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LUMINOSITIES, COLORS, MOTIONS, AND DISTRIBUTION OF FAINT BLUE STARS*

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ABSTRACT

Photoelectric (U,B,V) photometry of 500 faint blue stars and 150 possible late-type white dwarfs is used as a sample from which space densities can be estimated. The early-type, DB and DA white dwarfs probably have a space density of an order of magnitude smaller than that of the DF, DG, DK, and DM types. A conservative estimate of the mass density of the white dwarf population near the Sun is $1 - 2\odot/100$ ps^3.

The blue horizontal branch stars, which may contribute a minimum of 20 per cent to the faint blue star population, can be generally recognized over a limited color range from (U,B,V) photometry, but the bluest HB, WD, and sdOB stars are indistinguishable by this method.

I. INTRODUCTION

Although extensive proper motion and photographic colorimetric surveys, mainly at the University of Minnesota and Lowell Observatories, have identified a large population of faint blue stars, very little systematic, accurate photometry has been carried out with the aim of estimating the space densities of the constituents of this population. Klemola (1962) and Slettebak, Bahner, and Stock (1961) have gathered extensive material for the brighter stars, small samples near the galactic poles have been observed by Iriarte (1959) by Eggen and Sandage (1965), and in the far southern hemisphere by Hill and Hill (1966), and samples of the faintest blue stars have been studied by Sandage (1965) and Sandage and Luyten (1967). The present discussion is based on observations of 500 faint blue stars and 150 possible late-type white dwarfs.

II. LUMINOSITIES OF THE FAINT BLUE STARS

The (M_V, $U - V$) diagram for the 23 known white dwarfs with trigonometric parallax greater than 0".05 is shown in Figure 1 where large filled circles represent those with weight greater than 20 and small dots those with less weight. The trigonometric parallaxes are as listed elsewhere (Eggen and Greenstein 1965*a*, 1967) except that a few more recent determinations (Wagman 1964) have also been taken into account. The white dwarf members of the Pleiades (open circle) and of the Hyades and Praesepe (triangles) clusters, discussed elsewhere (Eggen and Greenstein 1965*a*), are also represented in Figure 1. Three new members of the Hyades cluster are in Table A. These stars, which are near the center of the Hyades cluster, were observed with the 40-inch reflector at Siding Spring Mountain. Luyten finds $\mu = 0''.10$, $\theta = 111°$ for LP 475–42, and van Altena gives the probability of membership, based on the proper motion, of greater than 80 per cent for the other two objects. VA 216 and 391 are very similar to the reddest previously known white dwarf in the cluster, GH 7–138 (Eggen and Greenstein 1965*a*, No. EG 32), which is also VA 71 with a membership probability of 90 per cent.

The white dwarf components in 11 wide binaries for which the brighter components are main-sequence stars with $B - V$ bluer than $+1.1$ (Eggen and Greenstein 1965*a*,

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TABLE 1

BLUE STARS IN THE FIRST 180 FIELDS OF THE LOWELL PROPER-MOTION SURVEY

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π pt (0.001)
GD1	$0^h02^m.4$	+39°47'	0.2-0.27	60°	16.5	0						
G131-19	0 03.8	+17 44	0 62	144	16.5	0						
GD2	0 05.0	+33 01	0.05-0.1	250	14.5	0	13.82	-0.29	-1.21	1,84	?	
GD3	0 06.2	+44 44	0.05-0.1	90	13.0	0					HB	
GD4	0 06.3	+36 29	0.1-0.2	105	16.0	0						
G130-49	0 07.0	+30 50	0.55	220	16.5	0	16.85	+0.25	-0.70	3,100	(WD)	14
GD5	0 08.8	+42 24	0.1-0.2	190	15.5	0						
G31-35	0 11.1	+00 03	0.55	114	15.8	0	15.31	+0.24	-0.58	Harris	DA	28
G171-52	0 19.6	+42 20	0.35	128	16.7	0						
G158-78	0 23.5	-10 54	0.27	160	16.2	0					DA	
G172-4	0 30.3	+44 48	0.27	112	16.6	0	16.59	+0.30	-0.50	1,200	(WD)	16
G158-100 L795-44	0 31.4	-12 24	0.29 0.21	135 131	15.7 15.1	0 m						
G1-7 L1011-71	0 33.0	+01 37	0.45 0 39	201 203	15.0 15.3	0 -	15.52	+0.24	-0.68	Harris	DA	25
GD7	0 36.0	+33 53	0.05-0.1	90	16.0	-1						
G132-12	0 36.4	+31 15	0.28	123	16.2	-1					DA	
GD8	0 37.3	+31 16	0.05-0.1	130	14.0	-1	14.66	-0.22	-1.20	1,84	?	
G69-31	0 52.1	+22 40	0.56	109	15.5	0						
GD9	0 58.5	-04 28	0.05-0.1	80	15.0	-1	15.38	+0.03	-0.75	1,40	(WD)	26

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G1-45	1.01.2	+04 48	0.42	55	13.9	+1	14.10	+0.14	-0.50	Kowal	DA	48
G2-17			0.48	52	14.0	0						
G70-32			0.40	52	15.0	+1						
GD10	1 04.1	+39 15	0.1-0.2	80	15.0	0						
G33-41	1 06.1	+15 00	0.58	144	16.2	0						
G34-5			0.63	149	16.9	-1						
GD11	1 06.6	+37 17	0.1-0.2	100	14.5	-1	15.25	-0.23	-1.05	1,200	DA	12
GD12	1 07.5	+26 45	0.2-0.27	120	15.0	0	14.93	+0.09	-0.64	1,100	DA	33
L1373-25			0.25	124	15.2	a						
G33-45	1 08.3	+14 24	0.27	108	16.4	0						
G33-49	1 15.3	+15 55	0.66	180	14.4	0	13.82	+0.11	-0.81	1,100	DC	55
G34-17			0.66	187	13.9	0						
W1516			0.65	180	14.4	-						
G2-36	1 20.0	+12 29	0.35	93	11.5	0	9.46	+1.04	+0.86	1,60	(sd?)	(32)
G33-55			0.39	82	11.0	+1						
G34-25			0.38	90	11.0	+1						
GD13	1 26.8	+42 13	0.05-0.1	115	14.0	0						
G2-40	1 26.8	+10 08	0.48	193	15.2	0	14.85	+0.27	-0.50	1,40	(WD)	34
G3-1			0.42	191	13.7	0						
G71-11			0.46	197	14.6	0						
W72			0.42	189	14.4	g						
G173-5	1 29.8	+45 50	0.27	270	15.7	-1						
G72-31	1 42.3	+31 18	0.34	114	14.8	0						
G133-36			0.34	116	15.1	0						
G39-49	1 42.5	+23 03	0.28	109	17.2	0	17.41	-0.05	-0.62	2,200	DC	10
G35-11			0.32	113	17.3	0						
G72-33			0.35	112	17.1	0						
G94-7			0.31	115	16.2	0						
G94-9	1 43.9	+21 40	0.27	240	14.5	0	15.05	+0.25	-0.65	2,100	DA	32
W82			0.29	248	14.4	-						
GD15	1 45.3	+02 37	0.2-0.27	85	16.5	0						
GD16	1 46.2	+18 48	0.2-0.27	110	15.5	0						
W88			0.34	100	14.6	-						

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
GD17	1 46.8	+23 46	0.1-0.2	60	16.5	0						
G72-40	1 50.0	+25 39	0.28	77	15.2	0						
G94-21			0.27	81	15.5	-1						
GD18	1 50.4	+00 46	0.1-0.2	200	16.0	0						
GD19	1 50.4	+09 35	0.1-0.2	80	14.0	0	14.22	+0.54	-0.19	1,84	(sd?)	
G71-B5B	1 50.5	+08 57	0.10	154	16.7	0	17.16	+0.21	-0.81	1,200	(WD)	12
G71-41	1 51.6	+01 47	0.36	95	15.1	0						
G73-4			0.31	96	15.2	+1						
G159-12			0.29	95	15.0	0						
GD256	1 53.5	+29 41	0.05-0.1	130	15.0	0						
GD20	1 55.1	+06 58	0.05-0.1	300	14.5	-1						
GD21	1 58.5	+11 58	0.2-0.27	245	16.5	0						
LP:469-55			0.19	267	15.7	g						
G22	1 59.6	+04 29	0.1-0.2	70	16.0	0						
G159-31	2 01.1	-05 14	0.27	144	16.2	-1						
GD23	2 01.6	+17 12	0.05-0.1	150	15.5	-1						
G35-26	2 43.0	+20 43	0.44	104	12.3	-1						
G94-37			0.41	106	13.1	0						
G35-29	2 05.9	+25 00	0.44	104	12.3	-1	13.22	-0.04	-0.85	2,100	DA	72
G95-37			0.41	106	13.1	0						
G74-7	2 08.2	+39 42	1.12	117	14.3	0	14.50	+0.30	-0.47	Sand.	DA	79
G133-72			1.19	113	14.7	0						
G134-8			1.14	118	14.5	0						
GD24	1 10.3	+16 29	0.05-0.1	180	16.0	0						
GD25	2 13.2	+39 38	0.1-0.2	245	14.5	0	14.54	+0.23	-0.61	1,200	(WD)	40
G134-22	2 13.8	+42 44	1.07	128	15.9	0	16.23	+0.73	+0.02	1,200	DC	50
GD26	2 14.2	+38 26	0.05-0.1	105	13.5	0	13.55	+0.50	-0.14	2,84	(sd?)	

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp	π
GD27	2 20.4	+48 03	0.05-0.1	100	14.5	0	14.83	+0.20	-0.95	1,200	(WD)	35
G94-B5B	2 20.7	+22 14	0.15	113	15.6	0	15.93	+0.07	-0.71	3,100	DA	21
GD28	2 25.6	+36 32	0.1-0.2	170	16.0	0						
GD29	2 30.1	+36 06	0.05-0.1	110	14.0	0	13.68	+0.50	-0.10	1,100	(sd?)	
GD30	2 30.6	+34 20	0.2-0.27	90	16.0	-1						
GD31	2 31.3	-05 25	0.2-0.27	70	14.0	0	14.24	+0.21	-0.68	1,40	(WD)	46
G174-5	2 32.8	+52 31	1.28	135	12.9	0						
GD32	2 37.8	+31 30	0.2-0.27	230	16.0	0						
G4-34	2 39.4	+11 00	0.39	156	15.8	+1						
G76-23			0.34	148	16.4	0						
G4-37	2 41.9	+08 16	0.31	208	11.6	0	11.40	+0.47	-0.20	1,60	(sd?)	
G76-26			0.29	203	12.7	+1						
LTT10900			0.26	202	11.1	g						
GD33	2 42.7	+39 24	0.05-0.1	80	16.5	-1	16.77	+0.19	-0.62	1,200	(WD)	14
G75-39	2 44.0	-02 40	0.54	159	15.6	0						
GD34	2 45.2	-00 09	0.1-0.2	100	16.5	-1						
G5-1	2 45.8	+22 24	0.36	186	10.3	0	10.07	+0.56	-0.04	Kowal	(sd?)	
G36-34			0.34	174	11.1	+1						
G37-5			0.36	185	10.1	+1						
+22°396			0.33	174	11.6	k						
GD36	2 51.7	+30 05	0.1-0.2	110	16.0	-1						
GD37	2 54.5	-00 34	0.05-0.1	120	16.0	0						
G76-48	2 57.3	+08 00	0.54	100	16.0	0						
GD38	2 59.4	+37 49	0.1-0.2	115	15.5	-1	15.55	-0.03	-1.06	1,200	(WD)	11
GD39	2 59.5	-01 34	0.05-0.1	170	15.5	0	15.11	+0.54	-0.08	2,40	(sd?)	
GD40	3 00.4	-01 20	0.05-0.1	250	15.0	-1	15.56	-0.05	-0.92	3,40	(WD)	11
G36-50	3 00.8	+29 24	0.43	136	12.4	+1	12.00	+0.62	-0.12	1,60	(sd?)	
G37-24			0.42	139	12.6	0						

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
GD41 F31	3 02.0	+02 45	0.05-0.1	210	14.0	-1	14.81	-0.25	-1.16	3,40	?	
GD42	3 02.1	+08 19	0.1-0.2	120	16.0	0						
GD43	3 13.0	+22 01	0.1-0.2	80	16.0	-1						
GD44	3 13.5	+39 22	0.1-0.2	160	16.0	-1						
GD45 BPM85584	3 16.6	+34 32	0.2-0.27 0.155	160 156	13.0	-1	14.16	+0.08	-0.68	1,84	(WD)	48
GD46	3 27.6	+27 57	0.1-0.2	160	16.5	-1						
G5-52 +20°578	3 28.4	+20 36	0.27	208	10.0 8.7	0 -	8.14	+0.68	+0.25	Kowal	G5	
G37-44 G38-4	3 32.2	+32 02	0.47 0.49	138 129	15.1 15.4	-1 0	15.50	+0.21	-0.55	3,100	DA	25
G5-46 G6-17 G79-49	3 33.2	+16 18	0.32 0.28 0.39	236 230 221	7.9 9.5 8.5	+1 0 +1	7.60	+0.56	-0.04	1,60	(sd?)	
GD47	3 39.4	-03 32	0.2-0.27	80	15.0	0	15.20	+0.15	-0.59	1,40	(WD)	28
GD48	3 41.1	-13 28	0.1-0.2	150	16.0	0						
GD50	3 46.3	-01 18	0.1-0.2	170	14.0	0	13.98	-0.16	-1.16	1,40	?	
GD51	3 47.9	-13 44	0.1-0.2	60	15.0	0	14.91	+0.34	-0.56	1,40	(WD)	33
GD52	3 48.8	+33 59	0.1-0.2	120	15.0	-1	15.20	+0.10	-0.63	1,200	(WD)	29
GD53	3 51.7	+09 16	0.1-0.2	105	15.0	0						
GD54	3 52.0	+05 15	0.1-0.2	130	16.0	0						
G80-34	3 52.2	+07 38	0.27	153	16.2	0						
GD55	3 52.5	-14 25	0.05-0.1	220	16.0	-1						
G8-8 LP357-134	4 01.6	+25 01	0.28 0.25	146 149	14.2 14.6	-1 b	13.80	+0.10	-0.58	3,60	DA	55
GD56	4 08.6	-04 06	0.2-0.27	170	15.0	0	15.50	+0.14	-0.54	1,40	(WD)	25
G7-27 +19°674	4 09.9	+19 46	0.27 0.24	1 95	10.9 10.5	0 g						

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B−V	U−B	n,T	Sp.	π
GD57	4 10.1	-11 38	0.1-0.2	10	16.0	0						
G160-51	4 10.1	-11 26	0.29	95	15.6	0						
GD58	4 11.2	-58 09	0.2-0.27	160	16.0	0						
G8-16	4 11.6	+22 14	0.63	134	8.9	0	9.24	+0.42	-0.20	2,20	F2	
+31°607			0.54	122	9.4	-						
GD59	4 12.3	+06 33	0.05-0.1	170	15.0	0						
GD60	4 12.0	+33 28	0.2-0.27	150	15.0	-1	15.33	+0.01	-0.73	1,200	(WD)	29
G38-29	4 17.0	+36 10	0.29	170	14.8	-1	15.63	+0.16	-0.53	3,100	DA	24
G39-7			0.27	172	15.1	-1						
G81-14			0.31	173	14.9	-1						
G83-10	4 23.1	+12 05	0.29	206	15.7	0					DA	
LP475-70			0.26	210	15.4	f						
G7-38	4 23.7	+19 05	0.31	128	16.1	0						
G8-34			0.33	130	15.4	+1						
G39-16	4 26.1	+29 00	0.27	155	17.0	-1						
G175-34B	4 26.8	+58 53	2.37	146	13.0	0	12.45	+0.33	-0.49	1,200	DC	200
G39-27	4 33.6	+27 04	0.36	116	15.8	-1	15.94	+0.65	-0.06	2,100	DC	55
GD61	4 25.2	+41 04	0.1-0.2	165	15.0	-1	14.79	-0.09	-0.99	1,200	(WD)	16
G175-46	4 40.1	+51 01	0.51	85	16.1	0						
GD62	4 47.2	+42 04	0.2-0.27	135	14.0	0						
GD63	4 49.0	+04 28	0.05-0.1	240	16.5	0	16.45	+0.57	-0.01	1,200	(WD)	44
G83-43	4 52.2	+10 23	0.36	123	16.6	0						
G97-4			0.36	140	16.6	+1						
GD64	4 53.8	+51 42	0.2-0.27	180	15.0	0	13.77	+0.23	-0.61	1.200	(WD)	57
G84-26	4 57.2	-00 27	0.30	140	15.8	0	15.12	+0.14	-0.62	1,40	(WD)	30
GD65	5 00.0	+25 00	0.05-0.1	140	16.5	0	15.50	+1.20	+0.58	2,200	?	

