STARS WHOSE SPECTRA HAVE BRIGHT H AND K LINES OF CALCIUM*

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ABSTRACT

Stars whose spectra are known to show the H and K lines of *Ca* II in emission are listed in Table 1, together with the first published reference to their discovery. The intensities were estimated from Mount Wilson spectrograms. In general, the supergiants and giants show the H3 and K3 reversals, whereas the subgiants and main-sequence stars have fairly sharp, single, emission lines. The strength of the bright lines in any star appears, at present, to be unpredictable; variation in intensity is suspected in many stars. Emission of *Ca* II seldom occurs in stars hotter than G5.

Since the announcement of the presence of emission H and K lines of *Ca* II in stellar spectra by Eberhard and Schwarzschild in 1913, the field has gradually expanded to such an extent that it seems important to list the wide variety of sources emitting *Ca* II.

In the sun, emission at H and K was found visually by C. A. Young many years ago and was studied in considerable detail with the aid of high-dispersion spectrograms by G. E. Hale and C. E. St. John. The emission was found to vary greatly over the disk, its highest intensity being at the limb and in the regions of sunspots and faculae. It is responsible for the beautiful mottled detail shown in spectroheliograms taken in the K line of calcium. The bright lines are usually double, with components of nearly equal intensity, but, when the intensity is greatest, the lines are single. Because the emission is limited to certain areas of the surface, integrated sunlight shows such feeble bright H and K lines that they can be observed only with high dispersion and at times of considerable solar activity.

For several years after intensive observation of stellar spectra had begun, few reports of bright H and K were forthcoming, but the gratings and more transparent optical systems in use in recent years have made it apparent that emission at H and K is not a rare occurrence among stellar atmospheres. On the other hand, emission in observable intensity does not appear to be a universal characteristic of stellar spectra.

A "bright" line in the sense in which the word is used here is one which rises above the regions of the spectrum immediately adjacent on either side. In the stars of late spectral type the strong absorption, several angstroms in width, of H and K so reduces the intensity of the photospheric radiation that faint superposed emission is readily observed. In most of the stars the emission, as defined in this way, is far weaker than the continuous spectrum outside the great absorption wings. This emission doubtless represents the radiation of the chromosphere, which lies above the strata producing the absorption of the reversing layer.

With the exception of novae, which are abnormal in many respects, all stars known to show H and K emission are listed in Table 1, which we hope is complete for published material. The notes refer only to the first publication for each star. The hitherto unpublished material has been gleaned from the Mount Wilson collection of stellar spectrograms, with the aid of several of our colleagues. The survey is in no sense complete, but we hope that the data may be sufficient to open up the field and induce further study on the calcium atmospheres of the stars.

* *Contributions from the Mount Wilson Observatory, Carnegie Institution of Washington,* No. 758.

