SPECTRA OF BD STARS WITHIN FIVE DEGREES OF THE NORTH POLE

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ABSTRACT

The spectral and luminosity classifications of nearly all the BD stars within 5° of the north pole have been determined with the 4°-objective prism of the Burrell telescope. Spectral classification criteria are established, as well as criteria for giant and dwarf stars of spectral class G2 and later. A general agreement exists between our classification and the HD system.

Our results show that the percentages of dwarfs for magnitude groups from 6 to 11 are in general agreement with the results obtained by other investigators. The selective absorption in the region is found to increase linearly to 0.30 mag. at 450 parsecs and to remain constant thereafter. The average intrinsic color is determined for each spectral class and for giant and dwarf stars later than G0.

The present investigation deals primarily with the spectral luminosity classifications of all the BD stars within 5° of the north celestial pole. Since stellar spectra[1] in this general region of the sky have been observed extensively, ample comparisons can be made with other classifications.

OBSERVATIONAL PROCEDURE

The spectra were secured with the 4° prism[2] mounted on the 24-inch Burrell telescope which has a field 5° in diameter. To widen the spectra of stars within 2°.5 of the pole, the polar axis of the instrument was set out of adjustment in altitude and the prism was adjusted so that the trailing due to the axis maladjustment produced spectra 0.25 mm wide in an exposure of 1 hour. To obtain spectra of the bright stars near the pole, a diaphragm was used in front of the prism and the exposure was kept the same. For other parts of the region the widening was produced by moving the telescope in declination, and for the bright stars short exposures were made and the telescope was moved accordingly. No guiding was found necessary.

For nearly all of the observations we have used Eastman 33 or II*a*-O plates, the latter yielding somewhat more satisfactory results. Each part of the area under investigation was covered by at least two plates, and the spectrum of each star on each plate was estimated independently by both observers.

CRITERIA FOR SPECTRAL CLASSIFICATION

Our criteria for classification were derived primarily by comparison with the known HD spectra of the stars at the pole as well as with bright stars in other regions. The adopted criteria are as follows:

B0 *H* lines weak. *He* lines λ 4026 and λ 4471 nearly as strong as the *H* lines.
B2 *H* lines well visible. *He* lines present.
B5 *H* lines prominent; *He* lines λ 4026 and λ 4471 just visible.
B8 *H* lines strong; *He* lines and K line invisible.
B9 *H* lines strong; K line just visible.
A0 *H* lines strong and broad; K line weak.
A2 *H* lines nearly as strong and broad as in A0; K line well visible, approximately one-third (H + *H*ε).

[1] Seares and Joyner, *Ap. J.*, **98**, 244, 1943.

[2] J. J. Nassau, *Ap. J.*, **101**, 275, 1945.

A3 *H* lines only slightly weaker than in A0; K line strong, about one-half of (H + $H\epsilon$).
A5 *H* lines weaker than A3. K approximately three-fourths of (H + $H\epsilon$).
F0 *H* lines weaker than in A5 but still strong; K slightly weaker than (H + $H\epsilon$). G band generally invisible.
F2 K nearly equal to (H + $H\epsilon$); G band sometimes visible; *H* lines pronounced but weaker than in F0.
F5 K = (H + $H\epsilon$); G band about one-half of $H\gamma$.
F8 G band equal to or slightly weaker than $H\gamma$. *H* lines well visible.
G0 G band stronger than $H\gamma$, *H* lines weak but visible.
G2 G band prominent, at least twice as strong as $H\gamma$, $H\delta$ still a well-formed line.
G5 G band very strong; perceptible break in continuum at the G band; $H\delta$ generally absent or very weak, λ 4227 of *Ca* I absent.
G8 Break at G band visible; λ 4227 sometimes visible; *H* lines absent.
K0 Break at G band well developed; G band very much stronger than λ 4227.
K2 G band slightly stronger than λ 4227.
K3 G band = λ 4227.
K5 Line λ 4227 > G band; *TiO* bands invisible.
M0 Band head at λ 4950 visible.
M2 Band head at λ 4950 strong; band at λ 4760 present.
M5 Band heads at λ 4950 and λ 4760 and double band at λ 4585 all present.
M8 All *TiO* bands very prominent.

The foregoing criteria represent only the prominent features which are visible on weak, as well as strong spectra and on plates taken under average conditions of seeing and sky fog. Plates taken under ideal conditions of exposure and sky show lines which, when used, are bound to increase the accuracy of the classifications. At this time we feel that it is best to describe the criteria used with average plates.

In order to establish criteria for giants and dwarfs, multiple-exposure plates have been taken of stars with known trigonometric parallax and of stars listed in the Mt. Wilson catalog of spectroscopic parallaxes.[3] The spectra measured by P. C. Keenan[4] at the north celestial pôle and the north galactic pole have also been used. The *Atlas of Stellar Spectra* by Morgan, Keenan, and Kellman[5] has been used extensively, as well as some unpublished classifications kindly furnished by Dr. Morgan.

Giant and dwarf characteristics begin to show in our spectra at G2, although supergiants may sometimes be detected in earlier spectral types. From G2 to K3, inclusive, the *CN* bands at λ 3883 and λ 4215 are used as luminosity criteria. If these absorption bands are strong for a given spectral type, the star is a giant; if weak, it is a dwarf. The λ 3883 band is most useful for stars at G2, whereas from G8 to K3 the *CN* band at λ 4215 is more sensitive as a luminosity criterion. It is important to classify each star first, before assigning giant or dwarf characteristics.

For stars of class K5 and later the intensity of the continuum between λ 4227 and the G band is the best indicator of luminosity on our plates. If the continuum on the red side of λ 4227 is as strong or stronger than the continuum to the violet of λ 4227, the star is a giant. If the continuum on the red side of λ 4227 is weaker than on the violet side, the star is a dwarf.

DATA

Table 1 lists all the BD stars within 5° of the north pole. The photovisual magnitudes (second column) and the color index (third column) are taken from the paper by Seares, Ross, and Joyner.[6] The fourth column gives the spectral types as obtained from our

[3] *Ap. J.*, **81**, 187, 1935.

[4] *Ap. J.*, **91**, 113, 1940; **91**, 506, 1940.

[5] ("Astrophysical Mono."), University of Chicago Press, 1943.

[6] *Pub. Carnegie Inst. Wash.*, No. 532, 1941.