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G84-41	5 11.4	+07 57	0.31	219	16.0	+1						
G76-29			0.42	220	15.9	0						
GD66	5 17.4	+30 46	0.1-0.2	170	16.0	0	15.56	+0.22	-0.59	1,200	(WD)	25
GD67	5 18.0	+00 35	0.05-0.1	150	16.0	-1	16.64	+0.17	-0.63	1,200	(WD)	15
G86-B1B	5 18.4	+33 19	0.18	113	17.0	0	16.20	+0.31	-0.04	3,200	DA	18
GD68	5 28.3	+41 27	0.05-0.1	150	16.0	0	16.36	-0.01	-0.76	1,200	(WD)	17
GD69	5 32.8	+41 28	0.05-0.1	285	15.5	0	14.75	+0.32	-0.54	1,200	(WD)	35
G98-18	5 23.9	+32 14	0.44	141	16.3	0						
G97-56	5 35.6	+11 49	0.27	165	14.1	0	14.10	+0.60:	-0.13:	1,60	(WD)*	115
G96-53	5 43.1	+43 38	0.28	161	16.4	0						
G101-8			0.27	158	16.2	0						
GD70	5 46.3	+26 30	0.2-0.27	210	16.5	-1	17.18	+0.14	-0.54	1,200	(WD)	11
GD257	5 48.1	+00 05	0.05-0.1	130	15.0	-1	15.10	-0.30	-1.21	2,40	?	
G99-37	5 48.8	-00 11	0.27	21	15.0	0	14.58	+0.46	-0.53	3,40	(WD)	80
GD71	5 49.6	+15 53	0.2-0.27	160	13.0	-1	13.06	-0.25	-1.16	2,84	sdO	
L1243-36			0.21	154	12.6	a						
G102-39	5 51.1	+12 24	0.30	181	16.0	0	15.86	+0.05	-0.76	3,200	DC	21
G105-2			0.28	189	15.5	0						
G99-47	5 53.8	+05 52	1.07	208	14.5	+1	14.12	+0.62	-0.16	1,100	(WD)	120
G102-40			1.09	207	14.7	0						
G106-15			1.02	205	15.4	+1						
G104-10	5 57.4	+23 43	0.27	170	16.3	±0						
GD258	5 58.7	+27 52	0.1-0.2	170	15.5	0						
GD72	6 06.8	+28 15	0.2-0.27	215	15.0	-1	14.63	0.00	-0.82	1,84	(WD)	38
GD259	6 10.6	+30 28	0.1-0.2	135	15.0	0						
GD73	6 10.8	+20 52	0.2-0.27	175	15.5	0	15.77	+0.24	-0.66	1,200	(WD)	22
GD104-27	6 12.4	+17 45	0.43	189	13.3	0	13.40	-0.15	-0.98	Harris	DA	29
G105-24			0.44	188	13.5	+1						
L1244-26			0.36	189	12.9	-						

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G105-B2B	6 25.0	+10 02	0.10	151	16.4	0	16.58	+0.21	-0.72	2,200	DF	15
GD74	6 25.5	+41 32	0.1-0.2	170	15.5	-1	14.99	-0.03	-0.81	1,200	(WD)	16
GD75	6 28.6	+47 39	0.2-0.27	190	14.0	0	13.67	+0.62	-0.09	1,60	(sd?)	
GD260	6 30.8	+38 51	0.05-0.1	210	15.5	0						
GD76	6 31.5	+05 54	0.2-0.27	140	15.0	-1						
G107-9	6 33.0	+40 57	0.29	208	16.1	0						
GD77	6 37.4	+47 47	0.2-0.27	160	15.0	-1	14.80	+0.13	-0.64	1,200	(WD)	35
G87-7	6 44.3	+37 35	0.97	190	11.2	-1	12.10	-0.08	-0.92	2,60	DA	55
G103-61			0.98	196	12.3	0						
G107-21			1.04	195	12.0	0						
L1534-1			0.95	191	11.4	-						
G108-26	6 44.8	+03 34	0.49	275	16.3	0						
GD78	6 48.8	+36 49	0.1-0.2	160	16.0	0	16.16	+0.53	-0.04	1,200	(WD)	47
GD79	6 50.8	+39 42	0.1-0.2	160	16.0	-1	15.96	+0.09	-0.80	1,200	(WD)	20
GD80	6 51.7	-02 05	0.1-0.2	140	14.5	-1	14.82	-0.21	-1.19	1,84	?	
G108-42	6 54.8	+02 45	0.27	161	15.9	-1	16.15	+0.13	-0.69	1,200	DC	19
GD81	6 58.2	+05 35	0.1-0.2	170	16.5	0	16.89	+0.15	-0.73	1,200	(WD)	13
G87-29	7 06.8	+37 45	0.42	223	16.1	0	15.64	+0.30	-0.55	5,200	λ4670	24
G107-54			0.46	222	15.15	0						
GD82	7 07.0	+38 12	0.05-0.1	125	16.0	0	15.29	+0.55	-0.18	1,200	(sd?)	
GD83	7 10.4	+21 39	0.2-0.27	220	15.0	-1	15.29	+0.19	-0.52	1,200	(WD)	27
GD84	7 14.4	+45 53	0.2-0.27	205	15.5	-1	15.19	+0.08	-0.79	1,200	(WD)	29
G89-10	7 15.4	+12 36	0.30	225	16.3	0					DA	
G110-49			0.32	229	15.4	0						
GD85	7 16.5	+40 27	0.1-0.2	114	14.5	-1	14.94	-0.11	-0.99	1,200	(WD)	15
GD86	7 30.7	+48 48	0.2-0.27	230	15.0	0	14.96	-0.09	-0.74	1,200	(WD)	32

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B−V	U−B	n,T	Sp.	π
GD87	7 37.8	+43 00	0.1-0.2	130	130	0	12.66	+0.22	+0.02	2.84	?	
GD89	7 43.9	+44.16	0.1-0.2	210	15.5	-1	14.92	+0.07	-0.73	1,200	(WD)	33
G90-28	7 52.2	+36 30	0.51	194	16.3	0						
G111-44			0.48	198	15.7	0						
G111-49	7 56.5	+43 43	0.34	294	16.2	0						
G111-54	8 02.3	+38 41	0.31	187	15.6	-1	15.55	+0.06	-0.82	1,200	(WD)	25
GD261	8 04.8	+35 58	0.05-0.1	200	15.5	0	15.35±	+0.75	-0.26	2,200	(sd?)	
GD262	8 06.5	+29 29	0.1-0.2	120	15.5	0	16.16	+0.38	-0.45	1,200	(WD)	39
GD263	8 10.9	+16 20	0.05-0.1	160	15.0	0						
GD90	8 16.5	+37 41	0.05-0.1	210	15.5	0	15.74	+0.22	-0.63	1,200	(WD)	23
G111-71	8 16.7	+38 44	0.38	212	16.4	0	16.58	+0.36	-0.58	2,100	DA,F	16
GD264	8.18.7	+33 44	0.05-0.1	150	14.0	0	14.50	+0.35	-0.02	1,200	?	
GD91	8 26.7	+45 31	0.1-0.2	220	16.0	0	15.08	+0.20	-0.52	1,200	(WD)	30
W309			0.21	220	14.3	-						
G51-16	8 27.5	+32 52	0.64	192	15.7	0	15.69	+0.35	-0.54	1,200	(WD)	46
G115-9	8 30.8	+37 10	0.28	216	16.3	0	16.01	+0.21	-0.59	1,200	(WD)	20
GD92	8 35.0	-02 33	0.1-0.2	160	14.5	0	14.02	+0.59	-0.17	1,84	(sd?)	
GD93	8 41.6	+45 48	0.1-0.2	180	16.5	0	15.95	+0.24	-0.53	1,200	(WD)	20
GD94	8 42.2	+38 13	0.2-0.27	140	16.0	0	16.02	+0.29	-0.60	1,200	(WD)	20
GD95	8 43.6	+35 50	0.2-0.27	260	15.0	0	14.81	+0.22	-0.67	1,200	(WD)	34
GD96	8 46.0	+34 41	0.1-0.2	280	16.5	-1	15.71	+0.28	-0.35	1,200	(WD)	48
GD98	8 51.3	+40 28	0.1-0.2	170	15.0	0	14.87	-0.13	-0.94	1,200	(WD)	15
G47-18	8 56.2	+33 09	0.37	269	15.1	0	15.18	0.00	-0.89	1,200	λ4670	23
G51-32			0.32	274	14.3	0						
GD99	8 58.7	+36 19	0.2-0.27	200	15.0	0	14.55	+0.19	-0.59	1,200	(WD)	39

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B−V	U−B	n,T	Sp.	π
GD100	9 07.7	-02 42	0.05-0.1	220	16.0	-1	16.14	-0.02	-0.73	1,200	(WD)	19
G195-19	9 12.5	+53 39	1.56	222	14.8	0	13.79	+0.30	-0.66	Sand.	(WD)	55
G116-16	9 13.4	+44 12	0.27	176	15.5	0	15.32	+0.24	-0.53	2,200	DA	28
GD101	9 18.2	-07 33	0.05-0.1	230	16.0	0	15.57	+0.80	+0.20	2,200	(sd?)	
G46-37	9 20.4	+01 16	0.37	173	16.9	0	16.64	+0.54	-0.25	1,200	(WD)	36
G117-B15A	9 21.2	+35 30	0.14	264	15.6	-1	15.52	+0.20	-0.56	3,100	DA	25
G41-39 G48-7	9 25.9	+08 54	0.33 0.32	148 135	16.2 17.0	0 0	16.60	+0.31	-0.65	2,200	(WD)	15
G161-36	9 26.8	-03 57	0.27	274	15.3	-1	14.79	+0.15	-0.58	2,200	(WD)	34
G117-25	9 30.8	+29 25	0.28	230	15.7	0	15.95	+0.25	-0.61	1,200	(WD)	20
GD102 BPM73571	9 39.9	- 8 42	0.05-0.1 0.076	110 119	15.5	0	14.43	+0.76	+0.26	1,200	(sd?)	
G161-68	9 41.3	-06 50	0.51	185	16.4	0	16.41	+0.57	-0.30	1,200	(WD)	39
GD103	9 42.3	+31 50	0.05-0.1	140	16.0	0	15.17	+0.75	+0.05	1,200	sdK	
G117-B11B	9 43.4	+32 05	0.14	133	16.7	0	17.24	+0.40	-0.51	2,200	(WD)	22
G116-52 LTT12591	9 43.5	+44 09	0.31 0.29	359 0	13.7 13.2	0 -	13.12	+0.07	-0.54	Harris	DA	76
GD104	9 44.6	-09 06	0	-	15.0	-1	15.89	-0.35	-1.23	1,200	?	
G116-57 G117-46 G118-15	9 47.0	+41 01	0.27 0.27 0.27	258 256 255	12.9 14.3 13.8	+1 +1 0	12.36	+0.59	-0.08	3,100	sdG	
GD105	9 51.6	+33 17	0.05-0.1	240	16.0	0	15.06	+0.70	+0.02	1,200	sdK	
G49-33 G54-6	9 55.0	+24 47	0.38 0.39	217 219	14.4 14.6	-1 0	15.09	+0.25	-0.54	2,100	DA	30
G48-57	9 55.6	+09 01	0.34	223	17.3	0						
GD108	9 58.3	-07 19	0.05-0.1	270	14.0	-1	13.57	-0.21	-0.91	1,200	sdB?	
G42-33	9 59.1	+14 56	0.34	276	15.1	0	15.37	+0.36	-0.49	1,200	(WD)	53

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
GD109	9 59.9	-00 26	0.05-0.1	145	15.5	0	15.40	+0.55	-0.10	1,200	(sd?)	
GD110	10 01.1	-03 23	0.1-0.2	260	16.0	0	15.43	+0.25	-0.59	1,200	(WD)	26
GD111	10 02.8	+43 03	0.05-0.1	260	16.0	-1	16.16	-0.08	-0.87	1,200	(WD)	9
GD112	10 02.8	+45 52	0.05-0.1	195	14.5	0	13.85	+0.40	-0.21	1,200	(sd?)	
GD113	10 03.6	+01 08	0.05-0.1	165	12.5	0	11.63	-0.09	-0.49	2,84	sdB?	
GD114	10 07.8	+35 50	0.1-0.2	180	14.0	0	13.26	+0.56	-0.08	2,100	(sd?)	
G43-38	10 12.4	+08 21	0.43	305	16.3	0	16.16	+0.41	-0.40	1,200	DF	40
G44-7			0.30	304	16.2	0						
GD115	10 13.3	-07 07	0.1-0.2	260	16.0	-1	16.67	+0.19	-0.54	1,200	(WD)	15
G53-38	10 13.6	-01 04	0.56	277	15.2	0	15.33	+0.32	-0.48	1,200	(WD)	55
G55-8			0.56	269	15.5	0						
G152-34			0.53	271	15.7	0						
G55-9	10 13.9	+03 57	0.32	89	16.9	0						
GD116	10 18.0	+36 42	0.1-0.2	200	16.0	-1	15.96	0.00	-0.81	2,200	(WD)	20
LP262-103			0.09	167	15.0	b						
GD117	10 19.6	+46 16	0.1-0.2	290	16.5	0	16.70	+0.33	-0.63	2,200	(WD)	14
GD118	10 22.2	+47 08	0.05-0.1	180	15.5	0	14.90	+0.46	-0.24	2,200	sdG	
GD119	10 25.0	+33 26	0.05-0.1	120	16.5	0	16.16	+0.51	-0.16	2,200	(WD)*	43
GD120	10 25.8	+36 21	0.05-0.1	160	15.0	0	14.05	+0.45	-0.13	1,200	(sd?)	
G43-54	10 26.6	+11 43	0.62	127	17.1	0	16.48	+0.72	+0.26	1,200	(WD)	48
GD121	10 28.1	-09 47	0.20.27	225	14.5	0	13.52	+0.48	-0.18	1,200	(WD)*	150:
GD122	10 29.3	+32 56	0.1-0.2	215	15.5	0	16.07	0.00	-0.88	1,200	(WD)	10
G162-66	10 31.2	-11 26	0.31	258	13.7	0	12.97	-0.15	-1.02	2,200	DA	38
L825-14			0.33	260	12.7	a						
GD123	10 36.4	+46 24	0.05-0.1	170	14.0	0	13.15	+0.55	-0.04	2,100	(sd?)	

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G44-32	10 39.2	+14 32	0.31	149	15.4	0	16.55	+0.29	-0.56	3,200	(WD)	15
G163-B9B	10 43.6	-03 24	0.08	115	15.6	0	15.32	+0.43	-0.21	2,200	Gp	
GD124	10 46.0	-01 45	0.1-0.2	195	16.0	0	15.81	-0.03	-0.88	1,200	(WD)	11
GD125	10 52.0	+27 23	0.1-0.2	270	14.0	-1	14.12	-0.08	-0.98	2,84	(WD)	22
G163-27	10.55.1	-07 15	0.82	277	14.9	0	14.28	+0.32	-0.51	3,200	DA	88
L898-25			0.80	275	14.4	-						
G163-28	10 55.2	-03 55	0.36	126	16.0	0	16.53	+0.40	-0.46	1,200	(WD)	33
GD126	10 56.2	-01 22	0.20.27	170	13.0	0	12.92	+0.48	-0.18	2,84	(sd?)	
BPM74316			0.166	171								
G119-47	10 56.7	+34 31	0.33	217	15.3	0	15.58	-0.11	-0.70	1,100	(WD)	16
G147-12			0.29	217	15.5	-1						
GD127	11 02.7	+00 33	0.2-0.27	290	16.0	0	15.25	+0.14	-0.63	1,200	(WD)	29
G10-IN	11 04.5	+04 22	0.37	184	16.1	0	17.03	+0.15	-0.74	1,200	(WD)	12
G10-IS			0.22	184	16.0	0	16.96	+0.11	-0.78	2,200	(WD)	12
G163-50	11 05.5	-04 53	0.43	185	13.7	0	12.92	+0.09	-0.69	3,200	DA	83
L970-30			0.43	180	12.6	-						
G56-17	11 06.1	+08 18	0.34	148	16.2	0	16.08	+0.31	-0.55	1,200	(WD)	19
GD128	11 07.3	+26 35	0.1-0.2	140	15.5	0	15.89	-0.07	-0.99	1,200	DB	10
L1403-379			0.20	144	15.2	-						
GD129	11 08.6	+47 35	0.2-0.27	220	15.5	-1	15.38	+0.15	-0.63	1,200	(WD)	27
GD130	11 12.1	+29 20	0.2-0.27	170	13.0	0	12.80	+0.45	-0.10	1,200	(sd?)	
L1403-9			0.22	172	11.9	-						
G45-45	11 14.1	+06 44	0.28	174	16.9	0	16.74	+0.46	-0.38	1,200	(WD)	28
GD131	11 15.2	+03 21	0.05-0.1	315	16.0	-1	15.39	+0.10	-0.57	1,200	(WD)	26
G10-11	11 15.7	-02 58	0.58	302	15.0	0	15.30	+0.09	-0.76	3,200	DC?	28
G163-73			0.58	294	15.5	-1						
L971-14			0.54	293	14.9	-						
GD132	11 16.0	+24 35	0.05-0.1	220	14.0	0						
BPM87278			0.165	224								

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G147-43	11 16.3	+28 53	0.27	286	15.9	o	16.56	+0.25	-0.58	1,200	(WD)	15
GD133	11 16.6	+02 37	0.05-0.1	300	15.0	0	14.57	+0.19	-0.59	1,200	(WD)	38
BPM87291			0.108	331								
GD134	11 16.8	+27 52	0.1-0.2	160	14.0	0	13.95	+0.43	-0.26	1,84	(sd?)	
BPM87295			0.114	180								
GD135	11 17.0	-02 23	0.2-0.27	280	15.0	0	14.46	+0.09	-0.66	1,200	(WD)	40
GD136	11 19.4	-04 35	0.1-0.2	140	14.0	0	13.71	+0.45	-0.16	1,200	(sd?)	
GD137	11 21.0	+24 10	0.1-0.2	170	16.0	0	16.25	+0.28	-0.53	1,200	(WD)	18
G120-45	11 21.6	+21 38	1.07	272	14.5	0	14.24	+0.31	-0.52	Harris	DF	90
R267			1.00	271	13.9	-						
GD138	11 31.1	+33 18	0.2-0.27	150	16.0	0	16.68	+0.23	-0.64	1,200	(WD)	14
LP265-19			0.16	157	15.7	a-f						
G122-31	11 32.1	+47 05	0.29	227	16.1	-1	16.38	+0.03	-0.92	1,200	(WD)	8
GD139	11 32.1	+21 47	0.05-0.1	240	15.5	0						
GD140	11 34.5	+30 05	0.1-0.2	260	12.5	-1	12.50	-0.06	-0.98	2,84	DA	46
GD142	11 42.2	+36 58	0.05-0.1	170	14.5	-1	15.07	+0.06	-0.52	1,84	(WD)	32
G148-7	11 43.4	+32 06	0.28	203	14.1	0	13.68	+0.05	-0.66	4,200	DA	58
G11-23	11 45.4	+08 04	0.31	256	15.1	0	15.93	+0.15	-0.75	1,200	(WD)	21
G57-20			0.34	244	15.5	0						
GD143	11 46.4	+19 24	0.05-0.1	130	15.0	0	14.42	+0.58	-0.16	1,200	(sd?)	
G121-22	11 47.8	+25 35	0.37	253	15.7	-1	15.55	+0.23	-0.58	4,100	DA	25
G148-12			0.34	262	15.3	-1						
L1405-40			0.30	259	15.8	-						
GD145	11 52.3	+22 46	0.05-0.1	220	15.5	0	14.58	+0.45	-0.22	1,200	(sd?)	
G57-29	11 54.2	+18 39	0.44	272	16.0	-	15.54	+0.30	-0.60	2,200	DC	25
G121-33			0.30	275	15.5	0						
L1261-24			0.32	274	15.8	g						
G122-61	11 57.5	+43 52	0.33	258	15.7	-1	15.71	+0.30	-0.57	1,200	(WD)	23

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G11 -33	11 57.9	-03 48	0.61	145	16.9	0	15.40	+0.94	+0.54	1,200	(WD)	100
GD146	12 00.6	+21 18	0.1-0.2	280	16.0	0	15.34	+0.61	-0.09	1,200	(WD)*	70
GD147	12 01.6	+30 42	0.05-0.1	190	16.5	0						
G13-6	12 02.4	+04 37	0.29	225	15.4	0	15.04	+0.64	-0.12	1,200	(WD)	83
G 148-B4B	12 15.0	+32 22	0.20	238	16.7	0	17.00	+0.35	-0.49	2,200	(WD)	25
GD265	12 23.2	+45 36	0.05-0.1	185	15.5	0						
GD148	12 32.6	+47 54	0.2-0.27	145	14.5	-1	14.52	+0.06	-0.68	2,84	DA	40
GD266	12 35.5	+37 47	0.1-0.2	180	16.0	0	15.62	+0.60	-0.11	1,200	(WD)	60
GD149	12 36.6	+31 46	0.1-0.2	170	15.5	0	14.52	+0.64	-0.05	1,200	(sd:)	
LP321-74			0.27	182	13.7	g						
G61-17	12 44.8	+14 59	0.44	300	16.4	0	15.86	+0.22	-0.53	3,200	DA	21
G149-8			0.48	294	16.5	0						
G60-38B	12 47.5	+04 15	0.00	-	16	0	16.71	-0.02	-1.13	1,200	?	
GD150	12 49.8	+16 01	0.1-0.2	130	15.0	-1	14.63	-0.27	-0.96	1,60	?	
BPM88529			0.143	131								
GD151	12 49.9	+18 13	0.05-0.1	320	15.5	0	15.48	-0.08	-0.85	1,200	(WD)	12
GD152	12 51.9	+39 01	0.1-0.2	150	15.0	0	14.57	+0.59	-0.06	1,200	(sd?)	
GD153	12 54.6	+22 18	0.1-0.2	185	13.0	0	13.42	-0.25	-1.18	1.60	DA	26
L1336-41			0.20	178	13.0	a						
GD267	12 57.3	+04 48	0.05-0.1	210	15.0	0	15.05	-0.09	-0.88	1,200	(WD)	14
G149-28	12 57.4	+27 50	0.34	273	15.6	0	15.40	+0.28	-0.58	1,200	DA	26
L1408-19			0.28	305	15.6	a						
G60-54	12 57.6	+03 45	1.00	208	16.0	0	15.90	+0.64	-0.09	John.	DC	55
G62-3			1.00	198	16.8	+1						
W457			1.05	210	16.0	-						