TABLE 1

EMISSION H AND K LINES

STAR	α(1900)	δ(1900)	MAG.	SPECTRUM	EM. INT.			ABS. K3 INT.	NOTES
					V Comp.	Single	R Comp.		
ADS 48A	$0^h\ 0^m4$	+45° 16′	9.4	dK6	.....	15	.....	....	3
ADS 48B	0 0.4	+45 16	9.4	dM0	.....	15	.....	....	3
Boss 6	0 1.4	+28 28	6.2	dK0	.....	3	.....	....	
SX Cas	0 5.5	+54 20	*9.5*	cA6e	1	.....	2	20	4
20 C 19A	0 12.7	+43 27	8.5	dM2.5	.....	3	.....	....	3
20 C 19B	0 12.7	+43 27	10.9	dM4e	.....	1 var.	.....	....	
R And	0 18.8	+38 1	5.0–15.3	gSe	15 var.	.....	0	....	5, 2
ADS 433	0 26.3	+66 41	10.4	dM2.5	.....	1	.....	....	
Boss 132	0 34.0	+30 19	3.5	gK4	2	.....	2	2	6
Boss 135	0 34.8	+55 59	2.5	gG7	1	.....	2	2	6
HD 3765	0 35.3	+39 40	7.5	dK5	.....	2	.....	....	
BD+61°154	0 37.5	+61 22	9.5	Be	.....	.....	.....	....	7
Boss 147	0 38.6	−18 32	2.2	gG6	.....	5	.....	....	1, 6
BD+34°106	0 37.3	+35 0	10.8	dM0e	.....	30	.....	....	8
Boss 164	0 42.0	+23 43	4.3	gG8	.....	30	.....	....	1
Boss 197	0 49.6	+23 5	6.1	sgK1	.....	2	.....	....	
20 C 65	0 55.1	+60 50	10.8	dM2.5	.....	1	.....	....	
20 C 66	0 55.3	+71 9	9.9	dM3.5e	.....	2	.....	....	
HD 5996	0 56.2	+68 42	8.1	dG5	.....	3	.....	....	
20 C 68	0 56.3	+61 48	9.5	dM2	.....	5	.....	....	9
Boss 230B	0 58.7	+ 0 50	9.0	dG8	.....	3	.....	....	
RX And	0 59.0	+40 46	10.3–13.6	Pec.	.....	6 var.	.....	....	10
Boss 259	1 4.1	+35 5	2.4	gM0	2	.....	8	2	11, 12
LPM 63	1 7.5	−17 32	11.6	dM5e	.....	3	.....	....	
AX Per	1 30.0	+53 45	10.8–12.5	gM3e	.....	5 var.	.....	....	13
Boss 357	1 31.9	+48 7	3.8	gK2	2	.....	1	1	
L 726-8A	1 34.0	−18 29	13.0	dM5.5	.....	30	.....	....	14
L 726-8B	1 34.0	−18 29	13.5	dM5.5	.....	30	.....	....	
Boss 384	1 37.4	+50 11	4.2	B0ep	1	.....	1	2	15
20 C 131	1 46.7	+17 27	10.5	dM0	.....	1	.....	....	
20 C 132	1 48.0	−22 55	9.0	dM1.5	.....	6	.....	....	
Ross 15	1 52.5	+58 1	12.1	dM4e	.....	30	.....	....	
ADS 1613	1 56.2	+36 14	8.0	dG5	.....	3	.....	....	
Boss 477	2 1.5	+22 59	2.2	gK1	1	.....	1	2	16
Boss 514	2 10.9	+33 46	5.1	dG0	.....	2	.....	....	
ADS 1752A	2 11.6	+28 17	6.6	dF6	.....	1	.....	....	
ADS 1752B	2 11.6	+28 17	7.6	dG0	.....	5	.....	....	
o Cet A	2 14.3	− 3 26	2.0–10.1	gM6e–9e	10 var.	.....	1 var.	....	2
o Cet B	2 14.3	− 3 26	10.0	dBep	20 var.	.....	40 var.	10	1, 17
BD+47°612	2 15.7	+47 24	9.4	dM1.5	.....	6	.....	....	
AC+49°2493-285	2 18.6	+49 21	11.2	dM0	.....	5	.....	....	
HD 15285	2 22.5	+ 3 59	8.6	dM1.5	.....	8	.....	....	
Boss 581A	2 29.5	+36 53	5.9	gK4	1	.....	1	1	
HD 16157	2 30.6	−44 13	8.8	dK6	.....	.....	.....	....	18
MWC 56	2 35.0	+60 50	11.6	Bep	.....	.....	.....	....	19
Boss 617B	2 37.4	+48 48	10.0	dM2.5	.....	6	.....	....	
Boss 619	2 37.6	+43 52	5.6	cG0	1	.....	1	5	
20 C 180	2 38.4	+25 6	10.5	dM3	.....	1	.....	....	
Boss 639	2 43.4	+55 29	3.9	cK4	1	.....	4	2	6
20 C 190	2 47.7	−13 11	6.1	dK0	.....	4	.....	....	