TABLE 1

BD	m_{pv}	CI	Sp.	BD	m_{pv}	CI	Sp.
+85°1	9.36	0.44	F8	+85°51	10.31	0.35	F8
2	8.37	0.42	dG2	52	10.05	0.24	F2
3	8.52	1.65	g:K5	53	9.04	0.19	F0
4	10.96	0.93	G5	54	9.37	0.32	F8
5	10.35	0.40	G0	55	10.48	0.57	G2
6	9.63	1.81	gK3:	56	10.09	0.41	A2
7	9.49	1.12	gG8	57	8.70	0.35	G0
8	9.83	0.49	G0	58	10.86	0.38	F8
9	7.90	0.63	dG5	59	....	....	G0
10	8.68	1.65	gK3	60	....	....	gG5
11	8.39	−0.02	A3	61	....	....	gG5
12	9.22	0.89	gG5	62	9.19	0.20	F2
13	9.81	0.23	A2	63	6.53	0.44	F8
14	9.82	0.67	dG5	64	8.81	0.41	dG2
15	10.21	1.36	G8	65	8.40	0.20	F5
16	10.10	0.19	F2	66	10.01	0.96	gG5
17	10.18	0.48	F8	67	10.24	0.35	F2
18	9.45	1.16	gG8	68	....	....	A3
19	4.28	1.19	gK0	69	....	....	A0
20	8.58	1.16	gK0	70	10.58	1.00	gG8
21	9.63	1.15	gG8	71	....	....	(dG5)
22	....	....	gG8	72	....	....	dG5
23	10.59	0.46	G2	73	10.25	0.54	dG5
24	9.97	0.33	F5	74	6.50	0.24	A3
25	9.71	1.15	gG8	75	8.06	0.80	dG8
26	10.51	1.10	gG8	76	10.64	0.32	F5
27	10.46	0.70	dG5	77	9.35	0.02	A0
28	10.00	0.69	G2	78	6.71	−0.10	A0
29	9.90	1.80	K3	79	9.73	1.06	gG5
30	9.99	0.43	G0	80	6.17	1.52	gK3
31	10.67	0.54	(F5)	81	7.47	0.96	gG5
32	9.14	0.19	F2	82	9.01	1.00	d:K5
33	9.71	1.37	gK2	83	9.73	0.26	A5
34	10.11	0.94	G5	84	9.52	0.92	g:G5:
35	9.48	1.01	gG8	85	9.53	0.42	G0
36	9.25	0.38	G0	86	10.09	1.09	d:G8
37	10.56	0.39	G0	87	8.99	0.84	gG5
38	9.52	0.27	A2	88	10.85	0.50	G0
39	10.34	1.05	....	89	10.05	0.50	G0
40	10.41	1.23	....	90	10.77	0.69	g:G5
41	6.95	0.84	g:G8	91	9.70	0.37	F5
42	10.49	1.37	g:K2	92	9.57	1.13	g:G8
43	10.74	0.41	....	93	10.08	−0.04	A0
44	10.72	0.96	....	94	8.75	1.03	gG8
45	7.84	−0.05	B9	95	9.87	1.35	gK0
46	8.97	0.71	F8	96	10.22	0.91	dG8
47	10.45	0.37	F5	97	10.60	0.70	dG5
48	8.81	0.15	F2	98	8.13	1.62	gM2:
49	10.22	0.45	dG2	99	8.79	0.96	g:G8
50	8.83	−0.21	B9	100	8.76	2.05	g:K2

TABLE 1—*Continued*

BD	m_{pv}	CI	Sp.	BD	m_{pv}	CI	Sp.
+85°101.....	9.02	0.12	A5	+85°151.....	8.43	0.27	F8
102.....	10.30	1.30	gG8	152.....	10.89	0.19	A5
103.....	9.16	0.87	d:G8	153.....	10.72	0.57	G0
104.....	10.01	1.20	gG8	154.....	9.42	0.48	F8
105.....	7.96	0.34	F8	155.....	8.53	0.87	gG5
106.....	10.62	0.32	F8	156.....	10.24	1.69	gK3
107.....	9.76	0.33	F5	157.....	9.20	0.90	gG8
108.....	10.38	0.14	A3	158.....	8.63	1.06	gG8
109.....	10.59	0.62	G8	159.....	10.01	0.52	dG5
110.....	9.96	1.02	g:K0	160.....	8.36	0.37	F8
111.....	8.94	1.23	gK0	161.....	7.27	0.72	(dG5)
112.....	10.61	1.08	d:G8	162.....	10.42	0.63	dG5
113.....	10.66	0.40	F8:	163.....	10.72	0.44	G0
114.....	10.34	1.27	gK2	164.....	10.03	0.42	F8
115.....	9.54	1.13	gK0	165.....	9.11	0.46	G0
116.....	10.47	1.44	K3:	166.....	8.05	1.04	gK0
117.....	8.44	1.34	gK0	167.....	10.46	0.51	dG2
118.....	9.74	0.42	G0	168.....	10.43	0.24	F0
119.....	10.59	0.58	F8	169.....	10.67	0.32	F0
120.....	10.60	0.96	....	170.....	8.56	0.96	gG8
121.....	10.62	0.35	F2	171.....	10.43	1.37	(gK2)
122.....	10.26	1.37	gM5:	172.....	9.61	1.75	(gK5)
123.....	10.78	0.33	F8	173.....	8.87	1.11	gG8
124.....	8.58	1.23	gK2	174.....	10.54	1.12	(gG8)
125.....	9.35	0.36	F5	175.....	9.71	1.05	gG5
126.....	10.57	0.20	F5	176.....	10.01	0.44	F5
127.....	9.06	0.95	dK2	177.....	10.54	0.57	F8
128.....	7.32	0.33	F8	178.....	10.49	0.57	(dG5)
129.....	8.39	0.99	gK0	179.....	10.71	0.61	(dG0)
130.....	10.60	0.63	dG5	180.....	10.63	0.65	(F8)
131.....	9.58	0.29	F0	181.....	10.46	0.52	dG5
132.....	8.41	0.11	F0	182.....	9.79	1.79	(gK5)
133.....	10.45	1.03	g:K5:	183.....	7.22	0.88	gG8
134.....	10.93	0.25	F2	184.....	9.50	0.41	F2
135.....	8.79	0.37	F8	185.....	10.74	0.63	G2:
136.....	9.16	1.51	gK2	186.....	10.57	0.35	F2
137.....	10.71	1.01	....	187.....	10.43	0.33	F8
138.....	10.44	0.61	dG5	188.....	10.30	1.33	(gK2)
139.....	....	....	F8::	189.....	9.52	0.65	dG5
140.....	....	....	g:K0	190.....	9.43	0.44	G0
141.....	10.34	0.38	F8	191.....	8.63	0.20	F5
142.....	8.72	0.30	F5	192.....	9.66	1.20	gG8
143.....	10.77	0.44	F8	193.....	10.31	0.48	dG2
144.....	10.79	0.77	d:G5	194.....	10.65	0.57	dG2
145.....	10.68	0.46	F8	195.....	10.38	0.79	dG5
146.....	10.68	0.38	F2	196.....	8.68	0.03	A3
147.....	8.20	1.57	gK5	197.....	9.68	0.38	F8
148.....	10.17	1.61	g:M2	198.....	10.56	0.63	dG5:
149.....	10.57	0.46	G0	199.....	9.29	1.26	gK0
150.....	7.79	0.88	g:G8	200.....	10.58	0.70	dG5