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G61-29	13.03.8	+18 17	0.38	286	16.2	-1	15.69	-0.10	-0.97	1,100	(WD)	11
G149-37			0.32	274	15.8	0						
GD268	13 04.9	+15 00	0.05-0.1	270	16.0	0	17.06	-0.05	-0.99	1,200	(WD)	10
BPM88763			0.121	300								
G164-46	13 06.2	+40 43	0.27	232	14.7	0	14.00	+0.80	+0.22	2,200	(WD)	160
GD154	13 07.6	+35 26	0.2-0.27	290	15.5	-1	15.33	+0.18	-0.59	1,200	(WD)	27
GD155	13 08.8	+38 11	0.05-0.1	170	16.0	0	15.54	+0.56	-0.09	1,200	(sd?)	
GD156	13 17.0	+20 34	0.05-0.1	230	16.5	0	16.29	+0.48	-0.17	1,200	(WD?)	42
G177-31	13 17.1	+45 21	0.53	289	13.9	0	14.13	+0.03	-0.56	1,200	DA	48
G177-34	13 19.1	+46 39	0.27	288	14.6	0	14.55	0.00	-0.66	1,200	(WD)	25
G63-26	13 22.1	+20 43	0.29	191	11.0	0	12.20	+0.45	-0.16	Kowal	(sd?)	
L1337-49			0.25	200	12.8	g						
GD157	13 23.0	+37 01	0.05-0.1	170	15.5	0	13.24	+0.44	-0.21	1,100	(sd?)	
G165-7	13 28.7	+30 45	0.58	263	16.0	0						
G62-46	13 30.3	+01 33	0.27	169	16.9	0	17.11	+0.38	-0.47	1,200	(WD)	25
GD269	13 30.8	+03 36	0.05-0.1	225	16.0	-1	15.86	+0.01	-0.79	1,200	(WD)	21
CPM89123			0.171	232								
GD270	13 32.0	-01 25	0.05-0.1	180	16.0	0						
G165-18	13 34.3	+36 39	0.27	231	15.9	0	16.31	+0.40	-0.51	1,200	(WD)	35
GD158	13 39.5	+26 13	0.05.0.1	150	13.5	0	12.82	+0.16	+0.01	1,200	?	
G63-54	13 45.0	+10 37	0.84	267	15.7	0	15.10	+0.30	-0.47	1,100	(WD)	60
G65-1			0.91	263	15.8	0						
G63-57	13 46.6	+14 35	0.28	207	16.5	0	16.68	+0.20	-0.56	1,200	(WD)	15
G150-43	13 47.5	+28 10	0.30	278	16.3	0	16.32	+0.33	-0.59	1,200	(WD)	17
GD159	13 50.6	+18 33	0.05-0.1	250	13.0	0	12.81	+0.20	-0.02	1,200	?	
GD160	13 54.7	+26 26	0.1-0.2	175	16.0	0	15.20	+0.63	-0.13	1,200	(WD)	76

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G165-B5B	13 54.9	+34 03	0.14	275	15.8	-1	16.16	+0.08	-0.68	4,200	DA	19
GD161	14 00.7	+21 01	0.05-0.1	180	15.0	0	14.96	+0.46	-0.24	1,200	(sd?)	
GD271	14 03.8	+12 22	0.05-0.1	250	16.0	0	14.36	+0.67	-0.03	1,200	(sd?)	
G64-43	14 03.8	-01 05	1.29	259	16.0	-1	15.80	-0.05	-0.99	1,200	(WD)	10
GD162	14 06.6	+13 57	0.05-0.1	220	15.0	0	15.40	+0.46	-0.25	1,200	(sd?)	
GD163	14 08.3	+32 23	0.2-0.27	175	14.0	-1	14.06	0.03	-0.81	1,200	DA	25
L1484-18			0.25	180	13.8	a						
G135-29	14 11.5	+15 41	0.31	259	15.7	0	16.20	+0.07	-0.65	4,200	DA	18
LP439-356			0.28	270	14.4	a						
G166-14	14 13.4	+23 11	0.27	283	15.9	0	16.41	-0.10	-0.95	1,200	(WD)	7
L1340-24			0.25	278	15.5	a						
GD164	14 13.6	+28 22	0.05-0.1	300	16.0	0	15.71	+0.62	-0.10	1,200	(sd?)	
G124-20	14 15.4	-06 26	0.27	226	15.8	0	16.20	+0.07	-0.86	1,200	(WD)	18
G124-26	14 18.3	-08 52	0.56	272	15.7	0	15.48	+0.31	-0.59	1,200	(WD)	25
GD165	14 22.2	+09 31	0.2-0.27	230	14.5	0	14.32	+0.14	-0.59	1,200	(WD)	44
L1124-10			0.25	235	13.6	-						
GD166	14 23.1	+21 55	0.05-0.1	230	15.5	0	15.25	+0.41	-0.23	1,200	(sd?)	
GD167	14 33.0	+14 42	0.05-0.1	140	16.0	-1	14.19	+0.53	-0.03	1,100	(sd?)	
GD168	14 34.4	+15 55	0.05-0.1	240	16.0	-1	16.58	0.00	-0.74	1,200	(WD)	15
GD169	14 38.9	+15 58	0.05-0.1	205	14.0	0	14.16	+0.51	-0.19	1,200	(sd?)	
GD170	14 40.6	+09 58	0.05-0.1	160	14.5	0	13.95	+0.44	-0.13	1,200	(sd?)	
GD172	14 48.3	+18 57	0.05-0.1	225	16.0	0	15.34	+0.60	-0.16	1,200	(sd?)	
G66-32	14 48.4	+07 46	0.91	245	15.8	-1	15.47	+0.02	-0.67	Harris	DA	25
G136-22			0.97	242	15.2	0						
L1126-66			0.94	243	15.3	-						
GD173	14 51.3	+00 38	0.1-0.2	260	15.0	-1	15.29	-0.14	-0.96	1,200	(WD)	13
G166-58	14 56.0	+29 50	0.69	162	15.6	0	15.61	+0.31	-0.59	1,100	(WD)	24
G167-8			0.66	165	15.7	0						

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
GD175	15 03.2	-07 03	0.1-0.2	260	15.5	0	15.91	+0.40	-0.42	1,200	DA	44
GD176	15 07.8	-10 34	0.1-0.2	270	15.0	0	15.42	+0.23	-0.50	1,200	(WD)	26
GD177	15 09.0	+0.7 26	0.05-0.1	260	13.0	0	11.78	40.46	-0.06	1,200	sdG	
GD178	15 09.4	+32 16	0.1-0.2	300	15.0	0	14.11	+0.09	-0.65	1,200	DA	48
GD179	15 10.0	-09 35	0.1-0.2	260	15.5	0	16.16	+0.23	-0.54	1,200	(WD)	18
GD180	15 18.5	-06 54	0.1-0.2	175	15.5	0	14.57	+0.58	-0.14	1,200	(sd?)	
GD181 BPM90669	15 19.0	+15 42	0.05-0.1 0.106	150 168	14.0	0	13.40	+0.62	0.00	2,60	(sd?)	
GD182	15 21.6	-12 41	0.2-0.27	250	14.0	0	13.52	+0.70	-0.07	1,60	(WD?)	165:
G15-24 G16-2 G37-11	15 28.3	+08 34	0.42 0.38 0.43	261 245 260	11.6 12.4 12.2	0 +1 +1	11.43	+0.57	-0.11	Sand.	(sd?)	
GD183	15 29.7	+11 08	0.05.0.1	190	16.0	0	15.40	+0.56	-0.18	1,200	(sd?)	
GD184	15 29.8	+14 06	0,2-0,27	170	16.0	0	15.74	+0.52	-0.15	1,200	(WD)	55
GD185 BPM77964	15 31.5	-02 17	0.1-0.2 0.136	200 202	14.5	-1	14.03	0.00	-0.81	1,200	DA	25
GD186	15 31.6	+18 29	0.1-0.2	190	16.0	0	16.20	+0.16	-0.58	1,200	(WD)	18
G137-24	15 32.8	+12 58	0.28	222	15.7	0	15.07	+0.24	-0.63	1,200	(WD)	20
GD187 L1488-33	15 38.6	+33 18	0.2-0.27 0.23	320 298	16.0 15.2	0 -						
GD188	15 39.5	+25 33	0.1-0.2	150	15.0	0	15.50	+0.14	-0.79	1,60	(WD)	25
GD189	15 39.6	-03 32	0.1-0.2	110	15.5	-1	15.20	+0.25	-0.55	1,100	(WD)	29
GD190	15 42.1	+18 16	0.05-0.1	165	15.0	-1	14.72	-0.10	-1.00	1,100	DB	16
G179-54 G180-5	15 44.3	+39 24	0.29 0.27	299 299	14.6 14.5	+1 0	13.51	+0.62	-0.14	1,100	(sd?)	

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
GD191	15 47.4	-12 41	0.1-0.2	255	14.5	0	13.11	+0.49	-0.05	1,60	(sd?)	
BPM78174			0.145	239								
GD192	15 49.6	-11 55	0.05-0.1	265	16.0	0	14.71	+0.61	-0.10	1,100	(sd?)	
GD193	15 49.8	+20 07	0.1-0.2	180	16.0	0	16.19	+0.07	-0.83	1,200	(WD)	18
GD194	15 50.2	+18 19	0.1-0.2	310	14.5	0	14.83	+0.11	-0.84	1,200	(WD)	35
L1273-18			0.23	311	14.9	-						
G152-B4B	15 55.4	-09 00	0.12	198	15.6	-1	14.80	+0.09	-0.63	3,100	DA	35
G180-23	15 59.6	+36 57	0.62	169	14.8	0	14.36	+0.17	-0.56	John.	DA	42
R808			0.57	167	14.4	-						
GD195	16 05.5	+17 45	0.1-0.2	160	16.0	0	16.68	+0.17	-0.49	1,200	(WD)	15
G138-8	16 09.1	+13 30	0.59	181	14.3	0	15.10	+0.23	-0.65	1,200	DA	30
GD196	16 10.8	+16 40	0.2-0.27	225	15.0	-1	15.82	+0.04	-0.63	1,100	(WD)	22
BPM91358			0.176	219								
GD197	16 11.3	-04 41	0.05-0.1	180	16.5	-1	15.81	+0.70	-0.02	1,200	(sd?)	
GD198	16 12.6	-11 11	0.05-0.1	135	15.5	-1	15.53	-0.11	-0.94	1,200	DB	12
G153-40	16 14.7	-12 50	0.27	212	15.1	-1	15.00	+0.10	-0.75	5,40	DA	32
L842-32			0.25	193	15.0	a						
G153-41	16 15.0	-15 28	0.27	228	13.2	-1	13.42	-0.21	-1.04	3,60	DA.	NOTE
L770-3			0.25	223	12.5	a						
GD199	16 18.6	-04 14	0.05-0.1	240	15.5	0	14.71	+0.68	-0.04	1,200	(sd?)	
GD200	16 20.5	+26 02	0.05-0.1	225	15.0	0	15.53	-0.17	-1.08	1,60	?	
G138-31	16 25.5	+09 19	0.53	193	15.7	0	16.14	+0.39	-0.50	1,200	(WD)	37
G180-57	16 26.6	+36 52	0.86	322	14.5	0	14.64	+0.22	-0.58	Harris	DF	38
G17-21	16 28.0	+04 18	1.57	99	8.4	0	7.29	+0.53	-0.10	Kowal	F7	
+4°3195			1.47	198	7.8	-						
GD201	16 29.2	+29 15	0.05-0.1	180	16.0	0						
G138-47	16 35.4	+13 47	0.27	186	16.5	0	16.90	+0.41	-0.50	1,200	(WD)	26
GD202	16 36.4	+16 00	0.05-0.1	160	15.5	-1	15.60	+0.14	-0.63	1,200	(WD)	24

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G138-56	16 39.6	+15 19	0.72	179	15.7	0	15.66	+0.35	-0.57	1,200	DA	23
G169-34	16 55.0	+21 32	0.58	174	15.1	0	14.08	+0.24	-0.62	2,100	DA	48
G170-2			0.64	179	14.0	0						
GD203	16 55.0	+21 01	0.2-0.27	230	16.5	-1	16.60	-0.21	-1.18	1,200	(WD)*	10
GD204	16 59.1	+21 00	0.1-0.2	230	14.5	0	14.10	+0.54	-0.17	1,60	(sd?)	
G139-13	17 05.6	+03 02	0.43	181	15.2	0	15.21	+0.45	-0.28	1,200	(WD)	66
G181-B5B	17 07.0	+33 17	0.14	170	16.0	0	15.92	+0.17	-0.55	1,200	DA	21
GD205	17 09.8	+23 05	0.1-0.2	170	15.0	-1	14.90	-0.09	-0.98	1,200	(WD)	15
BPM92077			0.162	168								
GD206	17 10.5	+19 47	0.05-0.1	215	16.0	0	15.08	+0.65	-0.04	1,200	(sd?)	
G170-27	17 12.4	+21 31	0.32	195	16.4	0	16.51	+0.32	-0.52	1,200	(WD)	32
G19-20	17 16.1	+02 00	0.64	238	14.8	0	14.62	+0.13	-0.59	5,100	DA	38
W672			0.59	232	14.3	-						
GD208	17 28.0	+13 49	0.1-0.2	100	15.0	0	15.10	+0.23	-0.56	1,200	(WD)	30
GD209	17 30.7	+24 11	0.05-0.1	215	16.0	0	15.40	+0.51	-0.18	1,200	(sd?)	
GD210	17 32.0	-13 57	0.165	200	13.0	0	13.03	+0.43	+0.12	4,40	sdA	
BPM79017			0.165	204								
GD211	17.35.8	+09 15	0.1-0.2	190	14.5	0	14.22	+0.64	-0.06	2,60	sdG	
G140-2	17 36.2	+05 18	0.28	187	15.5	0	15.89	+0.21	-0.55	1,200	(WD)	21
GD212	17 40.4	+24 34	0.05-0.1	185	15.5	0	14.02	+0.58	-0.06	1,200	(sd?)	
GD213	17 41.4	-21 12	0.05-0.1	220	14.5	0	12.87	+0.50	-0.17	1.60	sdG	
BPM92589			0.082	191								
G154-B5B	17 43.1	-13 17	0.09	25	15.5	-1	14.29	+0.30	-0.45	5,100	DA	89
G154-23	17 45.8	-16 21	0.29	222	16.4	0	16.09	+0.40	-0.54	1,200	(WD)	38
G140-B1B	17 50.6	+09 49	0.10	174	16.0	0	15.72	+0.10	-0.78	2,200	DC	23
G141-2	18 18.2	+12 37	0.28	19	15.7	0	15.89	+0.54	-0.17	1,200	(WD)	50
L1208-132			0.29	21	15.6	-						

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B−V	U−B	n,T	Sp.	π
G155-15	18 21.3	−13 10	0.62	196	15.8	0	15.60	+0.42	−0.60	1,200	DA	48
G21-15	18 24.8	+04 02	0.41	222	13.7	−2	13.90	+0.05	−0.55	2,100	DA	52
G141-11			0.42	225	14.1	−1						
R137			0.37	218	13.6	a						
G21-16	18 26.5	−04 32	0.32	175	15.2	−1	14.54	+0.24	−0.56	3,100	DA	40
L993-18			0.27	191	15.5	b						
G155-19	18 27.9	−10 39	0.32	140	15.9	−1	14.25	+0.14	−0.63	1,200	DA	44
GD214	18 37.1	+15 05	0.05−0.1	210	14.5	0	13 52	+0.81	+0.07	2,60	(WD)	180
G155-24	18 40.2	−11 12	0.41	224	15.1	−1	14.18	+0.15	−0.61	1,100	DA	46
L894-15			0.23	224	14.4	g						
GD215	18 41.0	+04 17	0.1−0.2	300	15.0	−1	14.73	+0.25	−0.62	1,200	(WD)	36
GD216	18 47.0	−10 01	0.2−0.27	170	16.0	−1	14.25	+0.14	−0.63	1,200	(WD)	45
L922-82			0.22	175	14.4	f						
G22-8	18 53.7	−04 29	0.29	192	15.1	0	13.54	+0.97	+0.35	4,100	(WD?)	220:
L992-8			0.22	193	14.5	k						
G141-54	18 57.5	+11 54	0.27	42	15.4	−1	15.52	+0.20	−0.57	3,200	DA	25
GD217	19 01.4	+13 28	0.05−0.1	190	14.0	0	13.59	+0.70	−0.14	1,100	sdG	
G142-B2A	19 11.3	+13 31	0.10	180	14.5	0	14.00	+0.12	−0.60	2,200	DA	50
G142-20	19 12.3	+14 23	0.44	196	16.0	0	14.25	+0.74	+0.19	1,200	(WD)	135
G125-3	19 17.2	+38 38	0.30	181	15.2	0	14.54	+0.45	−0.39	1,200	(WD)	85
GD218	19 18.2	+11 05	0.05−0.1	150	16.0	−1	16.23	−0.11	−0.86	1,200	(WD)	9
GD219	19 19.4	+14 35	0.05−0.1	200	13.0	0	13.01	+0.06	−0.66	1,100	DA	79
BPM94172			0.088	179								
GD220	19 21.6	+11 41	0.1−0.2	215	16.0	−1						
GD221	19 25.1	+10 01	0.2−0.27	210	15.0	0						
R749			0.33	213								

