12.9	A7/8 V	144	
7830	195094	2.889	0.022	5.80	+1.15						A1 V	301	
7938	197734	2.881	0.030	6.03	+0.14	-18/-30	-6.5	-25.8	-3.0	-3.5	A2 IV	55	
8091	201352	2.689	0.000	6.23	+3.16	121/-135	-42.7	+39.0	-40.6	+2.0	F2 IV/V		
8098	201616	2.888	0.014	6.00	+0.46	2/16	+6.9	+3.1	+11.4	+1.5	A2 V	60	
8188	203760	2.716	0.007	6.06	+2.26	4/36	+6.8	-5.1	+8.0	-7.4	F1 III		
8195	203805	2.834	0.007	5.59	+1.47	16/-169	-20.6	-5.4	-56.4	-9.6	F0 IV		
8208	204153	2.723	0.000	5.57	+2.96	189/51	+0.7	+26.9	-0.2	-14.8	F0 V		
8263	205765	2.889	0.020	6.12	+0.32	-15/-29	+16.9	-23.5	-1.8	-12.1	A2 V	156	
8266	205835	2.820	0.010	5.01	+1.09	-1/13	+7.0	+2.0	+7.4	+1.8	A5 V	171	
8295	206561	2.767	0.008	5.84	+1.06	-6/21	-13.4	+8.8	+2.1	+13.6	F0 IV		
8326	207155	2.899	0.036	(5.68)	+0.58	-32/1	+14.0	-20.9	+4.6	-0.4	A2 V	139	X
8346	207760	2.698	0.005	6.17	+1.97	149/-76	-41.7	+52.7	-44.2	-5.9	F0 III		
8446	210300	2.863	0.019	6.35	+1.05	32/20	+10.9	+10.5	+10.0	-17.9	A5 V		
8613	214454	2.766	0.000	4.64	+0.82	-55/-109	+12.0	-24.7	+15.9	-19.7	A8 IV	87	
8672	215729	2.889	0.007	6.30	+1.22	17/30	+7.8	+2.4	+6.0	-17.6	A2 V		
8715	216701	2.836	0.019	6.01	+0.60	20/6	+12.8	+9.2	+7.0	-13.2	A7 III		
8738	217186	2.886	0.008	6.29	+0.95	-34/-68	-0.7	-34.9	-20.0	-12.5	A1 V	56	
8767	217792	2.741	0.000	5.10	+2.60	76/80	-6.0	+16.4	+8.0	-0.3	F0 IV	0	X
8823	218759	2.764	0.000	6.47	+1.85	-40/-73	+25.4	-33.0	-18.5	-16.0	F1 IV	15	
8830	219080	2.742	0.000	4.53	+2.39	85/101	+12.5	+18.2	+8.8	+5.4	F0 V	59	
8907	220729	2.685	0.000	5.51	+3.29	38/123	+18.0	+0.4	+8.0	-23.4	F4 V	0	
8960	222098	2.872	0.000	6.25	+0.65	135/-6	-26.4	+64.2	-54.8	-8.2	A1 V	45	X
8973	222399	2.714	0.015	6.47	+1.94	-5/-85	-16.0	-19.4	-22.2	-22.7	F2 IV	--	
8983	222602	2.875	0.021	5.80	+0.65	-39/-39	-2.5	-26.9	-7.0	-3.9	A3 V	210	
8984	222603	2.832	0.000	4.49	+1.73	-129/-155	-12.0	-31.7	-3.7	-16.8	A7 V	63	
9093	225003	2.714	0.000	5.69	+2.75	-92/-49	+9.6	-17.7	+7.3	-9.6	F0 V		

Notes to TABLE 14.