TABLE 1—*Continued*

BD	m_{pv}	CI	Sp.	BD	m_{pv}	CI	Sp.
+85°201.....	10.31	0.64	d:K0	+85°251.....	....	....	g:G8
202.....	9.42	0.73	dG5	252.....	10.25	0.58	dG5
203.....	9.53	1.75	gK5	253.....	10.69	0.51	F8
204.....	10.89	1.12	G5:	254.....	10.22	0.49	G0
205.....	9.79	1.79	gK3	255.....	11.10	0.46	G0:
206.....	10.40	1.21	gG8	256.....	9.82	1.69	g:M2
207.....	10.05	1.56	gG5	257.....	9.43	0.29	F0
208.....	9.70	1.89	K5:	258.....	10.60	0.40	F5
209.....	9.09	0.63	dG2	259.....	10.84	0.58	G0
210.....	9.96	0.47	G0	260.....	10.80	0.93	K2:
211.....	9.55	0.48	G0	261.....	9.96	1.12	....
212.....	10.81	0.64	dG2	262.....	....	....	....
213.....	9.41	0.32	F5	263.....	6.88	0.91	gG5
214.....	9.24	0.56	dG8	264.....	9.04	0.62	dG5
215.....	10.95	−0.14	B8	265.....	9.10	0.95	g:G5
216.....	10.78	0.92	gG5	266.....	8.71	0.38	G0
217.....	9.77	0.55	dG2	267.....	10.50	0.20	....
218.....	10.93	0.89	(dG0)	268.....	10.45	0.55	G0
219.....	10.34	0.28	F8	269.....	6.91	0.09	A5
220.....	10.03	0.44	F5	270.....	10.22	1.37	(gK2)
221.....	....	....	dG2:	271.....	10.65	0.70	(dG0)
222.....	7.27	0.39	G0	272.....	10.37	0.46	G0
223.....	9.70	0.87	dK2	273.....	10.40	1.13	gG8
224.....	9.08	1.05	dG8	274.....	10.14	0.44	(dG0)
225.....	9.23	1.52	gK2	275.....	9.83	0.50	G0
226.....	10.94	0.28	F2p	276.....	10.59	0.93	dG8
227.....	10.67	0.37	F8	277.....	10.43	0.37	G0
228.....	10.48	0.25	A5	278.....	8.65	0.27	F8
229.....	10.87	0.98	G5:	279.....	9.78	1.24	(gG8)
230.....	10.56	0.78	d:K0	280.....	....	....	G5
231.....	10.07	1.21	gG8	281.....	9.95	1.87	K3
232.....	10.18	0.72	dG2	282.....	10.23	1.31	gG8
233.....	8.86	0.39	G0	283.....	10.09	1.16	dG5
234.....	7.74	1.15	gG8	284.....	....	....	g:G8
235.....	8.45	1.57	gK2	285.....	10.91	0.51	d:G5
236.....	10.50	0.92	gG5	286.....	9.49	0.92	dK0
237.....	10.39	1.25	gG8	287.....	10.60	0.47	F2p
238.....	10.62	0.30	F5	288.....	10.25	0.53	d:G2
239.....	9.14	0.19	A5	289.....	9.46	1.22	gG8
240.....	9.84	0.35	F5	290.....	10.66	1.11	G8
241.....	9.98	1.34	gG8	291.....	11.19	0.45	G0
242.....	8.61	1.28	gK0	292.....	10.58	0.74	d:G8
243.....	10.67	1.04	G5:	293.....	10.60	0.82	dG5
244.....	10.72	0.40	F8	294.....	7.64	0.14	F0
245.....	9.88	1.75	K2::	295.....	10.90	0.88	gG8
246.....	10.63	0.57	dG5:	296.....	10.86	0.94	gG5
247.....	9.18	0.37	F8	297.....	9.61	2.35	gM5
248.....	8.86	0.28	F5	298.....	10.65	1.35	(gM:)
249.....	7.50	0.87	gK0	299.....	10.84	0.44	F8
250.....	....	....	F2	300.....	....	....	(gK2)

TABLE 1—*Continued*

BD	m_{pv}	CI	Sp.	BD	m_{pv}	CI	Sp.
+85°301.....	10.88	0.64	dG5	+85°351.....	9.57	0.61	dG5
302.....	10.98	0.49	G0	352.....	9.83	0.30	F0
303.....	10.28	0.98	d:K0	353.....	9.04	1.40	gK2
304.....	9.05	0.51	F8:	354.....	7.88	1.44	gK3
305.....	10.95	0.45	F8	355.....	9.38	0.25	A5
306.....	10.87	0.69	G5:	356.....	10.49	1.25	g:G5
307.....	10.02	0.35	G0	357.....	9.10	0.57	dG2
308.....	10.82	0.75	d:G5	358.....	10.44	0.96	dG8
309.....	10.11	1.27	K0	359.....	8.43	0.10	A3
310.....	10.89	0.44	F2	360.....	11.09	0.45	A5
311.....	11.07	0.37	G0	361.....	....	....	A2
312.....	10.62	1.13	g:G8	362.....	10.51	1.15	gG8
313.....	10.64	1.22	gK0	363.....	10.66	0.10	A2p
314.....	10.63	0.39	F8	364.....	9.71	0.63	dG5
315.....	10.54	0.58	G0	365.....	10.62	1.09	g:G8
316.....	10.59	0.89	dG5	366.....	9.02	1.35	gK0
317.....	10.63	0.59	G2	367.....	9.01	−0.06	B9
318.....	10.43	1.22	gG5	368.....	....	....	G8
319.....	10.79	0.92	gG8	369.....	9.87	1.14	gG8
320.....	9.06	0.12	A0	370.....	9.45	0.38	F2
321.....	10.51	0.72	dG5	371.....	9.20	0.44	F8
322.....	10.78	0.72	(F8)	372.....	....	....	M5:
323.....	10.68	1.10	....	373.....	10.36	1.16	gG8
324.....	9.37	0.52	G0	374.....	10.16	0.34	A2
325.....	9.55	0.54	G0	375.....	10.57	0.44	G0
326.....	10.19	1.51	gG8	376.....	8.89	0.11	A5
327.....	10.88	0.98	gG8	377.....	10.83	0.63	G0:p
328.....	11.00	0.60	F8	378.....	9.87	0.91	dG8
329.....	7.93	1.06	gK0	379.....	10.76	0.98	gK0
330.....	8.64	0.79	d:G5	380.....	10.44	0.35	A3
331.....	9.51	1.49	gK0	381.....	10.16	1.56	gK0
332.....	9.53	2.06	R8	382.....	9.63	0.51	G0
333.....	10.36	1.10	dG5	383.....	5.30	−0.08	(A0)
334.....	9.73	1.19	gG8	384.....	6.65	1.07	gK0
335.....	9.21	1.64	gK0	385.....	10.85	0.82	d:G8
336.....	10.12	0.46	F8	386.....	9.36	1.30	gG8
337.....	8.82	0.09	A2	387.....	10.48	0.52	A0
338.....	10.01	1.08	gG5	388.....	....	....	G5
339.....	9.14	0.66	G0	389.....	9.38	0.39	G0
340.....	7.75	1.54	gK3	390.....	8.55	0.73	gG5
341.....	10.57	1.13	g:G5	391.....	10.51	1.17	G8
342.....	10.27	1.40	G8	392.....	9.44	0.39	A0
343.....	10.04	1.08	gG8	393.....	10.77	0.50	G0
344.....	10.44	0.19	A2	394.....	10.52	0.42	G0
345.....	9.42	1.25	gK0	395.....	9.99	1.44	gG8
346.....	10.69	0.59	F8	396.....	10.44	0.16	A3
347.....	8.58	0.74	dG5	397.....	10.76	0.62	A5
348.....	9.60	0.34	A5	398.....	8.59	1.03	gK0
349.....	9.75	0.44	F8	399.....	6.63	0.16	F0
350.....	10.34	0.42	G0	400.....	7.60	0.70	gG8