TABLE 1—*Continued*

Name	α (1950) δ		μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G185-72	19 35.2	+27 36	0.46	87	13.7	0	13.00	+0.17	-0.57	1,100	(WD)	79
GD222	19 36.6	+32 46	0.1-0.2	200	13.5	0	13.58	-0.12	-0.88	1,100	(WD)	69
BPM94484			0.119	208								
GD223	19 38.3	+35 06	0.2-0.27	25	16.0	0	16.27	+0.35	-0.60	1,200	(WD)	18
GD224	19 41.5	+12 28	0.1-0.2	160	15.0	0	14.08	+0.88	+0.39	1,200	(WD?)	170:
GD225	19 41.9	+08 47	0.2-0.27	200	15.0	0	13.76	+0.69	-0.02	1,200	(sd?)	
L1140-73			0.22	209	14.1	a						
G142-50	19 43.3	+16 20	0.29	180	14.5	-1	14.08	-0.06	-0.86	2-200	DA	23
G143-6			0.28	184	14.6	0						
L1285-97			0.24	180	13.3	-						
G92-40	19 53.9	-01 10	0.78	213	14.5	0	13.69	+0.25	-0.60	2,100	DA	57
L997-21			0.84	213	13.7	-						
GD226	19 59.8	+05 59	0.1-0.2	240	16.5	0	16.41	+0.15	-0.56	1,200	(WD)	16
GD228	20 05.0	+05 44	0.05-0.1	190	14.0	0					sdG	
BPM95033			0.095	199								
GD229	20 10.4	+31 05	0.05-0.1	20	14.5	0						
GD230	20 29.8	+18 21	0.2-0.27	80	16.5	0	16.31	+0.16	-0.59	1,200	(WD)	17
L1287-49			0.28	79	16.0	-						
GD231	20 33.0	+18 49	0.1-0.2	175	15.5	-1	15.34	-0.04	-0.80	1,200	(WD)	14
BPM95701			0.181	170								
GD232	20 59.0	+18 09	0.05-0.1	100	15.5	-1	15.03	+0.01	-0.75	1,200	(WD)	31
G144-51	20 59.8	+19 01	0.31	201	15.8	0						
G145-4			0.31	199	15.9	0						
G26-10	21 29.7	+00 02	0.34	81	14.7	+1	14.73	-0.07	-0.92	3,100	DB	16
G93-21			0.44	88	15.1	-1						
L1002-16			0.41	87	14.2	-						
GD233	21 31.0	-04 50	0.2-0.27	90	15.0	0	14.50	-0.05	-0.73	1,20	(WD)	40
1930-1			0.24	83	14.4	a						
GD234	21 34.3	+21 51	0.1-0.2	285	14.5	-1	14.45	-0.04	-0.83	1,200	(WD)	20

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G126-18	21 36.5	+22 56	0.33	68	15.8	0						
G145-56			0.27	76	15.7	+1						
GD235	21 39.0	+11 33	0.2-0.27	80	16.0	0	15.81	+0.08	-0.68	1,200	(WD)	22
G126-25	21 39.7	+13 15	0.35	110	16.3	0						
G126-27	21 40.4	+20 47	0.73	202	14.8	0	13.27	+0.17	-0.72	3,100	DC	70
G145-63			0.70	188	13.4	0						
L1363-3			0.66	201	13.6	-						
G26-31	21 45.0	-07 58	0.30	121	14.3	0	14.80	-0.06	-0.96	1,100	DB	16
L930-80			0.39	114	14.2	-						
G93-48	21 49.9	+02 09	0.33	182	13.9	0	12.77	0.00	-0.78	2,60	DA	88
G93-53	21 51.5	-01.31	0.29	177	14.9	0	14.41	+0.26	-0.51	1,200	DA	42
L1003-16			0.26	181	14.7	a						
GD272	21 57.2	+16 11	0.1-0.2	85	16.0	-1	16.19	-0.04	-0.81	1,200	(WD)	9
G18-34	22 07.4	+14 15	0.43	44	16.3	0	15.61	+0.32	-0.58	1,200	(WD)	24
G126-57			0.38	52	15.7	0						
G18-39	22 16.1	+08 12	0.33	125	11.3	0	10.43	+0.48	-0.17	1,100	(sd?)	
W1032			0.30	118	11.3	g						
GD236	22 26.6	+06 07	0.2-0.27	240	15.5	-1						
GD237	22 31.0	+12 31	0.1-0.2	45	16.0	0						
GD238	22 34.3	+15 50	0.1-0.2	205	14.5	0						
GD240	22 40.2	-04 30	0.2-0.27	80	16.0	-1						
G28-13	22 40.5	-01 43	0.34	209	15.8	0	16.17	+0.28	-0.60	2,200	DA,F18	
GD241	22 45.2	+21 31	0.1-0.2	185	15.0	0						
G67-23	22 46.6	+22 20	0.51	86	14.4	-1	14.32	+0.21	-0.68	5,100	DA	43
G127-58			0.59	84	14.3	0						
G128-4			0.50	91	14.5	0						
G128-7	22 49.0	+29 24	1.28	83	15.7	0	15.55	+0.67	-0.16	1,200	(WD)	65

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G128-7	22 49.0	+29 24	1.28	83	15.7	0	15.55	+0.67	-0.16	1,200	(WD)	65
GD242	22 50.8	+23 42	0.05-0.1	235	12.0	0					sdG	
GD243	22 53.2	-06 17	0.05-0.1	90	15.5	0						
G156-64	22 53.2	-08 06	0.59	91	16.4	0	16.50	+0.42	-0.46	3,200	DA,F	33
GD244	22 54.3	+12 37	0.2-0.27	80	16.0	-1						
G28-27	22 54.9	-07 40	0.31	220	15.9	0	17.2:	+0.1:	-1.0:	3,100	λ4670	10:
GD245	22 56.4	+25 00	0.1-0.2	115	13.5	0						
G28-40 L1150-76	23 05.6	+08 53	0.27 0.26	94 92	12.0 12.2	0 g	11.32	+0.72	+0.16	Kowal	(sd?)	
GD246 BPM97859	23 09.8	+10 31	0.1-0.2 0.128	90 95	12.5	-1	13.11	-0.32	-1.23	1,100	sd0	
G157-34 L935-50	23 11.8	-06 49	0.47 0.31	243 245	15.6 15.4	0 a						
GD247 BPM82728	23 12.7	-07 16	0.05-0.1 0.103	160 165	15.0	0	14.27	+0.49	-0.09	1,40	(sd?)	
G29-23	23 17.1	+03 06	0.36	112	11.3	0	10.20	+0.43	-0.21	Kowal	(sd?)	
GD248	23 23.6	+15 44	0.05-0.1	210	14.5	-1	15.11	+0.09	-0.78	1,200	(WD)	30
GD249	23 24.3	+13 20	0.1-0.2	130	14.5	0						
G29-38	23 26.3	+04 58	0.56	237	13.7	0	13.10	+0.20	-0.65	2,100	DA	76
GD250	23 27.5	-07 05	0.05-0.1	100	15.0	0						
G171-2	23 29.2	+40 45	0.30	116	13.4	-1	13.82	+0.03	-0.72	1,200	DA	55
G128-72 L1440-18	23 29.6	+26 42	0.52 0.42	87 87	15.2 15.7	-1 a	15.25	+0.22	-0.58	1,200	DA	28
GD251	23 31.9	+29 02	0.1-0.2	215	15.5	-1						
G157-82	23 33.4	-04 59	0.27	227	15.9	-1						
GD252	23 37.0	-03 15	0.05-0.1	200	14.5	0	14.24	+0.47	-0.21	1,40	(sd?)	
G129-D1A	23 40.8	+14 30	0.06	227	15.1	0	14.37	+0.43	-0.23	4,100	sdF?	

TABLE 1—*Continued*

Name	α (1950)	δ	μ	θ	Pg	CC	V_E	B-V	U-B	n,T	Sp.	π
G130-5	23 41.4	+32 16	0.27	254	13.6	0	12.90	+0.15	-0.61	3,200	DA	83
L1512-34			0.24	256	12.8	a						
G29-65	23 45.3	+03 54	0.34	90	8.8	+1	7.70	+0.62	+0.13	2,20	(sd?)	
G31-12			0.39	104	9.5	0						
+3°4896			0.34	96	8.5	-						
G171-27	23 52.4	+40 11	0.60	157	15.1	0						

NOTE: G153-41 = L770-3 = EG118 is given with the incorrect magnitude in a previous paper (Eggen and Greenstein 1965a).

1967) are represented in Figure 1 by open boxes; the luminosities were obtained by fitting the main-sequence components to the age-zero main sequence after correcting for line blanketing. Two additional pairs, not previously described, are the following:

Name	V_E	$B-V$	$U-B$	n,T	δ	M_V	Source
+28°2229A...	10.24	+0.665	+0.12	2,200	+0.09	+ 5.5	Luyten 1964
B...	16.41	+ .45	− .20	1,200	....	+11.7	μ=0″.09
LDS 157A....	6.44	+ .58	+ .13	5,40	−0.02	+ 4.5	Luyten 1956
C....	14.09	−0.09	−0.95	6,40	....	+12.2	μ=0″.34

Previously (Eggen and Greenstein 1965*a*), $R - I$ observations of a number of additional pairs containing M-type main-sequence companions were used in the calibration of the luminosities of white dwarfs. These have not been used here because subsequently (Eggen 1968*a*), it has been found that for values of $R - I$ greater than about +0.9, the dispersion for all population types in the $(R - I, M_V)$ relation is more than one

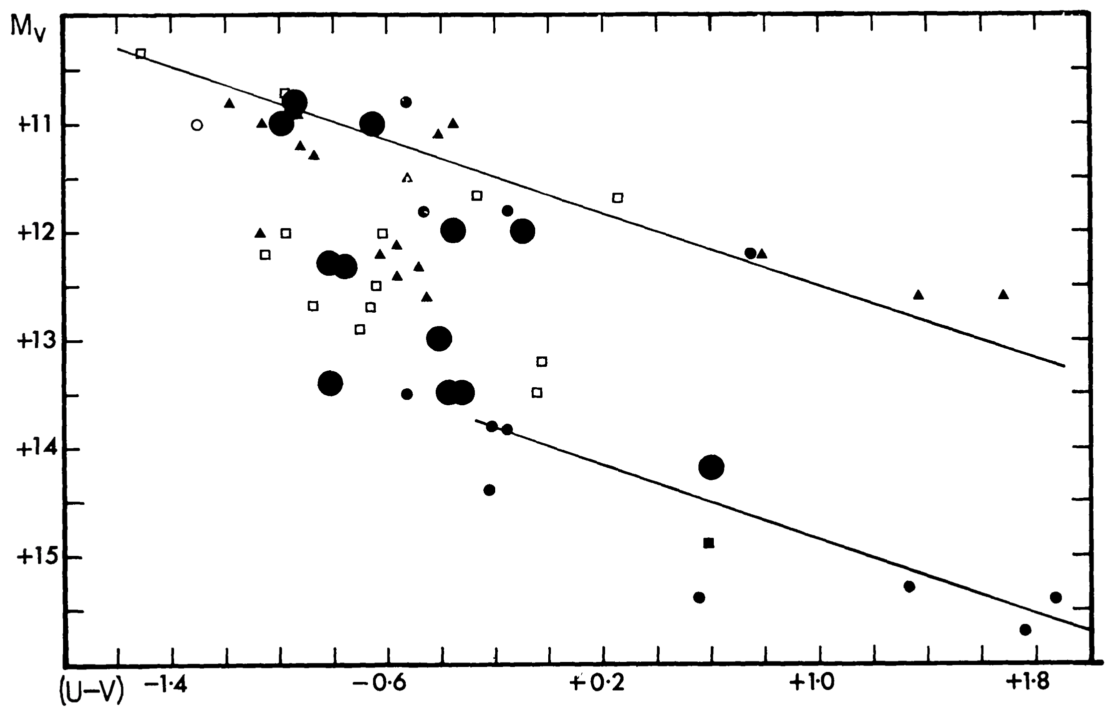

FIG. 1.—$(M_V, U - V)$ relation for white dwarfs with trigonometric parallaxes (weight greater than 20, *large dots*, smaller weights, *small dots*), Pleiades (*open circle*) and Hyades-Praesepe (*triangles*) cluster members, and components of binaries (*boxes*) with the brighter members bluer than $B - V = +1.1$.

TABLE A

NEW WHITE DWARFS IN THE HYADES CLUSTER

Name	V_E	$B-V$	$U-B$	M_V	Source
LP 475-42...........	14.94	−0.09	−0.95	+12.0	Luyten 1965*a*
VA 216.............	15.64	+ .96	+ .73	+12.6	van Altena 1966
VA 391.............	15.30	+0.70	+0.08	+12.2	van Altena 1966

magnitude, and this could introduce an equal dispersion into Figure 1. Six additional pairs of this type have been observed subsequently, and, although they are not used here for calibration purposes, they are listed in Table 2 for completeness.

Three pairs of special interest are in Table B. In LDS 500, which is a physical pair (Luyten 1961), either (*a*) both components are white dwarfs, one lying on the upper sequence and the other on the lower sequence in Figure 1, or (*b*) the fainter component is a subdwarf ($M_V = +6.2$), the brighter a subgiant ($M_V = +4.4$), and the transverse velocity is 425 km sec^{-1}, indicating a very old system. If the white dwarf companion to β TrA populates the ***upper*** sequence in Figure 1, then $M_V = +12.5$, and the brighter component, for which the spectral type is F2 IV, lies one magnitude above the main sequence, $M_V = +1.8$. The resulting photometric parallax is 0.063 compared with the single, low-weight, trigonometric determination of 0.078 (Cape). The spectra of the bright component of G163-B9 shows very broad lines (Eggen and Greenstein 1967). If the faint component is a subdwarf, $M_V = +4$, then the brighter star, $M_V = +0.1$, may be similar to the globular cluster stars that populate the red side of the horizontal branch; the resulting tangential velocity is 650 km sec^{-1}. The common proper motion of this pair should be confirmed.

TABLE 2

NEW PAIRS CONTAINING WHITE DWARF AND RED DWARF COMPONENTS

	V_E	$B-V$	$U-B$	n,T	μ	θ	Source
LTT 8767*.....	10.36	+1.51	+0.83	4,40	0.40	190	Luyten 1957
LTT 8768......	14.68	+0.16	−0.80	4,40	.40	190	....
LP 163-120.....	15.67	+1.56	....	1,200	.14	79	Luyten 1964
LP 163-121.....	18.16	+0.26	−0.55	1,200	.14	79	....
G161-36.......	15.22	+1.61	+1.25	2,200	.27	274	Giclas *et al.* 1964*b*
G161-37.......	14.79	+0.15	−0.58	2,200	.27	274	....
LP 435-59......	16.85	+1.52	....	1,200	.19	268	Luyten 1965*b*
LP 435-58......	17.20	+0.23	−0.55	1,200	.19	268	....
LP 135-155.....	15.78	+1.62	+1.41	1,200	.38	217	Luyten 1964
LP 135-154.....	16.29	+0.23	−0.58	1,200	.38	217	....
G138-46.......	13.97	+1.52	+1.24	1,200	.27	186	Giclas *et al.* 1963
G138-47.......	16.90	+0.41	−0.50	1,200	0.27	186	....

* This bright star may be composite: it appeared to be single in good seeing with the 40-inch reflector.

TABLE B

PAIRS OF SPECIAL INTEREST

Name	V_E	$B-V$	$U-B$	δ	n,T	μ	θ	Source
LDS 500A...	13.63	+0.61	−0.03	+0.27	1,40	0.13	254	Luyten 1941
B...	15.42	+ .66	− .08	+ .28	1,40	.13	254	....
β Tr A......	2.85	+ .30	+ .03	+ .04	3,40	.45	205	Luyten 1957
LTT 6333...	13.50	+ .86	+ .15	(+ .41)	2,40	.40	223	....
G163–B9A..	11.41	+ .62	− .01	+ .16	2,200	.08	115	Giclas, Burnham, and Thomas 1964*b*
B..	15.32	+0.43	−0.21	+0.21	2,200	0.08	115	....

In the discussions that follow, the adopted luminosities of the white dwarfs will be: for $U - V$ greater than -0.8, the upper sequence in Figure 1 will be used, $M_V = 11.65 + 0.85\ (U - V)$ (Eggen and Greenstein 1965*a*); for $U - V$ between -0.8 and -0.2, a mean value of $M_V = +12.5$ will be used; and for redder values of $U - V$, the lower sequence in Figure 1 will be adopted, $M_V = +14.0 + 0.85\ (U - V)$.

The available photometry for the blue horizontal-branch stars in several globular clusters gives the linear (M_V, $U - V$) relation shown in Figure 2. The clusters used are (*a*) NGC 6397, $E(B - V) = +0.10$, $m - M_V = 12.0$ (Eggen 1960; Searle and Rodgers 1966); (*b*) M15, $E(B - V) = +0.12$, $m - M_V = 15.0$ (Sandage 1964); and (*c*) M92, $E(B - V) = 0.00$, $m - M_V = 14.6$ (Sandage 1964).

The luminosities are available for three stars lying between the blue horizontal-branch stars and the white dwarfs. The (U,B,V) and (R,I) photometry of the SS Cyg variable, RU Peg, and its common proper-motion companion gives a luminosity of $M_V = +7$ and

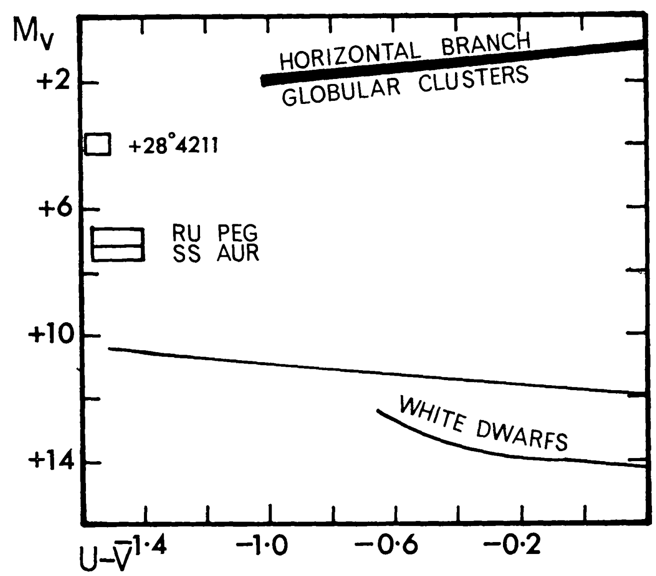

FIG. 2.—(M_V, $U - V$) diagram for faint blue stars

$(U - V) \sim -1.4$ for the blue component in the system (Eggen 1967*a*). As a member of the γ Leo group (Eggen 1959), the blue subdwarf BD + 28°4211 has a luminosity of $M_V = +4$ at $(U - V) = -1.6$. Another SS Cyg variable, SS Aur, is probably a member of the Hyades group. The proper motion of $(\mu_\alpha \cos \delta, \mu_\delta) = (+0.013, -0.025)$ (Luyten and Hughes 1965) and the systemic velocity of $+33$ km sec^{-1} (Kraft and Luyten 1965) give $(U,V,W) = (+37, -17, +9)$ for a modulus of 6.5 (200 pc); the Hyades cluster has $(U,V,W) = (+40, -17, -2)$. The light and color of SS Aur flicker rapidly, on a time scale of approximately 7 minutes, but no eclipses have been detected in the 4^h20^m period of the radial velocity variation (Mumford 1966). Median magnitude and colors, corrected for $E(B - V) = 0.30$, derived from neighboring stars, are $V = 13.80$, $B - V = -0.2$, and $U - B = -1.3$ (Mumford 1966). Membership in the Hyades group then gives $M_V = +7.3$, $(U - V) = -1.5$. The position of +28°4211, RU Peg and SS Aur are shown in Figure 2. It should be noted that if the red component in the system of SS Cyg is, like that in RU Peg, a main-sequence star, then the blue star in this system will lie between +28°4211 and RU Peg in Figure 2 (Eggen 1967*a*). Another possible, blue subdwarf is star "J" (Baum, Hiltner, Johnson, and Sandage 1959) in M13 for which $V = 19.8$ and $B - V = -0.23$. If the value for $(U - B)$ is "normal" and we adopt a modulus of 14.7 and $E(B - V) = 0$ for the cluster (Sandage 1964), $M_V = +5.2$ and $(U - V) \sim -1.1$.