184 Sp.B, P = 1.96d with equal components.

815 Eclipsing binary RZ Cas. P = 1.20d. The faint secondary is a G subgiant.

2788 Eclipsing binary R CMa, P = 1.14d. Spectra of both components (Tompkin 1985) give masses of 1.1 and $0.7M_\odot$ and radii of 1.6 and $1.1R_\odot$ for the brighter and fainter components, respectively. The star lies near the 10^9 yr isochrone (Castellani et al. 1992) but is undermassive by $0.5M_\odot$.

3310/1 Equal components separated by 5 arcsec.

3840 Equal components separated by 0.5 arcsec.

3880 Magnitude difference of 0.2 mag, separated by 0.03 arcsec.

3906 7 Sex.

4248 Sp.B, P = 15.83d.

4302 Equal components separated by 0.03 arcsec.

4564 Sp.B, P = 6.63d.

4677/8 Separated by 20 arcsec.

6032 Equal components separated by 0.1 arcsec.

6109 Sp.B, P = 39.89d.

6153 Similar to α^2 CVn.

6503 Near equal components, 0.4 arcsec.

TABLE 14. (continued)

6597	Equal components separated by 0.11 arcsec.
6917	Sp.B, P = 9.68d.
7152	Eclipsing binary ϵ CrA, P = 0.59d. The spectroscopic companion has been ignored.
8326	Equal components separated by 0.10 arcsec.
8767	Sp.B, P = 178.32d.
8960	Sp.B, P = 11.22d.

cluster motion and, if the cluster modulus is 13.5 mag, μ=0.10 arcsec cen^{-1} would be expected which is well within the uncertainties.

9. NEWBIRTH OR REBIRTH

(1) Perhaps the strongest argument for the hypothesis that the BS are newborn (or reborn under nearly identical conditions as newborn) is that alternate explanations have difficulty in explaining that 10% of both the BS and YD, A-type stars are Am. Although the numbers are small, even the distribution of normal, Am and USPC BS in the cluster M67 mimics that of the newborn YD.

(2) The strongest argument against newbirth as a source of blue stragglers is, perhaps, the question—"Whence the presteller matter?." About 50 white dwarf member of the Hyades supercluster are known in the immediate solar neighborhood (Eggen 1993c). If those now in the supercluster have evaporated from the cluster since they were formed, a minimum of 200 solar masses has been lost by them and may have been trapped in the cluster boundaries, together with whatever mass loss accumulates from other stages of evolution. The missing link in the process is, of course, the method by which the products of mass loss are concentrated into the cacoons from which mode A stars evolve. It should be recalled that Casertano *et al.* (1993) have demonstrated that the shape of the Hyades supercluster may be defined by the presence of a dark molecular cloud.

(3) Despite the fact that a few low luminosity USPC are also Am stars, the high percentage of binaries among the Am objects, and the situation where the rotational velocities of the USPC (and normal) stars is some 2.5 times that of the Am stars, makes the apparent evolution of the later into the former (e.g., Fig. 6) seem unlikely. This situation leads to the possibility that forward evolution ends at the blue edge of the instability region and merger of the components of Am stars produces the environment for rebirth or newbirth.

(4) The Am stars and USPC each constitute about 10% of both the OD (BS) and YD populations in the bright A-star