TABLE 1—*Continued*

BD	m_{pv}	CI	Sp.
+85°401.....	7.23	0.31	F8
402.....	10.10	0.35	F8
403.....	7.16	−0.01	A3
404.....	10.13	0.71	dG5
405.....	10.74	0.45	F8
406.....	8.90	−0.15	A2
407.....	9.93	0.21	F0
408.....	10.57	0.13	A5
409.....	6.82	−0.11	A2
410.....	9.61	0.54	dG5
411.....	10.09	0.18	F0
412.....	8.48	0.32	G0
+86°1.....	10.16	0.18	F0
2.....	9.14	1.67	gK3
3.....	10.24	0.72	G2
4.....	10.56	0.26	F2
5.....	10.92	0.44	F8
6.....	9.96	1.35	gK0
7.....	9.05	0.22	F5
8.....	10.45	0.21	F2
9.....	8.78	−0.09	A5
10.....	10.60	1.43	(gK5:)
11.....	9.99	0.39	F8
12.....	10.76	0.95	(gG8)
13.....	10.94	0.72	dG5
14.....	8.86	0.51	dG5
15.....	10.13	0.88	dG5
16.....	10.37	0.55	(F8:)
17.....	6.25	1.00	gK0
18.....	9.34	1.02	gG8
19.....	10.36	0.31	F8
20.....	10.34	0.33	G0
21.....	8.50	0.40	dG5
22.....	10.62	0.92	gG5
23.....	10.66	0.28	A3
24.....	10.44	1.45	gG8
25.....	8.12	0.14	F5
26.....	10.09	0.44	G0
27.....	9.45	1.23	gG8
28.....	10.84	0.39	G0
29.....	9.85	0.23	F0
30.....	9.01	1.41	gK0
31.....	9.95	0.02	B9
32.....	9.27	0.92	gG8
33.....	9.84	1.16	gG8
34.....	10.48	0.21	A5
35.....	10.78	0.52	dG2
+86° 36.....	10.38	1.02	gG5
37.....	10.47	0.84	g:G8
38.....	9.26	0.02	A3
39.....	7.88	0.13	F2
40.....	10.74	0.64	G0
41.....	9.81	1.09	gG8
42.....	10.32	0.17	A2
43.....	9.33	0.07	A3
44.....	9.17	0.30	F8
45.....	9.54	0.14	A5
46.....	10.34	0.31	F8
47.....	10.52	0.23	F5
48.....	10.31	0.44	F0
49.....	9.63	0.05	B8:
50.....	....	....	G0
51.....	5.83	0.28	F5
52.....	9.66	0.31	A5
53.....	10.81	0.82	g:G5
54.....	8.95	0.06	A5
55.....	9.56	0.36	F8
56.....	10.70	0.50	A2
57.....	10.70	0.27	F2
58.....	10.68	0.30	F5
59.....	9.80	1.46	gG8
60.....	10.66	0.39	G0
61.....	9.87	1.77	g:M2:
62.....	9.83	0.36	F8
63.....	10.21	0.39	G0
64.....	9.45	0.09	A5
65.....	8.53	0.42	G0
66.....	8.05	−0.18	B9
67.....	....	....	F8
68.....	10.51	0.28	G0
69.....	9.97	0.36	G0
70.....	9.85	1.13	gG8
71.....	10.74	0.18	F2
72.....	9.32	1.34	gK2
73.....	9.81	0.68	dG2
74.....	10.70	0.51	G0
75.....	9.61	0.32	F2
76.....	10.91	0.28	F0
77.....	8.69	1.19	gG8
78.....	10.43	0.34	dG2
79.....	6.55	1.15	gK0
80.....	10.47	0.03	B8
81.....	10.06	1.14	gG5
82.....	10.77	0.77	g:G5:
83.....	10.11	1.35	gG8
84.....	10.49	0.92	gG8
85.....	10.82	0.40	G0

TABLE 1—*Continued*

BD	m_{pv}	CI	Sp.	BD	m_{pv}	CI	Sp.
+86°86.....	....	....	F8	+86°136.....	10.86	0.64	dG5
87.....	10.22	0.39	G0	137.....	10.97	0.52	F5
88.....	10.60	0.24	F0	138.....	10.72	1.04	gG5
89.....	10.54	1.21	K0:	139.....	10.61	0.59	d:G2
90.....	10.07	0.98	g:G8	140.....	....	....	....
91.....	9.53	0.00	A0	141.....	10.56	0.61	dG5
92.....	9.57	0.61	dG5	142.....	....	....	....
93.....	10.51	0.47	F8	143.....	8.37	−0.03	A2
94.....	9.80	1.08	gG8	144.....	10.54	0.41	G0
95.....	11.01	0.31	F8	145.....	10.34	1.06	gG8
96.....	8.96	0.27	F5	146.....	9.25	−0.05	A0
97.....	10.66	0.47	G0	147.....	10.79	1.09	g:G5:
98.....	9.99	1.03	gK2	148.....	10.69	0.48	dG2
99.....	10.87	0.75	d:G5	149.....	8.85	1.19	gG8
100.....	10.10	0.51	dG2	150.....	10.42	0.42	d:G2
101.....	10.35	1.08	gG8	151.....	9.96	0.68	dG5
102.....	8.84	−0.18	A0	152.....	....	....	A3–F2
103.....	7.85	0.43	(dG0)	153.....	10.11	1.32	gG8
104.....	10.18	0.50	dG2	154.....	8.02	0.36	G0
105.....	10.23	1.16	g:G8	155.....	....	....	B5:
106.....	....	....	F0	156.....	....	....	gG8:
107.....	9.41	0.31	F8	157.....	9.34	1.19	gG5
108.....	10.65	0.98	gG8	158.....	10.68	0.87	(gG8:)
109.....	9.81	0.54	dG2	159.....	8.40	−0.05	A3
110.....	8.36	1.55	gM5	160.....	9.60	0.65	d:G5
111.....	10.67	0.47	d:G2	161.....	7.32	0.12	A5
112.....	10.19	0.49	dG2	162.....	10.81	0.39	F8
113.....	7.33	0.81	gG5	163.....	9.18	0.44	G0
114.....	10.40	0.69	dG5	164.....	....	....	....
115.....	10.68	1.25	K0::	165.....	9.71	0.14	A5
116.....	9.44	0.98	gG8	166.....	10.37	0.46	F2:
117.....	9.62	1.12	gG8	167.....	9.87	0.95	g:G8:
118.....	10.74	0.96	dK2	168.....	10.27	0.40	F8
119.....	9.61	0.31	G0	169.....	9.39	0.26	F2
120.....	8.48	0.95	gG8	170.....	7.31	0.25	F0
121.....	10.75	0.46	G0	171.....	8.96	0.29	F2
122.....	9.54	1.03	gG8	172.....	8.04	0.78	gK0
123.....	9.82	1.16	gG8	173.....	9.15	1.31	gK0
124.....	10.33	0.11	A5	174.....	10.65	1.11	gG5
125.....	10.58	1.09	d:G5	175.....	10.60	1.4	(gK5:)
126.....	7.82	1.39	gK2	176.....	6.31	0.44	F8
127.....	9.37	1.02	gG8	177.....	8.81	0.20	F5
128.....	10.47	1.22	gK3:	178.....	9.67	1.40	gK0
129.....	10.73	0.40	F2	179.....	10.43	1.44	K0:
130.....	9.52	0.51	F8	180.....	8.91	−0.05	A0
131.....	10.04	0.38	F8	181.....	....	....	K3:
132.....	9.04	0.73	G0	182.....	7.24	0.11	A5
133.....	10.18	0.55	dG5	183.....	10.25	0.67	dG2
134.....	9.34	1.35	gG8	184.....	8.79	0.61	dG5
135.....	10.76	0.67	d:G2	185.....	10.97	0.40	G0