The stars in Figure 2 represent a number of populations with the horizontal branch (HB) exclusively defined by halo population objects and the white dwarfs (WD) and, probably, the blue subdwarfs (sdOB) and SS Cyg (SS) stars containing both disk and halo population objects. The HB stars are indistinguishable, by (U,B,V) color alone, from the normal young disk population O- and B-type stars (Eggen 1960; Sandage and Walker 1966). Also, the bluest HB stars, the sdOB stars, and the bluest WD's cannot be separated by color alone. Because the black-body relation in the $(U - B, B - V)$ plane intersections the normal $(U - B, B - V)$ relation near $B - V = -0.3$, and $U - B = -1.2$, values of $E(B - V)$ greater than about 0.1 can cause a sdO or blue HB star to mimic the colors of a WD.

III. THE GICLAS STARS

The 461 stars with color class 0 or -1 found in the first 180 fields of the Lowell proper-motion survey (Giclas, Slaughter, and Burnham 1959; Giclas, Burnham, and Thomas 1961, 1963, 1964*a*, *b*, 1965) are listed in Table 1. The star numbers preceded by "G" indicate objects found to have annual proper motions of 0".27 or larger, whereas "GD" indicates those with small motions. The published GD stars cover only 111 of the survey fields. When other designations and measured motions are available (mainly from Luyten's Bruce Proper-Motion Survey), they are also indicated. For 347 (75 per cent) of these objects, photoelectric (U,B,V) photometry is available. The number of photoelectric observations and the aperture of the telescope used are given in the column "n,T". Spectral types, mainly by Greenstein (Eggen and Greenstein 1965*a*,*b*, 1967; and Greenstein 1966), are available for some of these stars.

The distribution of the stars in the $(U - B, B - V)$ plane is shown in Figure 3, where they are divided into groups according to the annual proper motion. The continuous curves in Figure 3 represent the age-zero relation for disk population stars (Eggen 1965) and the straight lines represent the black-body relation (Mathews and Sandage 1963). Stars brighter than $V_E = 14$ are represented by filled circles, between 14 and 15 by open circles, and fainter than 15 by triangles.

From previous discussions (Eggen and Greenstein 1965*a*, 1967) it is apparent that in the range of $B - V$ between about -0.1 and $+0.4$, the WD's can generally be recognized from the colors alone. As discussed in § II, above, the bluer WD's can be confused with the sdOB and HB stars. There is also some difficulty for the redder stars because the region of the $(U - B, B - V)$ plane occupied by the F- and G-type subdwarfs (sdFG) overlaps with that for the WD's, although, in general, stars displaced more than 0.3 in $U - B$ from the main-sequence $(U - B, B - V)$ relation are probably WD's. Therefore, for the present purposes, we will designate stars with greater displacement as WD's on the basis of color alone.

Stars that are almost certainly white dwarfs, on the basis of their colors alone, are designated (WD) in Table 1. Those that populate the region of the sdFG stars in Figure 3 are listed as sd?, and the few stars that lie near the "normal" $(U - B, B - V)$ relation, but well below the black-body relation, are listed as "HB". The stars bluer than $(U - B) = -1.1$ that lie near the intersection of the black-body and normal relations in Figure 1 are indicated by "?" in Table 1. The parallaxes of the known and supposed WD's have been derived from the luminosity calibration given in § II. Possible reddening corrections have been ignored. Although the procedure outlined above for selecting white dwarfs will overlook many such stars, especially the later types that are indistinguishable from sdFG stars, it will lead to an estimate of the minimum density of WD's. In three or four cases in Table 1, which are designated "WD*," the colors would permit the classification "sd?," but the resulting transverse motion would be greater than 600 km sec^{-1}.

The distribution of the stars in Table 1 among WD (shaded), sd? (hatched), and "?" (open) is shown in Figure 4 for each of the proper-motion groups in Figure 3. The

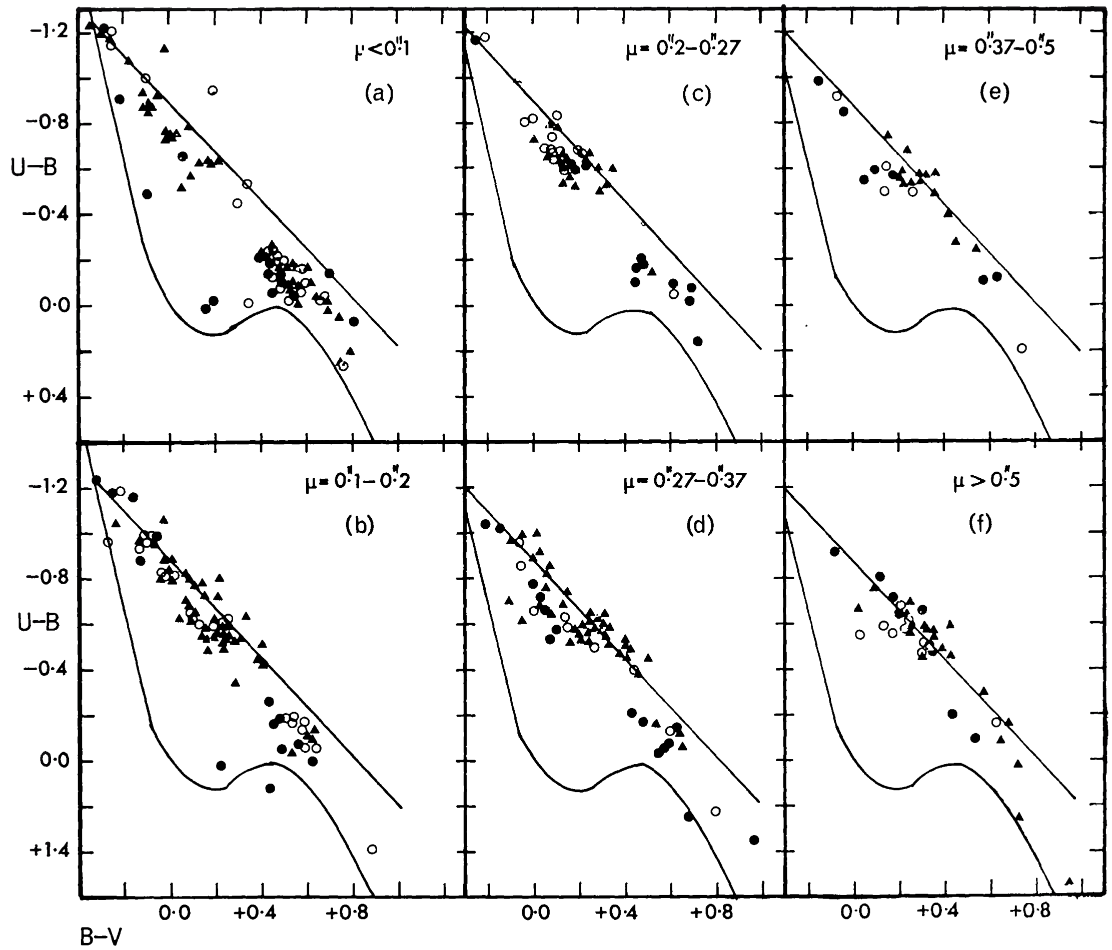

FIG. 3.—Positions of the Giclas stars (Table 1) in the $(U - B, B - V)$-plane. Filled ($V_E < 14$), and open (14–15) circles and triangles (>15) indicate the observed magnitudes. The continuous curves and straight lines represent, respectively, the relations for disk population stars and black bodies.

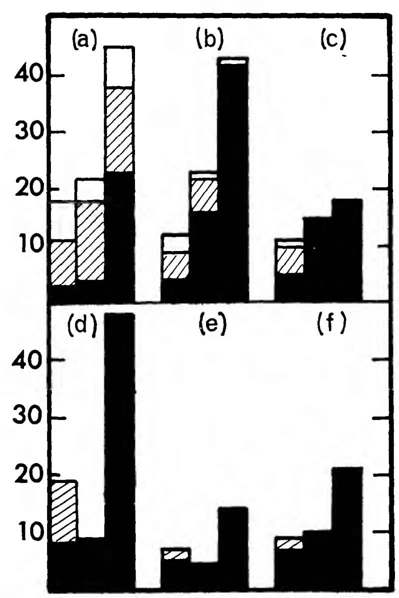

FIG. 4.—Distribution of "WD" (shaded), "sd?" (hatched) and "?" (open) stars in Fig. 3 among the various motion classes: (*a*) μ = 0.05–0.1; (*b*) 0.1–0.2; (*c*) 0.2–0.27; (*d*) 0.27–0.37; (*e*) 0.37–0.5; and (*f*) >0.5. The first pillar in each group represents the stars brighter than V_E = 14, the second, 14–15, and the third, fainter than 15.

first pillar for each of the proper-motion groups represents the stars brighter than $V_E = 14^{mag}$, the second represents the stars between 14 and 15^{mag}, and the third the stars fainter than 15^{mag}. A minimum of 75 per cent, or 350, of the stars in Table 1 are probably white dwarfs. If we exclude motions less than 0″.2, this becomes 90 per cent. The "?" stars, some of which may be sdOB or HB objects, occur mainly among the smallest motions (Group *a*) and, not unexpectedly, the sd? stars occur exclusively, for motions greater than 0″.1, among the stars brighter than $V_E = 14^{mag}$. Of the 70 fields in which motions smaller than 0″.27 have not been published, each contains the average number of 1.2 WD stars, the total minimum number of WD's is 434 in the first 180 fields of the Lowell survey. Although there is some variation from field to field, the average limiting magnitude is 17. Because these fields cover 30 per cent of the sky, the minimum number of WD's to $V_E = 17$ is 1500 or, taking $M_V = +12.5$, the minimum space density is $\sim 1 \times 10^{-3}$ ps^{-3}. Because of the method of discovery of these objects, this density refers essentially to the DA white dwarfs with values of $B - V$ between, roughly, 0 and 0.4 (Fig. 3). From several investigations of the stars in essentially this same color range

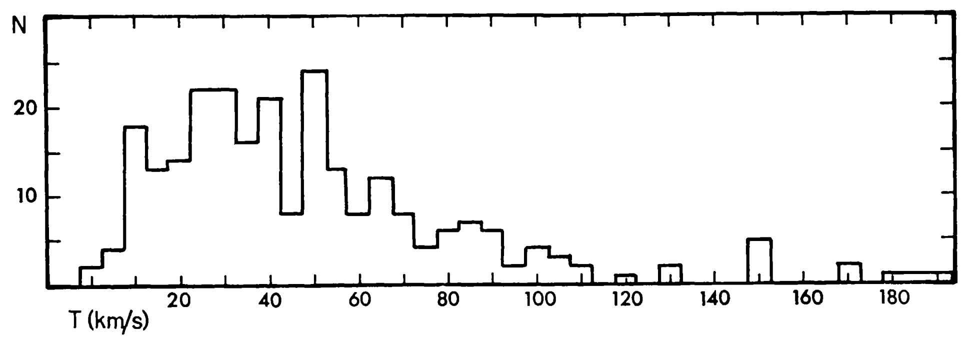

FIG. 5.—Distribution of tangential velocities, *T*, of the WD's in Table 1

Luyten (e.g., 1965*c*) finds a space density near 2×10^{-3} ps^{-3}. We might expect that these stars are mainly young disk objects and this expectation is borne out by the distribution of tangential velocities, *T*, in Figure 5. The velocities were computed from the parallaxes and proper motions given in Table 1; mean proper motions of 0.075, 0.15, and 0.235 were used for motion classes *a*, *b*, and *c*, respectively.

In an attempt at an estimate of the number of later-type white dwarfs that would be included in the large number of stars found in the Lowell survey with color classes +1, single observations were obtained for all stars of this color class in four Lowell fields and are listed in Table 3. The last column in this table gives the transverse velocity, *T*, in km sec^{-1}, based on the proper motion and the modulus obtained from fitting each star to the main sequence after correcting for line-blanketing effects. The corrections for line blanketing become uncertain for stars redder than about $B - V = +0.8$ (Sandage and Eggen 1959), and the resulting values of *T* are indicated by colors. In a few cases the ultraviolet excess is greater than 0.3, and these stars are indicated as "WD?" in the last column of Table 3. If we adopt $T = 600$ km sec^{-1} as a conservative upper limit for the transverse velocity, G138-6, -14, -16, -38, -49, -56, and G141-6, -48 are probably white dwarfs. If we add the four stars indicated as "WD?" on the basis of the color alone, the indication is that 25 per cent of the stars in the Lowell survey, with color class +1, may be late-type white dwarfs. This would imply a minimum density of these stars of $\sim 22 \times 10^{-3}$ ps^{-3} if they populate the lower sequence in Figure 1, with a mean $M_V = 14.5$ or $\sim 0.7 \times 10^{-3}$ ps^{-3} if they populate the upper sequence with a mean $M_V = +12$. However, the observed sample is too small for reliable conclusions and this point will be discussed further in the next section.

IV. THE LUYTEN STARS

In the Bruce Proper-Motion Survey by Luyten, supplemented with the surveys of Ross and Wolf near the equator, most of the southern stars brighter than about magnitude 15, with a proper motion of 0.″2 or greater, have been found. Of these some 10000 stars, color classes have been assigned by Luyten (1960) to all but about 10 per cent. The 88 stars brighter than $V_E = 15$ plus a few fainter stars, with color class *a* or *b*, are listed in Table 4; ten of these stars are also included in Table 1. Photoelectric (U,B,V) pho-

TABLE 3

ALL STARS OF COLOR CLASS +1 IN FOUR LOWELL FIELDS

Star	Pg	μ	V_E	$B-V$	$U-B$	T
G138- 3	12.7	0.27	12.14	+0.91	+0.69	190
- 4	13.4	.27	13.06	+0.48	−0.20	530
- 5	12.7	.30	10.66	+0.94	+0.68	90
- 6	13.1	.34	12.95	+0.40	−0.26	790
-12	14.5	.49	13.36	+1.17	+0.98	330:
-14	13.5	.47	12.24	+0.61	0.00	730
-16	15.7	.27	15.29	+0.83	+0.26	920:
-21	15.7	.27	15.00	+1.11	+0.86	440
-14	9.5	.38	8.45	+0.73	+0.25	60
-30	14.3	.29	13.00	+0.93	+0.48	240:
-34	8.9	.64	7.00	+0.85	+0.47	40
-38	15.2	.42	14.29	+0.97	+0.73	630
-42	9.8	.27	9.11	+0.61	+0.05	80
-49	16.0	.59	15.76	+0.77	+0.09	1800:
-51	12.8	.29	11.79	+1.01	+0.81	140
-53	15.1	.27	14.64	+0.93	+0.40	540:
-57	8.7	.28	7.96	+0.69	+0.22	40
-65	14.5	.49	13.78	+0.87	+0.67	800
-66	10.3	.27	9.13	+0.70	+0.18	60
G141- 6	15.7	.34	15.25	+0.87	+0.38	1000:
- 8	9.0	.53	7.86	+0.70	+0.19	70
-15	14.0	.28	13.06	+0.52	−0.19	470
-19	12.1	.29	10.56	+0.66	−0.06	100
-34	14.5	.29	13.50	+0.98	+0.54	300
-39	9.3	.31	8.59	+0.73	+0.21	50
-44	14.2	.55	13.20	+1.15	+0.81	360
-47	11.9	.27	10.54	+0.54	−0.10	150
-48	16.2	.57	16.13	+1.43	+1.13	800:
-49	13.5	.27	12.50	+0.91	+0.59	190
G178- 4	11.4	.34	9.92	+0.68	+0.16	120
- 5	13.8	.28	11.93	+1.14	+1.07	110
- 9	14.8	.27	13.74	+0.83	+0.07	WD?
-27	12.2	.29	11.22	+0.43	−0.22	250
-28	12.0	.30	9.74	+0.87	+0.54	70
-30	15.0	.29	13.51	+0.86	+0.27	WD?
-41	13.3	.30	12.66	+0.48	−0.22	470
-49	14.6	.27	13.60	+0.98	+0.50	WD?
-50	11.9	.35	10.56	+0.76	+0.25	130
-56	13.0	.30	11.94	+0.70	+0.13	220
-57	14.0	.28	13.01	+0.61	−0.10	370
G181-19	13.9	.34	12.63	+0.81	+0.11	WD?
-27	12.7	.30	11.75	+0.75	+0.32	230
-28	13.1	.27	12.02	+0.44	−0.27	340
-43	10.6	.35	8.89	+0.80	+0.43	70
-45	13.7	0.31	12.34	+0.74	−0.04	WD?