TABLE 1—*Continued*

Star	α(1900)	δ(1900)	Mag.	Spectrum	Em. Int.			Abs. K3 Int.	Notes
					V Comp.	Single	R Comp.		
Boss 660	2^h50^m2	+17° 56′	5.9	gM6	2	.....	2	2	
BD+29°503	2 51.8	+29 16	9.2	dK0	.....	2	.....	....	
Boss 691	2 57.0	+ 3 42	2.8	gM2	2	.....	15	2	11, 6
Boss 698	2 58.8	+38 27	3.2– 3.8	gM4	2 var.	.....	4 var.	5	
RX Cas Ft	2 58.8	+67 11	*11.1*	gA5e	.....	1	.....	....	20
20 C 221	3 11.6	+37 53	10.0	dM1.5	.....	3	.....	....	
Boss 752	3 14.1	+ 3 0	5.0	dG5	.....	2	.....	....	
BD+6°525	3 19.2	+ 6 40	10.0	dM0	.....	1	.....	....	
HD 21242	3 20.5	+28 23	6.5	dG5	.....	.....	.....	....	21
Boss 804	3 25.4	+12 36	4.3	gG7	2	.....	2	3	
BD+23°465	3 26.9	+23 21	9.0	gG8	.....	3	.....	....	
Boss 814	3 28.2	− 9 48	3.8	dK2	.....	8	.....	....	6
BD+20°598	3 31.7	+21 0	9.5	dK0	.....	6	.....	....	
BD+34°724	3 38.0	+34 39	10.7	dM0	.....	8	.....	....	
BD+27°555	3 38.3	+27 53	9.0	dG2	.....	3	.....	....	
Boss 848	3 38.5	−10 6	3.7	dK0	.....	1	.....	....	6
ADS 2768	3 40.9	+51 44	8.4	dG6	.....	8	.....	....	
Boss 876	3 43.1	+44 40	5.8	gG5	.....	3	.....	....	1
BD+16°516	3 44.7	+16 57	9.2	dK0	.....	4	.....	....	22
BD+23°571	3 45.1	+23 36	10.5	dK6	.....	2	.....	....	
20 C 271	3 49.1	+53 17	10.5	dM1.5	.....	4	.....	....	
ADS 2894A	3 52.4	− 1 27	8.6	dK5	.....	5	.....	....	23
ADS 2894B	3 52.4	− 1 27	11.3	dM3e	.....	12	.....	....	24
BD+19°641	3 54.8	+20 6	8.8	dG6	.....	2	.....	....	
RW Tau Br	3 57.8	+27 51	*8.0*	gB9	.....	40 var.	.....	....	25
ADS 2999B	4 2.0	+14 54	8.8	dK0	.....	2	.....	....	
Boss 967	4 7.6	+48 9	4.3	cG2	2	.....	1	5	
MH*α* 259-3	4 8.2	+27 55	13.5	dK5e	.....	30	.....	....	
HD 26736	4 8.6	+23 20	8.0	dG7	.....	1	.....	....	
MH*α* 259-22	4 8.7	+26 34	13	dM2e	.....	15	.....	....	
MH*α* 259-23	4 8.7	+26 31	14	dM3e	.....	20	.....	....	
HD 26756	4 8.8	+14 22	8.5	dG8	.....	1	.....	....	
BD+21°612	4 10.6	+21 40	9.0	dG9	.....	3	.....	....	
Boss 984	4 10.7	− 7 49	4.5	dK0	.....	2	.....	....	
ADS 3093C	4 10.7	− 7 49	11.1	dM4.5e	.....	20	.....	....	26
MH*α* 259-5	4 11.4	+27 57	13	dM2e	.....	10	.....	....	
HD 27149	4 12.2	+18 0	7.5	gG3	.....	2	.....	....	
MH*α* 259-6 Br	4 12.3	+28 1	13.5	dK5e	.....	25	.....	....	27
MH*α* 259-6 Ft	4 12.3	+28 1	15	dM3e	.....	20	.....	....	27
BD+28°637	4 12.3	+28 13	9.5	dK5	.....	20	.....	....	1
Hubble No. 4	4 12.6	+28 5	12.5	dK3	.....	10	.....	....	28
MH*α* 259-7	4 13.0	+28 52	11.5	dK5e	.....	50	.....	....	
HD 27250	4 13.1	+19 40	8.6	dK0	.....	1	.....	....	
HD 27282	4 13.4	+17 17	8.5	dG8	.....	1	.....	....	
RY Tau	4 15.6	+28 12	8.8–11.1	dF8–G2	15 var.	.....	10 var.	5	29
MH*α* 259-8	4 15.8	+27 41	12	dM1e	.....	50	.....	....	
T Tau	4 16.2	+19 18	9.0–12.8	dG5e	.....	40 var.	.....	....	30
HD 27685	4 17.0	+16 34	7.8	dG2	.....	2	.....	....	
HD 27732	4 17.5	+21 9	9.1	dG4	.....	2	.....	....	
BD+17°715	4 18.5	+17 47	9.8	dK6	.....	5	.....	....	