TABLE 1—*Continued*

BD	m_{pv}	CI	Sp.	BD	m_{pv}	CI	Sp.
+86°186	10.74	0.59	dG2	+86°236	10.72	0.32	F0
187	7.81	0.24	F8	237	10.32	1.16	gG5
188	10.18	0.14	A5	238	10.58	1.35	(gM)
189	11.02	0.63	d:G2	239	10.84	0.47	F8
190	...	...	F0	240	9.97	1.34	gG8
191	9.34	0.27	F2	241	10.73	0.59	d:G5
192	10.06	0.62	G2	242	8.46	0.97	gG8
193	7.95	0.19	F5	243	10.95	0.61	G0
194	10.64	0.75	dG5	244	...	...	A0
195	9.70	1.30	gK0:	245	10.96	0.46	F8:
196	10.43	1.21	gK0	246	9.76	0.54	G0
197	10.86	0.86	G8:	247	10.36	0.52	G0
198	10.71	0.58	d:G5:p	248	11.05	0.57	dG2
199	9.22	0.20	F0	249	10.29	1.12	g:G5
200	10.55	0.55	dG2	250	10.41	0.81	dK0
201	7.30	0.29	F5	251	10.43	1.18	G5
202	...	...	F5	252	9.93	1.16	gG8:
203	10.40	1.59	K3:	253	10.68	0.97	gG8
204	10.53	1.04	d:G5	254	9.54	0.60	dG5
205	...	...	G0:	255	10.78	0.61	F8
206	...	...	...	256	8.23	1.01	gG8
207	10.85	0.42	F5	257	10.02	0.61	dG5
208	10.92	0.58	d:G2	258	...	...	G8
209	10.86	1.07	g:G5	259	10.75	0.46	dG5
210	10.58	0.25	A3	260	9.90	0.48	G0
211	8.82	0.51	dG2	261	10.70	1.01	g:G8
212	9.78	0.39	F8	262	9.96	1.35	g:K0
213	10.65	0.18	F0	263	...	...	G0
214	10.39	0.27	F5	264	...	...	F5
215	9.60	0.30	F8	265	10.63	1.15	dG5
216	10.60	1.29	K0:	266	9.75	0.86	dG5
217	...	...	gG8	267	10.18	0.39	F2
218	10.63	1.16	gK0:	268	10.39	0.49	dG2
219	10.41	0.86	dG5	269	4.41	−0.02	(A0)
220	10.94	0.72	G0	270	10.74	0.93	d:G8
221	7.80	0.31	G0	271	10.04	0.50	dG8
222	9.11	0.46	G0	272	5.83	0.13	A2:
223	...	...	dG5	273	10.90	0.44	F8
224	10.50	0.53	dG2	274	10.96	0.46	G0
225	10.09	0.54	dG5p	275	7.66	1.06	gK0
226	10.86	1.05	G8:	276	10.91	0.49	G0
227	10.08	1.31	g:G8	277	9.15	0.22	A0
228	...	...	(d:K2:)	278	10.99	0.86	dG5
229	9.48	0.64	dG5	279	10.16	0.67	dG8
230	9.67	0.63	dG5:p	280	...	...	K3
231	9.72	1.15	dG8	281	9.09	1.12	gG5
232	10.44	0.31	F8	282	6.60	1.53	gM2
233	9.88	1.42	gG8	283	10.40	0.31	F2
234	9.59	0.35	F2	284	10.75	1.01	gG8
235	10.63	0.79	dG5	285	10.53	0.44	G0

TABLE 1—*Continued*

BD	m_{pv}	CI	Sp.	BD	m_{pv}	CI	Sp.
+86°286.....	9.31	0.40	F8	+86°336.....	10.92	1.06	G8
287.....	10.90	0.61	dG5	337.....	10.68	0.43	F5
288.....	10.44	1.12	gK0	338.....	10.51	1.15	gG8
289.....	9.29	1.40	gK0	339.....	10.72	0.24	F5
290.....	9.13	0.36	F2	340.....	10.40	0.17	F5
291.....	10.69	0.42	F0p	341.....	10.48	0.41	F8
292.....	10.87	0.49	G0	342.....	10.63	0.32	F8
293.....	9.96	0.54	G0	343.....	10.21	1.34	gK0
294.....	10.81	0.62	F8	344.....	5.60	0.14	A5
295.....	10.46	0.59	dG5	345.....	10.79	0.67	dG5
296.....	10.24	1.11	dG8	346.....	9.49	0.50	G0
297.....	9.21	0.44	F8	347.....	7.87	0.09	F0
298.....	10.23	0.56	dG2				
299.....	10.54	0.59	F8				
300.....	10.03	0.44	F8				
301.....	10.67	0.83	dG5	+87°1.....	9.17	0.03	A2
302.....	10.77	0.94	G5	2.....	9.92	0.89	dG5
303.....	8.74	1.05	gG8	3.....	10.75	0.61	dG5
304.....	10.91	0.34	A2	4.....	10.38	1.64	gK5
305.....	10.29	0.16	F0	5.....	9.45	0.30	F8
306.....	10.47	0.55	dG2	6.....	....	....	gG5
307.....	10.24	1.19	gG8	7.....	....	....	A3
308.....	10.59	1.13	gG8	8.....	9.10	1.06	gG8
309.....	10.62	1.04	g:G8	9.....	8.92	0.09	F2
310.....	10.64	0.96	gG8	10.....	10.86	0.61	dG2:
311.....	10.48	0.34	F5	11.....	10.22	0.21	F2
312.....	10.26	0.40	G0	12.....	7.89	1.10	gK0
313.....	10.86	0.65	F2p	13.....	9.72	0.40	G0
314.....	11.15	0.48	dG5	14.....	10.48	1.16	gG5
315.....	11.10	0.41	A2	15.....	8.18	0.03	A5
316.....	9.04	1.14	gK0	16.....	8.88	0.34	G0
317.....	9.56	0.56	G0	17.....	10.64	1.22	gG8:
318.....	8.56	0.21	F5	18.....	10.17	1.02	gG5
319.....	7.49	−0.07	A2	19.....	10.30	1.35	gG8
320.....	....	....	gG8	20.....	10.57	0.23	F5
321.....	....	....	A2	21.....	10.84	0.68	d:G5
322.....	10.77	0.59	F8	22.....	9.77	1.20	gG8
323.....	10.53	1.24	gK2	23.....	8.50	0.95	gK0
324.....	8.44	0.01	A2	24.....	11.09	0.51	d:G2
325.....	....	....	G0	25.....	10.92	0.55	dG2
326.....	8.77	1.96	g:M2	26.....	8.86	0.26	G0
327.....	9.74	0.49	G0	27.....	8.98	1.18	gG8
328.....	9.66	1.23	gG8	28.....	10.83	0.68	G8
329.....	10.90	1.04	G5	29.....	10.30	0.53	dG2
330.....	10.20	0.57	dG2	30.....	10.67	0.63	dG2
331.....	10.23	0.41	G0	31.....	9.76	0.41	G0
332.....	9.30	0.13	F2	32.....	10.03	1.84	(gK5:)
333.....	....	....	A0	33.....	8.61	0.15	F2
334.....	10.29	0.25	B9	34.....	10.47	1.20	gG2
335.....	8.29	−0.17	A0	35.....	9.47	0.42	G0

TABLE 1—*Continued*

BD	m_{pv}	CI	Sp.	BD	m_{pv}	CI	Sp.
+87°36.....	10.46	0.44	G0	+87°86.....	9.53	1.01	gG8
37.....	10.20	0.46	dG2	87.....	10.59	0.86	d:G2
38.....	10.07	0.32	F2	88.....	10.73	1.32	(gK5)
39.....	10.50	0.44	G0	89.....	9.79	0.32	F5
40.....	10.75	0.38	F8	90.....	10.40	0.26	F2
41.....	8.11	1.94	gK5	91.....	10.33	1.22	d:K5:
42.....	11.11	0.40	G0	92.....	10.60	0.38	G0
43.....	10.12	1.37	gG5	93.....	10.61	1.30	K2
44.....	10.60	0.42	A5	94.....	10.15	0.43	G0
45.....	9.25	0.14	A3	95.....	10.57	1.32	g:G5
46.....	8.31	0.88	gG8	96.....	....	....	....
47.....	9.42	1.69	gK0	97.....	10.96	0.44	G0
48.....	9.45	1.99	K3:p	98.....	....	....	dG5
49.....	10.88	0.47	F5	99.....	8.28	0.59	dG8
50.....	10.36	1.16	gG5	100.....	....	....	(F2)
51.....	5.06	1.61	g:M0	101.....	....	....	A0
52.....	....	....	d:K2:	102.....	9.59	0.33	F8
53.....	9.56	1.04	gG8	103.....	9.95	0.95	G5
54.....	10.17	0.43	G0	104.....	8.05	1.03	gK0
55.....	10.56	0.63	G0	105.....	9.97	1.26	G5
56.....	....	....	F8	106.....	10.79	0.58	dG5
57.....	10.77	0.86	dG5	107.....	6.31	0.33	F5
58.....	10.35	0.97	gG8p	108.....	9.70	0.40	G0
59.....	11.07	0.33	A3	109.....	10.07	0.29	F0
60.....	10.18	1.31	G8	110.....	9.96	0.91	gG8
61.....	10.86	0.50	d:G2	111.....	10.78	0.40	G0
62.....	11.07	0.56	G0	112.....	9.63	0.52	F2
63.....	9.90	0.48	G0	113.....	9.52	0.37	F8
64.....	10.82	0.72	d:G5	114.....	10.92	0.49	F0
65.....	....	....	gG5	115.....	8.64	0.34	G0
66.....	....	....	g:G5	116.....	10.38	0.74	G5
67.....	9.57	0.35	F0	117.....	9.40	0.34	F5
68.....	8.74	0.26	F8	118.....	8.84	1.02	dK3
69.....	9.06	0.83	gK0	119.....	....	....	(F8)
70.....	10.67	0.94	d:G5	120.....	....	....	G5
71.....	9.28	0.32	F8	121.....	8.71	0.97	gG8
72.....	9.81	0.41	F8	122.....	8.53	0.10	F2
73.....	9.86	1.11	gG8	123.....	10.76	0.39	F8
74.....	10.40	0.30	F8	124.....	9.57	0.15	A5
75.....	10.03	0.54	dG8	125.....	9.61	0.54	dG5
76.....	10.61	1.13	G5	126.....	10.75	0.54	dG2
77.....	10.65	0.43	G0	127.....	10.08	0.14	A2
78.....	8.31	0.12	F2	128.....	10.38	0.50	G0
79.....	8.32	0.99	gK0	129.....	8.78	1.44	gK0
80.....	8.66	1.09	gK0	130.....	9.14	1.14	gG8
81.....	9.49	0.47	G0	131.....	9.72	0.93	G5
82.....	9.28	0.29	F2	132.....	10.41	1.51	gK2:
83.....	7.76	0.94	gG8	133.....	9.30	0.86	g:G8
84.....	10.90	0.49	G0	134.....	10.47	0.47	G0
85.....	8.27	0.84	gG8	135.....	10.29	1.57	K0:

TABLE 1—*Continued*

BD	m_{pv}	CI	Sp.	BD	m_{pv}	CI	Sp.
+87°136.....	10.86	0.08	A0	+87°186.....	9.72	0.35	F8
137.....	9.83	1.03	gG8	187.....	8.08	1.11	gK0
138.....	10.21	0.35	G0	188.....	10.80	0.44	G0
139.....	10.45	1.27	d:G8	189.....	10.72	0.49	F5
140.....	10.72	0.63	G0	190.....	9.73	0.76	dG8
141.....	9.97	0.41	G0	191.....	10.01	1.21	gG5
142.....	10.41	0.52	dG5	192.....	9.99	0.44	dG2
143.....	6.89	1.39	gK0	193.....	9.41	0.27	G0
144.....	10.01	1.65	gK0	194.....	9.23	1.20	gK0
145.....	10.32	0.35	A5	195.....	9.49	0.42	dG2
146.....	....	....	A5	196.....	9.95	0.34	F5
147.....	8.16	0.31	G0	197.....	....	....	G0
148.....	9.62	0.52	dG2	198.....	....	....	g:K3
149.....	9.59	1.00	gG8	199.....	9.74	0.19	A5
150.....	10.39	1.18	gG5	200.....	11.00	0.47	G0
151.....	9.14	0.28	F8	201.....	8.42	0.22	F5
152.....	10.04	1.26	G5	202.....	10.46	1.11	gG8
153.....	10.77	0.97	G5:	203.....	10.31	1.20	gG5
154.....	10.57	0.58	dG2	204.....	10.58	1.30	g:G8
155.....	9.92	1.21	gG5	205.....	7.51	−0.05	A2
156.....	10.83	0.25	F5	206.....	9.51	0.31	F8
157.....	10.55	1.02	G5:	207.....	10.80	0.49	A5
158.....	10.01	0.55	dG5	208.....	11.14	(−0.16)	G0, F8
159.....	10.62	0.77	dG5	209.....	10.65	1.19	gK0
160.....	9.55	1.15	gK0	210.....	10.36	1.59	g:M2:
161.....	9.77	1.40	K0	211.....	10.42	1.08	g:G8
162.....	10.78	0.90	G8:	212.....	10.42	0.35	F5
163.....	10.56	0.28	F8	213.....	10.70	0.39	F8
164.....	9.87	0.51	G0	214.....	10.71	0.36	F5
165.....	10.15	0.40	G0	215.....	10.48	0.35	F8
166.....	8.97	1.12	gK0	216.....	10.76	0.51	F0
167.....	10.70	0.61	G2	217.....	9.07	−0.10	A2
168.....	9.56	0.74	G2	218.....	10.87	0.97	G5:
169.....	8.35	0.11	F0	219.....	10.99	0.37	F5
170.....	10.14	0.86	gG5	220.....	8.95	0.97	gK0
171.....	10.23	1.02	gG8	+88°1.....	10.50	0.44	dG2
172.....	10.51	1.27	g:G8	2.....	8.13	0.75	gG8
173.....	8.62	1.72	gK3	3.....	10.38	1.00	dK5p
174.....	9.74	1.10	gG8	4.....	6.48	0.01	A0
175.....	10.52	0.52	F5	5.....	8.93	0.58	gG8
176.....	10.82	0.38	F8	6.....	9.74	0.26	F5
177.....	10.30	0.42	G0	7.....	....	....	....
178.....	10.65	0.99	G8	8.....	....	....	G0
179.....	10.96	0.37	A5	9.....	8.14	0.14	F2
180.....	8.58	−0.07	A5	10.....	9.29	1.05	gG8
181.....	8.67	−0.08	A2	11.....	8.61	0.31	G0
182.....	10.81	0.39	F2	12.....	9.16	1.65	g:K0
183.....	9.65	1.01	dK5	13.....	8.86	0.07	F2
184.....	10.68	0.98	g:G8	14.....	9.53	1.32	gG8
185.....	9.44	0.18	F2	15.....	10.35	1.16	G8