TABLE 4

SOUTHERN STARS WITH PROPER MOTIONS GREATER THAN 0″.2 AND OF COLOR CLASS *a* OR *b*

LTT	α (1950)	δ (1950)	Pg	CC	μ	θ	V_E	$B-V$	$U-B$	n,T
3	0^h $0^m.2$	−34° 30′	15.0	*a–f*	0.76″	168°	14.90	+0.465	−0.435	2,40
11	0 1.1	−17 00	14.2	*a*	0.20	94	.....	.....	.....	.....
235	0 24.4	−55 41	14.6	*a*	0.58	214	15.21	+ .15	−0.68	1,40
524	0 53.3	−11 45	15.0	*a*	0.47	350	15.25	+ .35	−0.48	1,40
615	1 3.4	−27 54	14.8	*a*	0.27	108	14.10	+ .60	+0.05	3,40
805	1 26.1	−53 17	13.8	*a*	0.20	90	14.48	+ .01	−0.725	2,40
877	1 33.7	−11 36	14.2	*a*	0.44	99	14.10	+ .20	− .54	1,100
880	1 34.8	−17 43	14.9	*a*	0.29	200	.....	.....	.....	.....
888	1 35.5	− 5 16	13.0	*a*	0.67	121	12.80	+ .35	−0.48	1,40
1227	2 26.4	−32 57	14.6	*a*	0.23	208	13.96	− .12	−0.94	2,40
1419	2 55.8	−70 34	14.0	*a*	0.67	98	14.08	+ .23	−0.59	3,40
1648	3 26.7	−27 32	13.9	*a*	0.80	63	.....	.....	.....	.....
1765	3 42.3	−51 33	14.8	*a*	0.47	183	15.96	+ .29	−0.50	2,40
1908	4 13.1	− 7 44	9.5	*a*	4.08	213	9.52	+ .03	−0.68	2,200
2437	5 59.4	−12 30	14.3	*a*	0.26	77	14.54	+ .65	−0.24	3,40
2511	6 15.6	−59 11	13.7	*a*	0.34	190	14.09	− .09	−0.95	6,40
2884	7 32.1	−42 47	13.9	*a*	0.66	5	14.16	+ .11	−0.66	1,40
2915	7 38.1	−17 17	12.9	*a*	1.26	117	12.98	+ .29	−0.61	2,100
2980	7 52.8	−14 38	13.4	*a*	0.32	204	13.50	− .05	−0.80	1,40
3012	7 56.2	−35 46	11.7	*a–f*	0.31	145	10.42	+ .55	−0.17	1,40
3059	8 6.4	−66 09	13.6	*a*	0.47	128	13.92	+ .05	−0.90	2,40
3218	8 39.6	−32 48	11.8	*a*	1.69	321	11.90	+ .25	−0.59	5,40
3496	9 28.6	−71 20	16.2	*a*	0.43	313	15.44	+ .175	−0.44	2,40
3537–8	9 35.0	−37 07	14.6	*a*	0.37	295	14.30	+ .13	−0.72	1,40
3682	10 0.2	−36 58	15.0	*a*	0.23	200	16.20	− .36	−0.84	3,40
3782	10 16.3	−30 53	15.0	*a*	0.23	285	14.84	+ .05	−0.66	3,40
3870	10 31.3	−11 26	12.7	*a*	0.33	260	12.97	− .15	−1.02	2,200
3843	10 42.6	−69 02	12.3	*a*	0.28	267	13.09	− .04	−0.84	2,40
4013	10 53.3	−55 04	13.8	*a*	0.40	305	14.32	+ .095	−0.62	4,40
4020	10 55.2	− 7 15	14.4	*a*	0.80	275	14.28	+ .32	−0.51	3,200
4099	11 05.6	− 4 52	12.6	*a*	0.43	180	12.92	+ .09	−0.69	3,100
4181	11 15.8	− 2 58	14.9	*a*	0.54	293	15.30	+ .09	−0.76	3,200
4364	11 42.9	−64 34	11.3	*a*	2.68	97	11.63	+ .22	−0.66	2,40
4516	12 2.8	−23 15	12.7	*a*	0.27	1	12.94	+ .26	−0.62	2,40
4707	12 23.8	−53 16	12.6	*a–f*	0.30	297	12.36	+ .595	−0.15	3,40
4816	12 36.1	−49 33	13.4	*a*	0.57	257	13.96	+ .18	−0.70	2,40
4893	12 44.9	−12 32	14.4	*a*	0.26	297	14.81	+ .14	−0.57	3,40
4895	12 45.3	−65 06	13.8	*a*	0.24	300	13.24	+ .725	−0.09	2,40
5178	13 23.0	−51 26	14.2	*a*	0.50	268	14.60	+ .00	−0.79	2,40
5215	13 27.7	− 8 21	12.2	*a*	1.17	249	12.30	+ .08	−0.61	3,100
5267	13 34.6	−67 49	15.6	*a*	0.54	263	15.57	+ .30	−0.59	4,40
5382	13 48.5	−27 20	15.0	*a*	0.23	164	.....	.....	.....	.....
5410	13 50.7	− 9 02	14.6	*a*	0.43	135	14.70	+ .33	−0.63	3,40
5583	14 11.4	−13 20	14.8	*a*	0.22	182	.....	.....	.....	.....
5712	14 25.4	−81 07	13.2	*a*	0.45	208	13.75	+ .25	−0.53	1,40
5869	14 43.9	−27 02	8.6	*a*	0.21	244	8.20	+ .06	+0.10	2,40
5938	14 53.4	− 3 07	13.9	*a*	0.29	187	13.18	+ .60	−0.15	2,40
6143	15 20.1	−34 01	14.7	*a*	0.45	235	15.55	+ .14	−0.76	5,40
6175	15 24.3	−74 55	15.3	*a*	0.44	238	15.93	− .06	−0.93	1,40
6194	15 27.4	−29 30	13.5	*a*	0.41	199	12.91	+ .52	−0.13	1,40
6248	15 36.0	−28 26	12.9	*a*	0.28	231	11.90	+ .51	−0.22	1,40
6302	15 44.2	−37 46	13.2	*a*	0.48	243	12.72	+ .37	−0.46	1,40
6441	16 06.3	−37 56	10.9	*a–f*	0.31	202	9.69	+ .47	−0.12	1,40
6451	16 07.8	−25 06	15.2	*a*	0.23	320	15.35	+ .16	−0.65	1,40
6494	16 14.7	−12 50	15.0	*a*	0.25	193	15.00	+ .10	−0.71	5,40
6497	16 15.0	−15 29	12.5	*a*	0.25	223	13.42	− .21	−1.04	3,60
6795	16 57.8	−52 43	15.1	*a*	0.34	188	15.85	− .155	−1.185	2,40
6847	17 8.5	−14 54	14.1	*a*	0.36	132	14.30	+ .02	−0.68	2,100
6859	17 9.8	−57 34	14.6	*a*	0.20	207	15.10	+0.03	−0.76	3,40

TABLE 4—*Continued*

LTT	α (1950)	δ (1950)	Pg	CC	μ	θ	V_E	$B-V$	$U-B$	n,T
7083........	17h44m5	−46°14′	14.1	*a*	0.20	234	13.90	+0.53	−0.11	3,40
7219........	18 6.8	−23 38	9.6	*a*	0.20	242	8.53	+ .10	−0.76	4,40
7392........	18 34.7	−78 08	15.1	*a*	0.33	161	15.45	− .06	−0.80	1,40
7406........	18 37.6	−61 56	14.5	*a*	0.39	226	14.9v	+ .11	−0.70	6,40
7658........	19 17.9	− 7 45	12.2	*a*	0.20	198	12.24	+ .07	−0.84	4,100
7819........	19 44.8	−63 07	10.6	*a*	0.44	186	10.89	+ .42	−0.21	3,40
7873........	19 52.9	−20 37	14.6	*a*	0.36	165	14.7v	+ .2v	−0.6v	6,40
7875........	19 53.2	−71 31	14.4	*a*	0.22	180	......	....	....	......
7879........	19 54.0	− 1 09	13.7	*a*	0.84	213	13.69	+ .25	−0.60	2,100
8148........	20 34.5	−53 16	13.8	*b*	0.20	162	14.46	− .05	−0.94	3,40
8154........	20 35.4	−37 00	15.0	*a*	0.23	104	14.97	+ .20	−0.56	2,40
8189........	20 39.6	−20 15	11.6	*a*	0.33	106	......	....	....	......
8198........	20 40.5	−39 13	13.7	*a*	0.31	179	13.88	+ .19	−0.54	3,40
8381........	21 05.2	−82 01	13.7	*a*	0.37	167	......	....	....	......
8452........	21 15.8	−56 03	14.5	*a*	0.45	114	14.28	+ .26	−0.59	2,40
8579........	21 30.9	− 4 46	14.4	*a*	0.24	83	14.50	− .05	−0.73	1,40
8596........	21 33.6	−13 31	13.9	*a*	0.24	123	13.70	+ .26	−0.52	1,40
8702........	21 45.0	− 7 58	14.2	*a*	0.39	114	14.80	− .06	−0.96	1,100
8747........	21 51.5	− 1 31	14.7	*a*	0.26	181	14.41	+ .26	−0.51	1,200
8768........	21 54.4	−51 14	15.0	*a*	0.40	190	14.68	+ .16	−0.80	4,40
8771........	21 54.8	−43 42	14.5	*a*	0.22	144	......	....	....	......
8962........	22 16.2	−65 43	14.8	*a*	0.65	161	14.43	+ .135	−0.77	2,40
9030........	22 24.6	−34 27	13.9	*a*	0.21	94	......	....	....	......
9082........	22 32.0	−57 31	15.0	*a*	0.20	96	......	....	....	......
9491........	23 17.1	−17 22	14.4	*a*	0.26	80	......	....	....	......
9631........	23 35.1	−41 27	14.2	*a*	0.20	128	14.94	− .01	−1.025	2,40
9768........	23 51.5	−33 33	14.5	*a*	0.50	217	......	....	....	......
9774........	23 51.8	−36 49	15.1	*a*	0.68	178	15.13	+ .15	−0.68	1,40
9857........	23 59.6	−43 25	13.0	*a*	0.90	138	13.00	+0.10	−0.90	1,40

tometry of 76 (86 per cent) of these have been obtained, mainly with the 40-inch reflector at Siding Spring Mountain. The distribution of the stars in the ($U-B$, $B-V$) plane is shown in Figure 6 where, as in Figure 3, the continuous curves and straight lines repre-

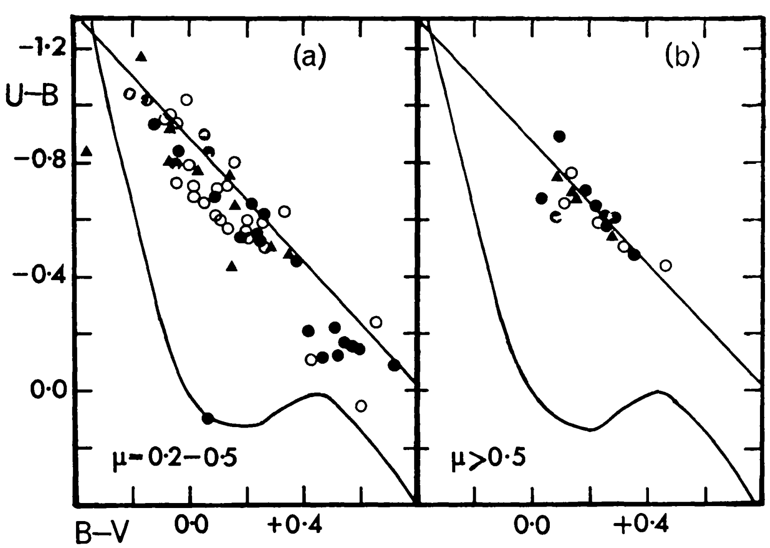

FIG. 6.—Distribution in the ($U-B$, $B-V$) plane of the stars in Table 4. The coding is as in Fig. 3

sent, respectively, the normal and black-body relations, and the filled circles (>14), open circles (14–15), and triangles (>15) indicate the apparent magnitudes. The stars with proper motions greater than 0″.5 in Figure 6*b* are apparently all WD's, but Figure 6*a* contains nine possible sdFG stars, one or two possible HB objects, and one exceedingly blue star. If LTT 5869 (=HD 130095) is a HB star, with $M_V = +0.8$, then $(U,V,W) = (+95, -269, +54)$ (Eggen 1967*b*). LTT 7219 is probably a runaway B star (Eggen 1967*b*). The two bluest stars in Figure 6*a*, indicated by filled circles, are LTT 6497 (=G 153-41) and LTT 3870 (=G 162-66), both of which have been classified as white dwarfs from their spectra (Eggen and Greenstein 1965*a*, EG Nos. 118 and 70). The bluest star in Table 4 (Fig. 6*a*) is LTT 3682. The present observations make the star a magnitude fainter than Luyten's estimate, and the colors, $(B - V, U - B) = (-0.36, -0.84)$, have only been matched, in the several hundred blue stars I have observed, by the recurrent nova T Pyx five months after maximum; T Pyx (April and May 1967) $V_E = 10.0$–12.5, $B - V = -0.31$– -0.35, $U - B = -0.58$– -0.80. The new observations of LTT 3682 show no appreciable variation. The nine possible subdwarfs in Figure 6*a* together with the transverse velocity computed from the moduli obtained by fitting to the main sequence after correcting for line blanketing, are in Table C. The stars LTT 615, 6194, and probably 7083 may be white dwarfs. Two stars in Table 4, LTT 7406 and 7873, have rapid variations in light and color and may be SS Cyg variables.

TABLE C

TANGENTIAL VELOCITIES OF 9 STARS IN FIGURE 6a

LTT	T	LTT	T
615	810	6248	280
3012	140	6441	150
4707	280	7083	550
5938	390	7819	400
6194	710		

In summary, the observed stars in Table 4 probably contain one HB object, a young B-type star, an old nova, 2 SS Cyg variables and 66, or 87 per cent, WD's. The comparable number for the Giclas stars was 90 per cent WD's. Because, as in Table 1, these WD's have colors indicating a mean $M_V = 12.5$, the density of the WD's brighter than $V_E = 15$ and with proper motions of 0″.2 or more is then 1.2×10^{-4} ps^{-3}, which agrees well, considering the difficulties, with 0.9×10^{-4} ps^{-3} derived from the material in Table 1.

Table 5 contains a selection of 104 southern stars with proper motion greater than 0″.2 and of color classes *f*, *g* or *k* in the LTT (Luyten 1957). If we adopt the accompanying luminosities and color for the various color classes, then tangential motions can be estimated from the proper motions, photographic magnitudes, and color classes given in the LTT. The 63 stars with LTT numbers followed by asterisks in Table 5 have values of T greater than 500 km sec^{-1}, if computed in this way. These velocities, $T(1)$, are listed in

	Color	M_V
f	+0.4	+4.5
g	+ .6	+5.5
k	+1.0	+6.5

TABLE 5

SOUTHERN STARS OF COLOR CLASSES *f*, *g*, AND *k* AND PROPER MOTIONS GREATER THAN 0″.2

LTT	α (1950)	δ (1950)	Pg	CC	μ	θ	V_E	$B-V$	$U-B$	n,T
125*.......	0h 13m7	−24° 41′	14.8	g	0.20″	201°	14.08	+0.56	−0.23	1,40
306........	0 32.2	−25 12	13.5	g	0.24	108	12.67	+0.66	+0.06	1,40
325*.......	0 34.2	−60 13	14.3	f	0.28	69	13.84	+0.26	−0.61	2,40
329*.......	0 34.9	−21 09	14.2	g	0.32	230	14.53	+0.45	−0.57	3,40
375*.......	0 39.0	−22 38	15.1	g:	0.60	232	14.60	+0.65	−0.32	4,40
377*.......	0 39.2	−33 54	12.5	f	0.45	237	11.23	+0.47	−0.09	2,40
405........	0 41.6	−30 42	10.1	f	0.23	238	9.09	+0.52	−0.02	1,40
424*.......	0 43.3	−21 51	14.5	g	0.24	127	13.86	+0.77	−0.02	1,40
458*.......	0 46.1	−17 10	14.1	g	0.26	181	14.10	+0.53	−0.17	1,40
528........	0 53.6	−61 58	12.4	g	0.33	95	11.84	+0.52	−0.18	2,40
568*.......	0 58.2	−37 43	14.1	f	0.21	134	14.30	+0.455	−0.245	2,40
598*.......	1 1.5	−46 03	11.8	k	1.71	188	11.63	+1.09	+0.92	2,40
601........	1 1.7	−34 56	10.6	g	0.69	113	10.24	+0.75	+0.20	3,40
650*.......	1 7.2	−53 14	15.6	f	0.23	72	15.04	+0.38	−0.09	3,40
676........	1 11.0	−32 26	12.9	g	0.20	111	13.14	+0.58	−0.15	2,40
710........	1 14.5	−29 00	13.0	g	0.22	168	12.62	+0.56	−0.08	1,40
784*.......	1 23.0	−26 14	14.9	f	0.51	160	14.94	+0.40	−0.55	6,40
864........	1 33.2	−33 54	12.9	f	0.20	84	11.89	+0.50	−0.18	1,40
867........	1 33.3	−26 23	12.6	g	0.32	106	11.43	+0.50	−0.18	1,40
877........	1 34.4	−61 19	10.1	f	0.63	186	10.16	+0.485	−0.20	2,40
934*.......	1 41.6	−67 32	14.7	k	1.05	198	13.90	+0.43	−0.44	3,40
1020........	1 52.5	−27 42	12.8	g	0.36	125	11.52	+0.54	−0.25	2,40
1045........	1 55.5	−26 10	12.6	g	0.31	121	12.10	+0.545	−0.225	2,40
1056........	1 57.2	−27 48	13.4	g	0.22	196	13.50	+0.44	−0.20	1,40
1109........	2 5.7	−69 06	9.6	f	0.25	186	10.43	+0.34	−0.03	2,40
1116*.......	2 6.5	−49 28	14.4	g	0.22	174	14.21	+0.545	−0.10	2,40
1216........	2 23.5	−42 14	13.0	g	0.30	119	12.19	+0.505	−0.265	2,40
1534*.......	3 12.0	−56 18	14.1	g	0.30	200	14.71	+0.16	−0.55	3,40
1607........	3 21.2	−71 51	13.4	g	0.24	84	13.70	+0.48	−0.21	2,40
1788*.......	3 46.5	−39 19	13.6	f	0.27	136	13.30	+0.465	−0.31	3,40
1815*.......	3 50.2	−46 05	15.2	k	0.51	115	14.36	+1.22	+0.86	1,40
1821*.......	3 51.5	−37 11	12.8	k	1.14	199	12.19	+1.415	+1.12	2,40
1925*.......	4 15.1	−26 10	13.4	g	0.62	70	11.77	+1.37	+1.11	2,40
1951*.......	4 19.6	−48 46	14.8	f	0.56	176	14.36	+0.52	−0.45	2,40
2162........	5 2.2	−24 23	12.6	g	0.30	358	11.58	+0.745	+0.275	2,40
2169........	5 3.9	−57 09	12.5	g	0.38	11	11.33	+0.77	+0.29	1,40
2175........	5 5.3	−23 15	14.1	k	0.40	138	13.71	+0.63	−0.02	3,40
2236........	5 16.9	−53 43	13.1	k	0.52	154	13.19	+1.16	+0.72	2,40
2282........	5 27.0	−29 55	12.3	g	0.45	126	11.68	+0.48	−0.24	2,40
2466*.......	6 7.2	−44 34	15.0	k	0.48	153	14.09	+0.72	+0.38	1,40
2487*.......	6 11.0	−12 23	13.0	f	0.26	140	12.28	+0.53	+0.03	2,40
2535*.......	6 20.3	−12 50	13.3	g	0.88	140	13.18	+1.00	+0.53	3,40
2552........	6 23.9	−60 08	11.4	g	0.46	27	11.14	+0.40	−0.24	1,40
2669*.......	6 51.3	−16 11	14.3	g	0.29	122	13.54	+0.50	−0.01	1,40
2672*.......	6 52.9	−19 51	14.3	f	0.26	145	13.46	+0.61	−0.11	1,40
2692*.......	6 55.1	−39 06	15.2	f	0.35	244	14.73	+0.72	+0.05	1,40
2729*.......	7 2.9	−38 30	13.4	k	1.21	101	12.36	+1.49	+1.08	1,40
2744........	7 5.6	−57 25	11.2	f–g	0.68	352	9.54	+0.50	−0.12	1,40
2746*.......	7 6.9	−22 44	13.3	g	0.47	338	11.57	+1.50	+1.26	2,40
2826*.......	7 22.2	−39 13	14.8	f:	0.86	154	13.68	+1.33	+1.0:	1,40
2920........	7 38.8	−76 57	12.2	f	0.31	354	11.70	+0.61	−0.12	1,40
2981*.......	7 52.8	−67 38	15.0	f–g	2.05	135	14.09	+0.66	−0.17	5,40
3021........	7 56.9	−60 10	12.0	k	0.53	77	9.93	+1.345	+1.13	2,40
3025*.......	7 57.8	−63 48	12.4	f	0.42	336	11.82	+0.89	+0.46	2,40
3028........	7 58.4	−63 30	9.8	g	0.34	334	10.08	+0.58	−0.12	1,40
3085........	8 11.4	−21 57	12.7	g	0.20	235	11.74	+0.97	+0.72	2,40
3356........	9 4.1	−65 10	11.4	f	0.41	344	10.41	+0.66	+0.06	4,40
3396........	9 10.8	−24 53	13.0	g	0.29	298	12.75	+0.56	+0.03	4,40