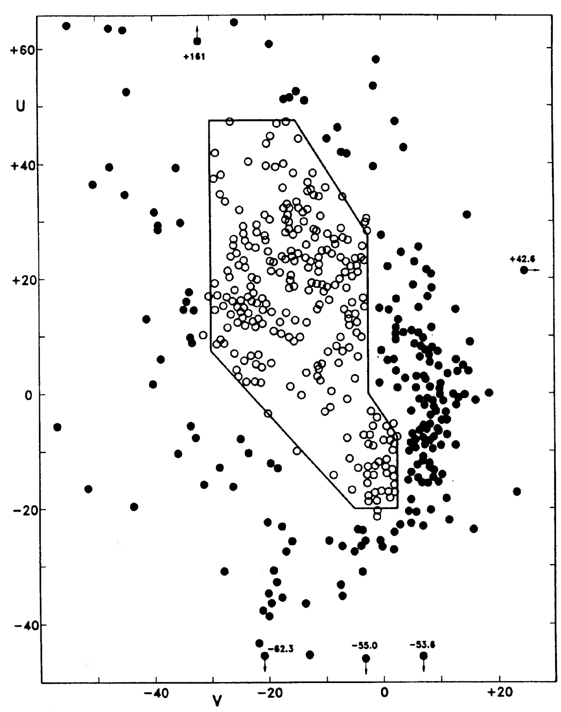

FIG. 15. The normal stars of the bright A-star sample in the (U,V) velocity plane.

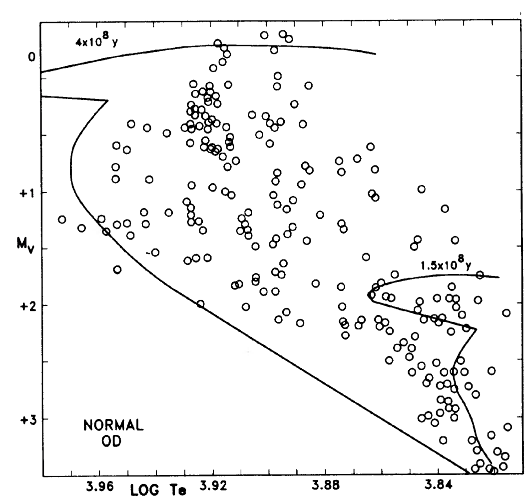

FIG. 16. The OD normal stars of the bright A-star sample in the $(M_v$, log $T_e)$ plane. The isochrones are from Castellani *et al.* (1992).

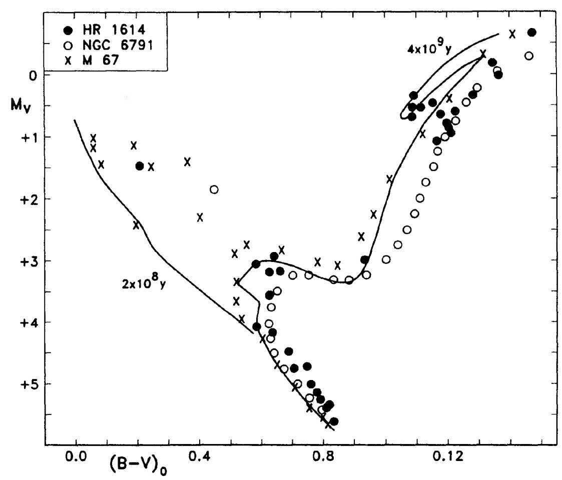

FIG. 17. The old disk clusters and superclusters in the (M_v, log T_e) plane. The isochrones are from Castellani *et al.* (1992).

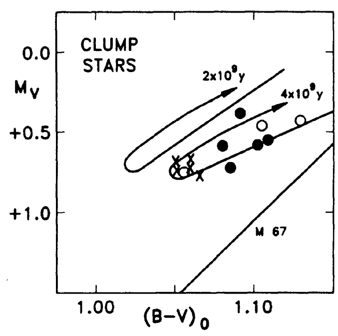

FIG. 18. The He-burning "clump" stars of old disk clusters in the (M_v, log T_e) plane. The closed circles, open circles, and crosses represent HR 1614, NGC 6791, and M67 members, respectively. The isochrones are from Castellani *et al.* (1992).

sample. If successive cycles occur in which the Am stars alone, in one generation, produce the whole array of A stars in the next, each cycle represents about 90% decrease in the local population. A comparison between the Pleiades and M67, with the assumption that the original luminosity functions were the same (Sandage 1957; Racine 1971), as indicated by the equal number of stars with M_v between +5 and +6.5 mag, shows that the eight BS of M67, represented by crosses in Fig. 17, are a minimum of 40% of the original M67 main-sequence stars in the same luminosity range, or only a 60% reduction of the original population.

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