TABLE 1—*Continued*

BD	m_{pv}	CI	Sp.	BD	m_{pv}	CI	Sp.
+88°16.....	9.67	0.45	G0	+88°66.....	10.81	0.45	dG2
17.....	9.72	1.85	K3	67.....	10.30	0.31	G0
18.....	10.50	0.85	dG5	68.....	10.47	0.43	gG2
19.....	9.62	1.64	gK0	69.....	9.76	1.01	gG8
20.....	9.39	1.18	gG8	70.....	10.72	1.02	g:G8
21.....	10.74	0.28	A2	71.....	6.31	0.20	F0
22.....	10.48	0.40	G0	72.....	9.67	0.24	F5
23.....	10.86	0.26	F8	73.....	10.24	0.33	F8
24.....	10.58	0.32	G0	74.....	9.63	1.34	gK0
25.....	10.61	0.66	dG2	75.....	9.14	0.32	F8:
26.....	10.48	0.56	G0	76.....	7.52	1.35	gK2
27.....	10.41	0.30	F8	77.....	8.66	0.13	F5
28.....	10.63	0.69	dG5	78.....	9.73	0.86	gG8
29.....	9.23	0.83	gG8	79.....	....	....	K0
30.....	10.52	0.34	G0	80.....	9.12	0.01	A2
31.....	9.49	1.66	gK0	81.....	10.88	0.47	F8
32.....	9.88	1.74	gK2	82.....	10.51	0.52	dG2
33.....	10.00	0.39	G0	83.....	10.41	0.33	G0
34.....	10.31	0.77	gG5	84.....	10.58	0.52	G0
35.....	9.35	0.33	F8	85.....	9.43	0.95	gK0
36.....	10.04	1.30	gG5	86.....	....	....	B9
37.....	10.41	1.20	gG8	87.....	10.88	0.47	A5
38.....	10.98	0.44	F2	88.....	10.74	0.57	G0
39.....	9.10	0.18	A2	89.....	10.44	1.24	gG8
40.....	10.29	1.06	dG5	90.....	9.08	0.77	g:G8
41.....	9.86	0.41	F8	91.....	10.33	0.14	F0
42.....	....	....	g:G5	92.....	9.93	0.23	F5
43.....	9.61	0.32	F2	93.....	10.42	0.48	G0
44.....	9.82	1.34	gG8	94.....	....	....	gM0
45.....	10.77	0.80	dG5	95.....	....	....	G2
46.....	9.93	1.46	gG8	96.....	9.78	0.32	F2
47.....	10.12	0.45	G0	97.....	10.69	0.44	F8
48.....	10.13	1.05	gG5	98.....	10.71	0.17	F2
49.....	10.60	0.32	G0	99.....	10.20	0.41	d:G2
50.....	10.88	0.97	G5	100.....	9.09	0.41	G0
51.....	11.05	0.48	dG5	101.....	9.32	0.29	F5
52.....	10.60	0.46	dG2	102.....	9.54	0.34	F8
53.....	10.44	0.43	G0	103.....	10.24	1.35	g:K0
54.....	10.04	0.42	G0	104.....	8.20	0.20	F8
55.....	9.97	0.32	F5	105.....	8.38	0.66	gG8
56.....	10.50	1.14	gG5	106.....	10.31	0.20	A3
57.....	10.47	0.54	G0	107.....	9.85	1.26	g:K0
58.....	10.43	0.55	dG5	108.....	10.26	0.34	G0
59.....	10.62	0.49	dG5	109.....	9.49	1.20	gG8
60.....	8.82	0.27	F8	110.....	9.09	0.15	F5
61.....	10.36	0.40	G0	111.....	....	....	F5
62.....	10.70	1.03	gG5	112.....	6.37	1.53	g:M2
63.....	10.38	0.36	G0	113.....	10.36	1.35	K3:
64.....	7.58	−0.22	A0	114.....	8.29	0.90	gK0
65.....	10.01	0.27	F5	115.....	9.22	−0.03	A3

TABLE 1—*Continued*

BD	m_{pv}	CI	Sp.	BD	m_{pv}	CI	Sp.
+88°116.....	10.19	0.29	F5	+89°6.....	10.31	0.35	A3
117.....	....	....	dG2	7.....	9.99	0.29	F2
118.....	9.56	0.44	G0	8.....	10.67	0.93	dK2p
119.....	10.64	0.19	F2	9.....	9.22	1.31	gG8
120.....	....	....	gG5	10.....	10.36	0.39	G0
121.....	....	....	....	11.....	10.70	0.41	G0
122.....	9.94	1.77	K5	12.....	9.82	0.50	G0
123.....	10.45	0.11	F2	13.....	7.09	0.09	A2
124.....	9.55	1.49	gG8	14.....	10.72	0.33	G0
125.....	10.62	0.78	dG5	15.....	9.63	0.69	gG5
126.....	10.94	0.51	G0	16.....	10.73	0.98	d:K3
127.....	10.59	0.66	d:G5	17.....	9.49	0.41	G0
128.....	10.37	0.36	F5	18.....	9.61	0.15	F2
129.....	10.64	0.26	F8	19.....	10.84	0.60	d:G2
130.....	9.28	0.23	F2	20.....	10.66	0.96	d:G5
131.....	8.98	−0.02	A3	21.....	....	....	F8
132.....	10.64	0.58	dG5	22.....	8.62	1.58	gK5
133.....	9.89	0.05	A5	23.....	....	....	g:G5
134.....	9.27	1.01	gG5	24.....	....	....	g:G5
135.....	....	....	g:K5:p	25.....	9.81	0.26	A3
136.....	10.44	0.23	F5	26.....	10.71	0.64	dG8
137.....	9.93	0.39	G0	27.....	10.53	0.40	G0
138.....	10.4:	1.4	g:M2	28.....	8.68	1.59	gK3
139.....	9.39	0.37	G0	29.....	10.40	0.15	A5
140.....	10.57	1.04	gG5	30.....	10.26	0.28	F8
141.....	10.10	0.38	G0	31.....	10.45	1.01	gG8
142.....	9.41	1.02	gG5	32.....	10.49	0.38	F2
143.....	10.46	0.98	dG5	33.....	10.42	0.18	F0
				34.....	10.02	0.60	dG5
+89°1.....	10.52	0.39	F2	35.....	9.85	1.15	gG8
2.....	9.15	1.70	gK2				
3.....	9.07	0.08	A3	36.....	10.39	0.34	F8
4.....	10.47	0.43	G0	37.....	....	....	G5
5.....	10.44	1.11	gG8	38.....	9.75	0.13	A0

NOTES TO TABLE 1

BD 85° 46	Very red for F8 star
100	Very red for g:K2 star
226	λ 4000 and λ 4040 prominent
246	λ 4227 strong
284	λ 4270 strong
287	Hγ weak, Hδ strong
363	Strong *He* λ 4027
377	λ 4150 present
387	Very red for A0 star
397	Very red for A5 star
86° 56	Very red for A2 star
152	λ 4077 strong; G band present
179	λ 4550 strong
198	λ 4227 strong
BD 86°225	λ 4077 and λ 4400 blend strong, Hγ weak
230	λ 4040, λ 4077, and Hδ strong
261	λ 4270 and λ 4400 blend strong
291	Strong line at λ 4470
313	Very red for F2 star; λ 4383 strong
87° 47	Very red for gK0
48	Many additional strong lines
58	Lines at λ 4470 and λ 4550 strong
139	Very red for d:G8
208	Two stars
88° 3	λλ 4040, 4077, 4470, and 4550 strong
135	Lines at λ 4470 and λ 4620
89° 8	λ 4550 strong

plates. For the sake of completeness we include in parentheses the spectra of a few stars which, for various reasons, we were unable to classify on our plates. These were secured, when available, from the Upsala spectral classifications as made by Petersson.[7]

COMPARISON WITH OTHER SYSTEMS

Table 1 includes 150 stars for which Henry Draper spectral types are available; these are plotted against our spectral classifications in Figure 1. Although the material is limited, it appears that a general agreement exists between the two systems. The large spread at G8 (Case) is due to the absence of that subclass in the *Henry Draper Catalogue*. The three stars shown by crosses in Figure 1 are: BD+85°412, 86°96, and 88°39. They

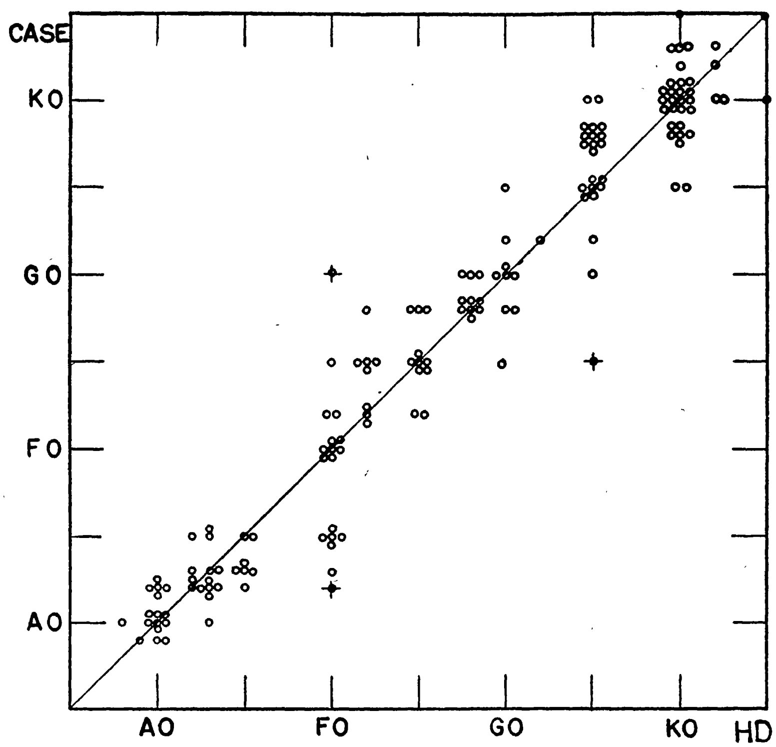

FIG. 1.—Plot of HD spectral type against spectral type determined at the Warner and Swasey Observatory of the Case School of Applied Science.

seem to have been wrongly classified in the *Henry Draper Catalogue*. Investigation showed no detectable magnitude error in our spectral classification.