TABLE 5—*Continued*

LTT	α (1950)	δ (1950)	Pg	CC	μ	π	V_E	$B-V$	$U-B$	k,T
3430*.......	9h16m4	−66°59′	13.8	*f*	0.31″	333	13.50	+0.405	+0.08	2,40
3483*.......	9 25.8	−80 21	11.0	*f*	1.25	9	10.09	+0.585	−0.16	2,40
3578*.......	9 42.6	−18 00	14.3	*k*	1.58	263	12.70	+1.58	+1.38	2,40
3746*.......	10 11.0	−57 35	13.9	*g*	0.37	353	13.12	+0.645	+0.11	2,40
3770........	10 14.4	−11 42	12.7	*k*	0.73	214	11.06	+1.47	+1.12	1,40
3854........	10 28.5	−20 56	9.7	*g*	0.42	188	8.78	+0.535	−0.115	2,40
3966........	10 46.0	−19 58	11.6	*g*	0.24	253	11.52	+0.535	−0.19	3,40
3967........	10 46.0	−19 58	13.3	*g*	0.24	253	13.16	+0.83	+0.23	3,40
4103........	11 6.3	−43 59	10.5	*f*	0.23	180	9.83	+0.57	−0.02	3,40
4124*.......	11 9.1	−40 48	13.8	*k*	1.26	264	14.32	+0.99	+0.68	2,40
4210........	11 20.1	−26 56	12.2	*g*:	0.31	287	12.78	+0.56	−0.18	3,40
4211*.......	11 20.1	−26 56	14.8	*g*:	0.31	287	14.94	+1.00	+0.54	4,40
4226........	11 23.4	−38 36	9.3	*f*	0.21	330	9.05	+0.47	−0.21	2,40
4391*.......	11 46.9	−26 15	13.1	*f*	0.31	289	12.20	+0.47	−0.23	1,40
4430*.......	11 52.0	−19 9	13.2	*f*	0.25	181	12.54	+0.48	−0.18	1,40
4569*.......	12 9.1	−15 19	12.7	*f*	0.45	234	12.38	+0.74	+0.02	3,40
4667*.......	12 20.2	−28 22	13.7	*g*	0.41	226	13.59	+1.08	+1.00	1,40
4697*.......	12 23.4	−24 19	13.7	*k*	0.98	263	12.80	+0.97	+0.48	2,40
4806*.......	12 35.4	−51 44	11.4	*g*	1.02	272	10.82	+1.53	+1.18	3,40
4836*.......	12 38.1	−43 18	13.7	*k*	1.04	312	12.24	+1.75	+1.39	3,40
5028*.......	13 5.8	−33 50	14.4	*g*	0.31	249	13.53	+0.58	−0.08	3,40
5046*.......	13 8.4	− 0 28	13.5	*f*	0.23	259	12.76	+0.49	−0.21	1,40
5074*.......	13 11.9	− 3 50	13.7	*g*	0.58	288	12.94	+0.95	+0.30	3,40
5299*.......	13 38.1	−24 21	14.1	*f–g*	0.71	236	13.26	+0.78	−0.04	2,40
5428*.......	13 53.5	−15 59	14.7	*f*	0.23	268	13.98	+0.70	+0.20	3,40
5453*.......	13 56.4	−23 19	14.6	*f*	0.35	257	15.02	+0.30	−0.62	2,40
5622*.......	14 15.2	−52 10	15.0	*g*	1.11	249	13.27	+1.47	+1.10	1,40
5808........	14 36.4	−56 41	13.4	*k*	0.50	125	11.33	+1.42	+1.16	3,40
6033........	15 6.5	−67 48	12.0	*f*	0.40	225	11.29	+0.53	−0.12	1,40
6079*.......	15 12.1	−18 26	12.2	*f*	0.51	222	11.52	+0.565	−0.23	2,40
6108*.......	15 16.7	−24 20	12.6	*f*	0.43	151	11.68	+0.61	−0.08	2,40
6130........	15 19.1	−13 52	14.6	*k*	0.34	275	13.54	+0.90	+0.38	3,40
6333*.......	15 50.3	−63 17	14.0	*f*	0.40	223	13.50	+0.86	+0.15	2,40
6576*.......	16 27.0	−41 59	15.1	*f*	0.58	222	14.79	+1.25	....	1,40
6713........	16 47.0	−64 22	12.4	*g*	0.53	258	11.04	+0.73	+0.05	2,40
6819*.......	17 1.9	−14 39	12.8	*f*	0.42	209	11.78	+0.72	+0.02	1,40
6885*.......	17 15.1	−43 23	14.6	*g*	1.06	226	13.98	+0.76	+0.27	3,40
6978*.......	17 30.2	−62 07	13.5	*f*	0.44	206	12.75	+0.62	+0.03	1,40
6999*.......	17 33.2	−54 24	15.6	*f*	0.45	193	15.90	+0.50	−0.40	2,40
7050*.......	17 39.9	−16 37	13.8	*g*	0.70	191	13.15	+1.73	....	1,40
7132........	17 53.1	−16 24	11.4	*g*	0.60	181	11.35	+0.70	−0.09	2,40
7829*.......	19 46.6	−59 18	12.6	*g*	0.55	192	13.36	+0.73	+0.30	1,40
7983*.......	20 7.3	−21 55	14.4	*f*	0.29	155	14.20	+0.23	−0.61	4,40
8376........	21 4.3	−47 30	11.2	*g*	0.58	200	10.10	+0.67	+0.02	3,40
9267*.......	22 52.3	−75 42	12.6	*k*	1.44	226	10.22	+1.49	+1.20	1,40
9765*.......	23 51.4	−19 15	14.0	*g*	0.75	169	13.55	+0.87	+0.395	4,40

Table 6. The values of $T(2)$ in Table 6 were derived from the photoelectric photometry, using moduli obtained by fitting to the main sequence after correcting for blanketing effects. Seventeen of these stars are apparently white dwarfs, as judged by the colors alone, and in these cases "WD" is entered in the column "T(2)." The last column of Table 6 gives a "yes-no" classification as a WD based on either the color or on the fact that the tangential velocity would exceed 600 km sec^{-1} if the star is assumed to be a main-sequence object. The limit of 600 km sec^{-1} for $T(2)$ is presumably a conservative one and the resulting number of WD's should be a minimum. The positions in the $(U-B, B-V)$ plane of the WD's in Table 6 are shown by the open circles in Figure 7;

the filled circles represent the few late-type WD's previously recognized (Eggen and Greenstein 1965*a*) from trigonometric parallaxes or common proper-motion companions. Except for those with the strongest ultraviolet, it is obviously impossible to separate the late-type WD's from the sdFG stars on the basis of color alone.

The combination of the color and kinematic criteria gives the result that at least 41, or 65 per cent, of the stars whose photographic magnitudes and colors, together with the calibration given above, yield tangential velocities in excess of 500 km sec^{-1}, are late-type WD's. The break-down by color class is as follows:

	Table 6	WD	%
f..........	30	18	57
g..........	26	17	75
k..........	11	6	55

The largest yield, as might have been expected, is for color class *g*.

TABLE 6

TANGENTIAL VELOCITIES FOR 63 STARS OF TABLE 5

LTT	$T(1)$	$T(2)$	WD?	LTT	$T(1)$	$T(2)$	WD?
125.........	520	600	Yes	3578........	1750	370:	No
325.........	630	WD	Yes	3746........	640	640	Yes
329.........	640	WD	Yes	4124........	1080	1700	Yes
375.........	1800	WD	Yes	4211........	800	600:	Yes
377.........	700	490	No	4391........	640	400	No
424.........	540	WD	Yes	4430........	540	400	No
458.........	500	700	Yes	4569........	780	520	No?
568.........	690	760	Yes	4667........	640	370	No
598.........	1500	620	Yes	4697........	800	670:	Yes
650.........	1500	2400	Yes	4806*.......	560	110:	No
784.........	2400	WD	Yes	4836*.......	860	100:	No
934.........	1360	WD	Yes	5028........	670	610	Yes
1116.........	500	660	Yes	5046........	570	380	No
1534.........	570	WD	Yes	5074........	910	WD	Yes
1788.........	700	WD?	Yes?	5299........	1750	WD	Yes
1815.........	840	530	No?	5428........	990	520	No?
1821*........	620	280:	No	5453........	1440	WD	Yes
1925*........	850	130:	No	5622........	3200	3400	Yes
1951.........	2550	WD	Yes	6079........	690	WD	Yes
2466.........	720	1190	Yes	6108........	710	310	No
2487.........	510	450	No	6333........	1250	WD	Yes
2535.........	1140	730	Yes	6576........	2950	680:	Yes
2669.........	600	930	Yes	6819........	760	220	No
2672.........	940	400	No	6885........	2540	1900	Yes
2692.........	1200	740:	Yes	6978........	1100	600	Yes
2729.........	870	260:	No	6999........	4650	WD	Yes
2746.........	610	70:	No	7050*.......	1150	40:	No
2826.........	3900	530:	No	7829*.......	520	970	Yes
2981.........	7700	WD	Yes	7983........	1090	WD	Yes
3025.........	630	160	No	9267........	720	110:	No
3430*........	890	1500	Yes	9765........	2120	780:	Yes
3483.........	980	670	Yes				

* LTT 1821, $\pi_t = 0.049$, wt. 15.
1925, $\pi_t = 0.045$, wt. 12.
2981, $\pi_t = 0.170$, wt. 1.
3430, $\pi_t = -0.015$, wt. 7.
4806, $\pi_t = 0.116$, wt. 18.
LTT 4836, $\pi_t = 0.047$, wt. 10.
7050, $\pi_t = 0.050$, wt. 6.
7829, $\pi_t = 0.031$, wt. 7.

If we now extrapolate this result to the 250 southern stars brighter than visual magnitude 15 and of color classes *f* and *g* in the LTT for which the tangential motions exceed 500 km sec^{-1}, we arrive at ***minimum*** space densities of (1) 39 $\times$ 10^{-3} ps^{-3} for a mean M_V = 14.5 or (2) 1.3 $\times$ 10^{-3} ps^{-3} for a mean M_V = +12. These mean luminosities are adopted on the basis of the mean colors of the WD's in Table 6 (and Fig. 7) and the assumption that they all populate (1) the lower, or (2) the upper sequences in Figure 1. From the calibrating stars used to construct Figure 1, remembering that the stars represented by triangles in this figure are all members of the Hyades and Praesepe clusters, it appears that assumption (2) is more nearly correct than assumption (1). However, even if we assume that the two sequences are equally populated, we arrive at a minimum space density for the WD's of intermediate color of 7 $\times$ 10^{-3} ps^{-3}.

The space density of the DA and DB WD's (§ II) of ~10^{-3} ps^{-3} and of the DF and

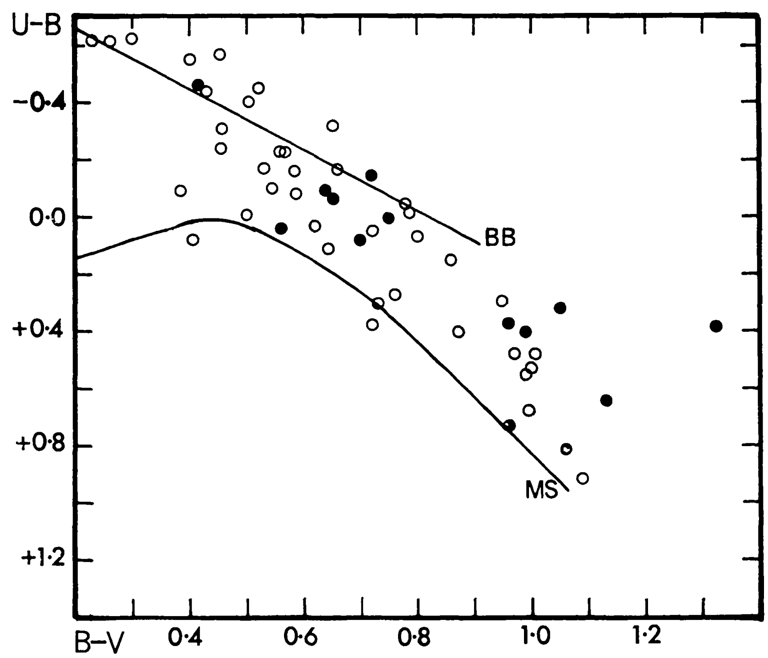

FIG. 7.—Distribution in the $(U - B, B - V)$ plane of the suspected white dwarfs (open circles) in Table 6; some white dwarfs known to be of late type, from trigonometric parallaxes or a common proper-motion companion, are indicated by filled circles.

DG, ~10^{-2} ps^{-3}, are decidedly minimum values. Incompleteness factors in the surveys used here could lead to a 10 per cent underestimation. The use of a kinematical criteria might lead to an underestimation by an order of magnitude. The fact that the kinematic argument was *not* used to arrive at the low density of the DA and DB stars in § II, but was for the later types in § IV, underlines the much greater space density of the DF, G stars. Another large factor in the underestimate of the later-type WD's is the limitation to (*a*) those of color class *f* and *g*, and (*b*) those with proper motion exceeding 0".2. In § II, where the density of the DB, A stars was estimated, limitation (*b*) did not apply but, from Figure 4, it appears that if we did limit the discussion to >0".2, one-third of the WD's would have been omitted. It can be argued that the later-type WD's may have average motions that are larger than those of the DA, B stars, so that the limitation to >0".2 is not as serious, but in any case, a 10 per cent underestimation on this account seems to be a conservative guess. Our sample of color class *k* stars is probably too small, compared to the large number of such stars in the LTT, so that an estimate of the effect of limitation (*a*) is not possible; similarly an estimate of the percentage of the very populous group of color class *m* stars that may be late-type WD's is also impossible from the present material.

In summary, if we increase our value for the minimum density of DA, B stars only by 10 per cent for incompleteness, we obtain $\sim 10^{-3}$ ps^{-3}. If we increase the minimum density for later types by 10 per cent for incompleteness, 10 per cent for the omission of stars with proper motion less than 0″.2, 10 per cent for the omitted DK and DM stars, and a very conservative factor of 2 for the use of the kinematic discriminate, we obtain densities of $\sim 20 \times 10^{-3}$ ps^{-3} if these late-type WD's are equally divided between the upper and lower sequences in Figure 1, or 75×10^{-3} ps^{-3} if they mainly populate the lower sequence. The mass of the DA, B stars is near 0.75 $\odot$. Direct determinations of the mass of the later types are not available. Adopting two values for these we obtain Table D. For comparison, data for the M dwarfs discussed elsewhere (Eggen 1968*b*) give a space density, in approximately the same volume around the Sun, of 1.2×10^{-3} ps^{-3} for main-sequence stars with mass between 0.55 and 0.75 $\odot$. Until mass determination for the late-type WD's becomes available, the value 1–2 $\odot$/100 ps^{-3} may be the best estimate possible.

TABLE D

MASS DENSITY OF WHITE DWARFS

	$\odot$/1000ps^3	
	$M_V = +13.2$	$M_V = +14.5$
Late type (m=0.1$\odot$)..........	2.0	7.5
Late type (m=0.5$\odot$)..........	10.0	37.5
DA, B (m=0.75$\odot$)............	0.7	0.7

The large space density of late-type WD's suggests that perhaps some nearby examples have not been recognized. In a discussion of M dwarfs near the Sun (Eggen 1968*b*) it was suspected from $R - I$ observations that CC 212 ($3^{\rm h}10^{\rm m}$m + 18°39′; 1950) and Wolf 1037 ($22^{\rm h}26^{\rm m}$, +5°34′; 1950), with nearly identical parallaxes, 0.05, and space motions, $(U,V) = (-15, -200)$, may be WD's; the trigonometric parallaxes place them about $5^{\rm mag}$ below the main sequence and near the upper sequence in Figure 2 at $(U - V) \sim +1.7$ and $M_V = +12.8$. Both have been classified as weak-lined M-type stars, and Greenstein (Eggen and Greenstein 1965*a*, 1967) has emphasized the difficulty in separating weak-lined dwarfs and WD's among the late-type stars. Another source of possible late-type WD's is the list of 13 Giclas stars for which $B - V > 0.8$ and $\delta\,(U - B) > 0.2$ (Wolff, Wallerstein, and Sandage 1965). The descriptions of the spectra of these stars by Wolff *et al.* do not, in some cases, differ markedly from the description of late-type WD spectra. Although the stars discussed by Wolff *et al.* have tangential velocities less than 500 km sec^{-1} as main-sequence objects, some stars in Tables 3 and 5, with nearly identical colors, greatly exceed this limit and are almost certainly WD's. Three striking cases of large ultraviolet excess among late-type stars are the faint components in the three common proper-motion pairs of Table E. The values of M_V, obtained by correcting the colors of the brighter components for the apparent blanketing effects and fitting to the main sequence would then give the listed luminosities for the fainter components, 1–2 mag below the main sequence at the observed colors. The observed values of $R - I \doteq +0.26$ and $+0.41$ for the brighter and fainter components of LTT 7511/12, respectively, give main-sequence luminosities of +6 and +7 from a calibration given elsewhere (Eggen 1968*b*); the agreement between main-sequence luminosities from $B - V$ and $R - I$ colors would seem, in this case at least, to rule out the possibility of large blanketing corrections for the fainter component. Furthermore, considering the limitation of WD's to M_V fainter than $+10$ and the normally observed combinations of $(U - B)$ and $(B - V)$, it is difficult to match the observed colors of the fainter components with any reasonable combination of red and white dwarfs. The possibility that among the large number of observed objects with uncommonly large ultraviolet excess, for $B - V$ redder than $+0.8$, there exists a population that is either intermediate in luminosity between the main sequence and the WD's or forms close binaries with some type of ultraviolet star, can perhaps only be tested with trigonometric parallaxes for some of the objects in Table 5. The stars in Tables 5 and 6 for which trigonometric determinations exist are inconclusive; LTT 7829 with parallax of 0.031 (wt. 7) lies 1.7^{mag} above upper sequence at $(+10.8, +1.0)$ in Fig. 1.

V. BLUE STARS

In addition to the proper-motion surveys, where photographic colorimetry has also been supplied as in the Luyten and Giclas surveys discussed above, there have been many searches for faint blue stars without knowledge of the motions. Two of these, made near the galactic poles and for which proper motions have been subsequently determined, are the Haro-Luyten (PHL) survey with the 48-inch Schmidt (Haro and Luyten 1962) and the Feige (F) survey (Feige 1958). A selection of PHL and F stars is given in Table 7.

TABLE E

FAINT RED COMPONENTS, BRIGHT IN THE ULTRAVIOLET

	V_E	$B-V$	$U-B$	δ	μ	θ	M_V
LTT 3966........	11.52	+0.535	−0.19	+0.25	0.24	253°	(+5.4)
LTT 3967........	13.16	+0.83	+ .23	+ .27	.24	253	+7.1
LTT 4210........	12.78	+0.56	− .18	+ .27	.31	287	(+5.7)
LTT 4211........	14.94	+1.00	+ .54	+ .30	.31	287	+7.9
LTT 7511........	10.10	+0.70	+ .15	+ .14	.32	193	(+6.0)
LTT 7512........	13.52	+0.96	+0.33	+0.44	0.32	193	+9.4

The photometric observations of the PHL stars were made with the 40-inch reflector, those for the F stars are a compilation of published values by ES (Eggen and Sandage 1965), F (Feige 1958), K (Klemola 1962), and new observations with the 200-, 100-, 60-, and 40-inch reflectors. The proper motions are by Luyten and Hughes (1963) for the PHL stars and by Luyten (1959) for the F stars. The spectral classifications for the Feige stars that are designated by an asterisk are by Greenstein (1966), and the remainder are from Klemola (1962). The distribution of the PHL (triangles) and F (circles) in the $(U - B, B - V)$ plane is shown in Figure 8.

From the discussion in the previous sections, and using Greenstein's spectral classifications as a control, the stars in Table 7 can be roughly divided as follows.

1. White dwarfs.—The five Feige and one PHL stars near the black-body line in Figure 8, redder than $B - V = -0.15$, would appear, on the basis of the colors, to be WD's. The proper motions are in Table F. The parallaxes and space motions are obtained by fitting to the upper sequence in Figure 1. The WD nature of three stars is confirmed by Greenstein's spectra; the spectra of F80 may be composite, which would account for its position in Figure 8. The mean tangential motion, which near the galactic pole is essentially the (U,V) motion of these five probable WD's in Table 7, is only 10 km sec^{-1}, but this is not inconsistent with the distribution of motions shown in Figure 5. Only two of these stars have proper motions below the limit on which the stars in Table 1 were selected and would indicate that about 5 per cent of the DA, B stars were missed because of this limit. Photometry of 67 blue stars in the far southern hemisphere by Hill

1968ApJS...16...97E

TABLE 7

PHOTOMETRY OF FEIGE AND PHL STARS

PHL	α (1950)	δ (1950)	$\mu_\alpha \cos\delta$ (0ʺ001)	μ_δ (0ʺ001)	b^{II}	V_E	$B-V$	$U-B$	n	Sp.
6605...	00ʰ45ᵐ3	−31°40′	+ 46	+ 7	−86°	11.65	−0.02	−0.02	2	....
6772...	00 49.3	−32 10	0	− 24	−85	13.65	+0.09	+0.15	2	....
6918...	00 54.0	−31 28	+ 9	− 8	−86	10.60	−0.065	−0.18	2	....
6984...	00 57.0	−32 14	0	+ 18	−85	9.70	+0.29	+0.03	4	....
7081...	1 0.8	−30 00	+ 1	− 23	−86	11.24	−0.02	−0.235	6	....
7104...	1 1.6	−18 51	+ 30	+ 43	−81	9.27	−0.06	−0.095	2	....
7147...	1 3.4	−20 5	+ 19	+ 2	−82	11.02	−0.01	−0.05	2	....
1000...	1 6.2	−27 10	+ 5	+ 9	−86	12.54	−0.15	−0.59	3	....
7202...	1 8.8	−21 55	+ 18	+ 15	−83	13.14	0.00	+0.065	2	....
1003...	1 9.8	−26 31	+ 21	+ 1	−85	13.20	−0.24	−1.04	3	....
1126...	1 41.4	−24 20	+103	− 7	−78	11.76	−0.32	−1.15	3	....
3802...	1 46.4	−26 52	+ 85	− 35	−77	12.31	−0.03	−0.952	2	....
8374...	2 32.4	−21 20	+ 24	+ 3	−66	12.50	+0.01	+0.14	2	....
8677...	3 25.5	−21 32	+ 12	− 6	−54	9.94	−0.10	−0.48	2	....
8704...	3 30.5	−23 48	− 4	+ 6	−54	10.02	−0.09	−0.41	2	....
25...	21 29.2	−17 32	+ 10	− 59	−43	12.01	−0.14	−0.68	3	....
5901...	23 27.6	−27 00	− 7	− 7	−72	12.64	−0.02	+0.02	2	....
5950...	23 31.0	−21 2	+ 1	− 7	−71	10.99	+0.42	−0.14	1	....
5980...	23 34.5	−26 31	+ 34	+ 23	−73	12.12	+0.12	+0.14	1	....
5992...	23 35.6	−24 10	+ 62	+ 1	−73	9.81	+0.32	+0.16	2	....
6029...	23 40.0	−31 24	+ 37	+ 3	−74	10.45	+0.175	+0.07	2	....
Feige										
4...	0 17.4	+13 36	+ 36	+ 8	−48	15.22	−0.12	−0.97	ES	DB*
10...	0 56.4	− 5 41	+ 13	− 12	−67	10.68	−0.02	−0.18	K	Ao
11...	1 1.7	+ 3 58	+ 20	− 27	−58	12.06	−0.26	−1.02	K	Bp*
15...	1 46.5	+13 18	+ 1	− 8	−46	10.41	+0.06	−0.01	ES,K	Bp*
16...	1 52.1	− 7 01	+ 19	− 9	−64	12.47	−0.02	−0.03	K	Ao
18...	1 56.3	− 5 03	+ 9	+ 24	−62	10.46	+0.07	−0.05	K	Ao
22...	2 27.7	+ 5 03	+ 95	− 19	−49	12.65	−0.06	−0.83	ES	DA*
23...	2 29.7	+ 2 47	− 14	− 19	−50	11.91	−0.11	−0.44	K	Bp*
24...	2 32.5	+ 3 31	+ 83	+ 10	−49	12.30	−0.25	−1.23	F	DAe*
25...	2 36.0	+ 5 15	+ 4	+ 2	−47	12.05	−0.04	−0.39	K	B7
27...	2 37.6	+ 8 48	+ 3	− 5	−44	11.79	+0.08	−0.23	K	Bp*
28...	2 52.5	− 4 01	− 2	− 7	−51	10.82	+0.13	+0.09	K	A2
29...	2 55.3	− 2 12	+ 17	− 17	−49	10.27	−0.11	−0.63	K	B3 III
34...	10 36.7	+43 21	+ 34	− 24	+60	11.21	−0.30	−1.35	ES	sdO
35...	10 42.6	+25 08	− 5	+ 12	+63	12.16	+0.05	−0.01	1,00	....
37...	11 8.2	+ 7 36	− 3	+ 15	+60	14.04	+0.22	+0.10	ES	....
38...	11 14.2	+ 7 16	− 8	+ 1	+61	12.99	−0.225	−1.00	ES	sdBp*
40...	11 18.9	+11 36	− 26	− 14	+65	11.14	−0.13	−0.62	ES,K	B5*
41...	11 23.3	+ 6 47	− 32	+ 6	+62	11.00	+0.09	−0.02	F	Ao
42...	11 25.7	+39 44	+ 10	− 42	+70	13.17	+0.05	+0.12	ES	Ap*
43...	11 26.5	+38 28	− 78	− 49	+71	11.89	−0.12	−1.01	ES	DA
46...	11 34.9	+14 27	− 54	+ 44	+69	13.17	−0.25	−1.16	ES	sdO*
47...	11 35.4	+45 13	....	....	+68	16.50	−0.21	−0.69	ES	....
49...	11 45.0	−15 49	− 36	+ 10	+44	12.88	−0.33	−1.01	ES	B1n*
50...	11 47.8	+52 50	− 16	+ 10	+63	11.96	+0.19	+0.13	1,60	Ap
51...	11 51.7	+18 53	+ 11	+ 10	+75	10.20	−0.12	−0.45	ES,K	B5p*
52...	11 56.0	+12 31	− 29	+ 18	+71	12.87	+0.44	−0.07	1,00	....
55...	12 2.5	+60 51	− 3	− 36	+56	13.61	−0.38	−1.25	1,60	....
56...	12 4.1	+11 57	− 7	0	+72	11.06	−0.12	−0.57	ES,K	B5p*
57...	12 6.3	+ 7 44	+ 16	− 5	+68	13.30	−0.03	−0.06	1,00	....
58...	12 11.4	+ 2 17	+ 3	+ 5	+63	11.80	+0.18	+0.07	F	....
59...	12 14.4	+15 51	− 12	+ 1	+76	11.55	−0.06	−0.10	ES	B9nn*
60...	12 16.5	+15 24	− 7	− 15	+76	12.89	+0.07	+0.13	1,00	....
61...	12 19.3	+48 04	− 12	+ 7	+69	11.96	+0.02	+0.01	1,60	Ao
65...	12 33.4	+42 39	+ 12	− 9	+76	12.02	−0.23	−0.99	ES,K	sdB2*
66...	12 34.9	+25 21	− 3	− 20	+87	10.52	−0.27	−1.15	ES,K	sdOp*

TABLE 7—*Continued*

PHL	α (1950)	δ (1950)	$\mu_\alpha \cos\delta$ (0".001)	μ_δ (0".001)	b^{II}	V_E	$B-V$	$U-B$	*n*	Sp.
Feige—*Cont.*										
67...	12^h39^m4	+17°49′	− 8	− 32	+80°	11.84	−0.33	−1.21	ES,K	sdOp*
68...	12 39.8	+16 41	− 14	− 16	+79	12.20	+0.05	+0.10	F	A2p*
70...	12 52.3	+52 01	+ 2	+ 4	+65	11.26	−0.08	−0.14	K	B8
71...	12 59.5	+29 51	− 3	− 3	+86	10.64	−0.06	−0.12	ES,K	B9
72...	13 3.0	+ 6 15	− 18	+ 2	+68	11.62	+0.17	+0.13	2,40	....
75...	13 13.5	+13 14	− 4	− 8	+74	14.51	−0.21	−0.93	1,200	....
76...	13 14.8	+13 03	+ 13	− 14	+73	15.18	−0.12	−0.65	ES	....
77...	13 16.4	+29 02	− 17	− 2	+82	15.11	+0.56	−0.15	1,200	....
78...	13 17.4	+29 40	− 21	+ 15	+82	13.79	+0.07	+0.02	2,60	....
80...	13 17.6	+12 20	− 8	0	+72	11.37	−0.10	−1.04	K	Comp?*
81...	13 29.4	+15 56	+ 33	− 15	+74	13.48	−0.22	−1.02	ES	Bp*
82...	13 29.6	+32 02	− 35	− 27	+79	10.47	−0.01	+0.02	K	Ap*
83...	....	....	....	....	......	12.72	+0.03	+0.03	1,60	....
84...	13 32.8	+13 43	− 14	− 8	+72	11.85	−0.17	−0.72	ES,K	sdB3*
86...	13 36.1	+29 37	− 34	−103	+78	10.07	−0.15	−0.66	ES,K	B5p*
87...	13 38.1	+61 07	+ 6	− 40	+55	11.63	−0.07	−0.90	2,60	....
89...	14 3.6	+ 7 02	....	....	......	14.36	−0.22	−0.91	1,60	....
90...	14 5.4	+ 5 22	− 18	+ 6	+60	14.04	−0.12	−0.48	1,60	....
91...	14 6.9	+59 55	− 52	+ 30	+55	13.38	−0.28	−1.07	1,60	....
92...	14 10.0	+50 21	+ 15	− 11	+62	11.53	−0.13	−0.61	ES,K	Bp*
93...	14 15.3	+13 16	....	....	......	15.33	−0.23	−1.12	ES	DA*
94...	14 21.0	+21 03	− 77	− 26	+67	13.87	−0.05	−0.06	1,60	....
95...	14 26.3	+21 20	− 9	+ 17	+66	13.22	−0.24	−1.07	1,60	Bp*
96...	14 28.0	+21 30	− 31	− 8	+65	13.00	+0.08	+0.18	ES	....
97...	14 33.8	+30 20	− 27	+ 17	+65	12.36	+0.03	+0.15	ES,K	AO
98...	14 36.2	+27 43	− 18	− 10	+65	11.76	−0.02	−0.05	ES	B7
99...	14 37.2	+19 39	− 7	+ 9	+63	10.19	−0.13	−0.52	ES,K	Bp*
100...	14 32.4	+19 21	− 9	− 2	+62	11.53	+0.19	+0.12	ES,K	Ap
101...	14 38.4	+18 07	− 11	+ 3	+62	11.52	−0.05	−0.19	K	Ap*
102...	14 41.4	+51 56	+ 14	− 25	+57	16.13	−0.18	−0.78	1,200	....
103...	14 49.3	+11 52	− 13	+ 6	+56	12.38	−0.16	−0.55	ES	....
104...	14 49.8	+54 49	....	....	......	13.85	−0.03	−0.08	1,60	....
105...	14 53.1	+12 57	....	....	......	12.99	+0.02	+0.05	ES	....
107...	22 47.8	−13 34	− 24	+ 3	−60	10.13	−0.13	−0.59	K	sdB*
108...	23 13.6	− 2 07	− 15	− 11	−57	12.20	−0.28	−1.06	ES	DA*
111...	23 49.0	+ 8 25	+ 5	− 11	−51	11.33	+0.02	−0.13	K	Bp*

TABLE F

WHITE DWARFS IN FIGURE 8

	μ	π	T	Greenstein
PHL 3802.........	0.09	0.050	9 km sec⁻¹	....
F 4.........	.04	.012	14	DB
22.........	.10	.044	10	DA
43.........	.09	.058	8	DA
80.........	.01	.073	0.5	Comp.?
87.........	0.04	0.068	3	....

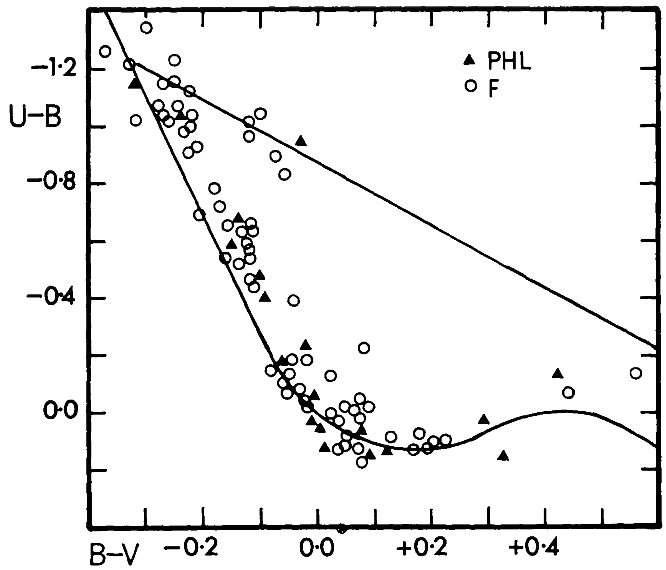

FIG. 8

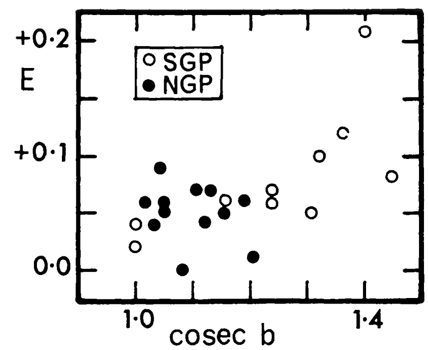

FIG. 9

FIG. 8.—Distribution in the $(U - B, B - V)$-plane of the PHL (*triangles*) and Feige (*open circles*) stars in Table 7.

FIG. 9.—Correlation between *csc b* and $E(B - V)$ for the stars in Table 8.

TABLE 8

VALUES OF $E(B - V)$ FOR HB STARS IN TABLE 7

PHL	E	M_V	b^{II}
6918.........	+0.02	+1.3	−85°
1000.........	+ .04	+1.8	−86
8677.........	+ .07	+1.7	−54
8704.........	+ .06	+1.7	−54
25.........	+ .08	+1.9	−43
Feige			
23.........	+ .05	+1.7	−50
25.........	+ .12	+1.7	−47
27.........	+ .21	+1.5	−44
29.........	+ .10	+1.9	−49
40.........	+ .07	+1.9	+65
47.........	.00	+1.9	+68
76.........	+ .09	+2.0	+73
84.........	+ .05	+2.0	+72
86.........	+ .06	+1.9	+78
90.........	+ .05	+1.7	+60
92.........	+ .07	+1.8	+62
99.........	+ .04	+1.7	+63
102.........	+ .06	+2.0	+57
103.........	+ .01	+1.7	+56
107.........	+0.06	+1.8	−60

and Hill (1966) yielded only one white dwarf, LB 3303, by the color criterion used here, and that has a proper motion of 0".09, giving a parallax of 0".1 and $T = 4$ km sec^{-1}.

2. HB stars.—High latitude stars with $B - V$ between approximately 0 and -0.2 that populate the "normal" $(U - B, B - V)$ relation are probably HB stars (Fig. 2); a few exceptions may represent "run-away", B stars of the young disk population. The stars with $(B - V)^3{}_0 = -0.1$–-0.25 in Table 7 are listed in Table 8 with the values of $E(B - V)$ derived from the assumptions that (*a*) these objects are HB stars, and (*b*) HB stars lie on the same $(U - B, B - V)$ relation as the early-type stars in the young disk population (Eggen 1960). The values of $E(B - V)$ are plotted against *csc b* in Figure 9 where the stars near the North Galactic Pole are indicated by filled circles and those near the South Galactic Pole by open circles; all these objects are at distances in excess of 400 ps and probably lie beyond the half-thickness of the absorbing layer. The absorption is probably the same at both poles, $E(B - V) = 0.04$–0.06.

Of the stars in Table 8 for which Greenstein's spectral types are available, Feige Nos. 23, 27, 84, 86, 92, and 99 are described as having very weak He I and/or metal lines. This line weakness supports the assignment as HB stars (Searle and Rodgers 1966; Greenstein and Münch 1966). The only meaningful proper motions for the stars in Table 8 are 0".11 for F 86 and 0".06 for PHL 25, which lead, at distances of 400 and 700 ps, respectively, to a tangential motion of 200 km sec^{-1} for both stars. The 37 Humason-Zwicky (HZ 1947) stars near the North Galactic Pole, for which Harris (Greenstein 1966) has determined magnitudes and colors, contain seven stars which, by the color criterion adopted here, are probably HB objects. The three of these stars for which Greenstein (1966) has spectra indicate that the He I and/or metal lines are very weak. Both the HZ and Table 7 samples of blue stars indicate a minimum of about 20 per cent HB stars.

3. sdO, B, and SS Cyg stars.—The stars with $(U - V)$ bluer than about -1.2 (Fig. 2) will be a mixture of the bluer white dwarfs, DO, B, and DAwk (Eggen and Greenstein 1965*a*), the bluest and faintest ($M_V \sim +2$–$+6$) HB stars, and the SS Cygni variables ($M_V \sim +6$–$+10$). It is not possible to separate these stars on the basis of (U,B,V) photometry, except for the presence of rapid light variations in the SS Cyg stars. The line weakness characteristic of the spectra of HB stars may serve to segregate these objects among the bluer stars but the spectroscopic discrimination between sdOB and DOB is extremely weak (Greenstein 1966). Graham (1967) has had some success in separating these stars with the use of narrow- and intermediate-band photometry, and this approach should be exploited.

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