The stars common to the Upsala[7] and Case lists which are classified as giant and dwarf indicate that there is agreement between the two lists for 231 of the 262 stars, or for 88 per cent of the stars in common. On the other hand, a comparison for the 63 stars common to the *Bergedorfer Spectral Durchmusterung*[8] and Table 1 show an agreement as to giant and dwarf classifications in only 33 per cent of the cases.

The percentages of dwarf stars near the pole are given in Table 2 from photovisual magnitude 6 to 11 and from G2 to M5. Our results agree closely, particularly for the K stars, with those obtained by Van Rhijn,[9] Bok,[10] and Van de Kamp and Vyssotsky[11]

[7] *Medd. Astr. Obs. Upsala*, **29**, 1, 1927.

[8] Schwassmann and Van Rhijn, Bergedorf, 1935.

[9] *Zs. f. Ap.*, **10**, 161, 1935.

[10] *Harvard Circ.*, No. 400, 1935.

[11] *Pub. McCormick Obs.*, Vol. **7**, 1937.

from secular parallaxes and from proper motions. For the G2 and G5 stars Table 2 indicates a somewhat larger percentage of dwarfs than found by the foregoing authors. The rapid change in percentage of dwarfs from G2 to G8 is noteworthy and indicates the necessity for accurate spectral classifications in this range when attempts are made to draw conclusions regarding percentages of dwarfs.

TABLE 2

PERCENTAGES OF DWARF STARS WITHIN 5° OF THE NORTH POLE

m_{pv}	6 to 7		7 to 8		8 to 9		9 to 10		10 to 11	
Sp. Class	Percentage Dwarfs	No. Stars	Percentage Dwarfs	No. Stars	Percentage Dwarfs	No. Stars	Percentage Dwarfs	No. Stars	Percentage Dwarfs	No. Stars
G2	....	0	....	0	100	3	100	8	95	42
G5	0	1	50	4	62	8	59	27	65	102
G8	0	1	0	5	10	20	9	64	18	68
K0	0	4	0	3	0	17	7	27	27	15
K2	....	0	0	2	0	4	10	10	33	9
K3	0	1	0	2	25	4	0	3	40	5
K5	....	0	....	0	0	4	40	5	29	7
M0–M5	0	2	....	0	0	3	0	3	0	4
G8–K5	0	6	0	12	6	49	11	109	22	104

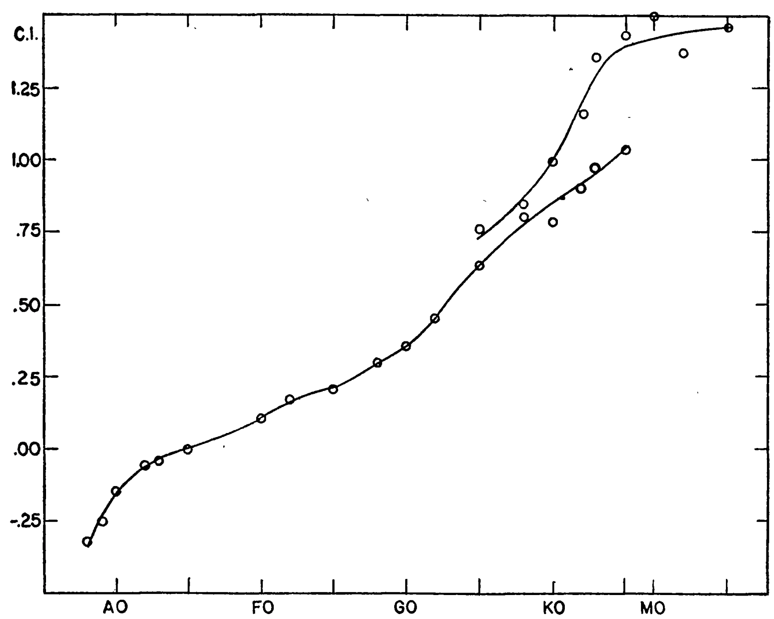

FIG. 2.—The intrinsic color-spectrum relation for stars near the north pole of rotation. The lower curve is for dwarf stars; the upper curve for giant stars.

COEFFICIENT OF SELECTIVE ABSORPTION AND THE COLOR-SPECTRUM RELATION

From a study of the spectra and corresponding color indices of stars near the pole, Seares and Joyner[1] have obtained the coefficient of selective absorption and established the intrinsic color-spectrum relation for stars within a region of 10° of the north celestial pole. All spectra used were reduced to the HD system, but the division of stars into giants and dwarfs was made primarily on the basis of the color indices.

In our case we are dealing with a uniform source of 1150 spectra, divided, as far as possible, into giants and dwarfs independent of their colors, with the stars confined within 5° of the north pole. With this material and with the colors obtained from Seares,

TABLE 3

INTRINSIC COLOR INDICES OF STARS

Sp.	CI (Case)	No. of Stars	CI (Sears and Joyner)	Diff.	Sp.	CI (Case)	No. of Stars	CI (Seares and Joyner)	Diff.
B8......	−0.35	3	−0.29	−0.06	dK0......	+0.85	6	+0.89	−0.04
B9......	− .24	6	− .23	− .01	dK2......	0.91	4	+1.01	.10
A0......	− .15	18	− .15	.00	dK3......	0.96	3	+1.06	.10
A2......	− .06	25	− .05	− .01	dK5......	1.03	4	....	....
A3......	− .04	21	− .02	− .02					
A5......	.00	35	.00	.00	gG5......	0.73	53	+0.78	.05
F0......	+ .11	31	+ .12	− .01	gG8......	0.87	138	+0.90	.03
F2......	+ .17	57	+ .16	+ .01	gK0......	0.99	61	+1.06	.07
F5......	+ .21	59	+ .26	− .05	gK2......	1.20	21	+1.25	.05
F8......	+ .30	105	+ .35	− .05	gK3......	1.30	12	+1.37	.07
G0......	+ .35	149	+ .42	− .07	gK5......	1.40	12	+1.45	.05
dG2......	+ .45	54	+ .50	− .05	gM0......	1.42	2	(1.47)	.05
dG5......	+ .63	91	+ .64	− .01	gM2......	1.44	8	(1.49)	−0.05
dG8......	+0.78	20	+0.79	−0.01	gM5......	+1.46	3	....	....

Ross, and Joyner[6] and with the values of absolute magnitude for the different spectral classes referred to in the Seares-Joyner[1] paper, the selective absorption at the pole was obtained. The results indicate that the selective absorption increases linearly to 0.30 mag. at 450 parsecs and remains constant thereafter. This result is in substantial agreement with the results of Seares and Joyner.[1] However, Stebbins, Huffer, and Whitford[12] obtained, from the photoelectric colors of 75 stars in a region within 10° of the pole, a value of the coefficient of selective absorption approximately two-thirds of the one given above. Using our derived coefficient of selective absorption, we obtain the average intrinsic color for each spectral type. These colors are shown in Figure 2 and Table 3. The fourth column of this table lists the corresponding values obtained by Seares and Joyner. The fifth column is the difference, Column 2 *minus* Column 3. A small systematic difference having an average value of −0.04 is present between the two determinations.

[12] *Ap. J.*, **94**, 215, 1941.