TABLE 1—*Continued*

Star	α(1900)	δ(1900)	Mag.	Spectrum	Em. Int.			Abs. K3 Int.	Notes
					V Comp.	Single	R Comp.		
HD 27836	$4^h18^m.5$	+14° 32′	7.6	dG0	.....	2	.....	....	
BD+16°593	4 19.3	+16 45	10.1	dK4	.....	4	.....	....	
HD 27990	4 20.0	+17 48	9.9	dK6	.....	3	.....	....	
HD 28068	4 20.7	+16 37	8.2	dG2	.....	2	.....	....	
MHα 259-11	4 20.9	+25 28	12	dM1e	.....	40	.....	....	
MHα 259-10	4 21.1	+25 50	11.5	dGe	.....	50	.....	....	31
BD+13°684	4 21.7	+14 0	10.0	dK5	.....	4	.....	....	
HD 28258	4 22.4	+13 38	9.4	dK0	.....	3	.....	....	
HD 28291	4 22.7	+19 31	8.8	dG7	.....	5	.....	....	
Boss 1045B	4 22.9	+15 44	4.0	gG8	.....	2	.....	....	
HD 28343	4 23.1	+21 41	9.0	dM1	.....	8	.....	....	
BD+26°722	4 23.4	+26 28	9.0	dG8	.....	4	.....	....	
MHα 259-9 n.pr.	4 23.5	+26 20	13	dM0e	.....	30	.....	....	
MHα 259-9 s.f.	4 23.5	+26 20	13	dM1e	.....	15	.....	....	
BD+17°734	4 23.7	+17 40	9.1	dK0	.....	2	.....	....	
BD+15°634	4 23.8	+16 2	9.5	dK5	.....	4	.....	....	
HD 28462	4 24.2	+16 26	9.9	dK0	.....	4	.....	....	
UX Tau A	4 24.2	+18 0	10.5–13.4	dG5	.....	6 var.	.....	....	29
UX Tau B	4 24.2	+18 0	13	dM2e	.....	20	.....	....	29
MHα 259-12	4 24.6	+25 49	12	dM1e	.....	10	.....	....	
HD 28545	4 24.9	+15 31	9.4	dG8	.....	4	.....	....	
XZ Tau	4 25.9	+18 1	*10.4–13.5*	dGe	.....	40 var.	.....	....	29
UZ Tau A	4 26.6	+25 40	9.2–13	dGe–dM2e	25 var.	.....	25 var.	5	32
UZ Tau B	4 26.6	+25 40	13.3	dM3e	.....	20	.....	....	32
MHα 257-2	4 26.7	+17 19	12.5	dK6e	.....	50	.....	....	
MHα 259-13	4 27.6	+25 8	13.5	dGe	.....	50	.....	....	
MHα 259-20	4 27.9	+22 38	13	dGe	.....	50	.....	....	
HD 28977	4 28.8	+15 37	9.4	dK0	.....	5	.....	....	
MHα 257-6	4 28.9	+17 57	13	dK5e	.....	15	.....	....	
MHα 259-17	4 28.9	+24 17	13.5	dM1e	.....	25	.....	....	
MHα 259-18	4 29.4	+24 2	12	dM0e	.....	25	.....	....	
α Tau	4 30.2	+16 18	1.1	gK5	3	.....	8	6	33
HD 29159	4 30.4	+15 28	9.1	dG8	.....	3	.....	....	
MHα 259-15	4 31.9	+25 59	13.5	dGe	.....	50	.....	....	
BD+23°722	4 34.0	+23 6	9.0	dG8	.....	4	.....	....	
HD 29608	4 34.7	+16 20	9.4	dK3	.....	8	.....	....	
HD 29713	4 35.7	+69 54	8.8	dK0	.....	3	.....	....	
MHα 259-19	4 36.5	+25 4	13.5	dM0e	.....	30	.....	....	
MHα 259-24	4 36.9	+25 9	15	dK5e	.....	20	.....	....	
20 C 303	4 37.0	+18 47	9.8	dM2.5	.....	6	.....	....	
RZ Eri Ft	4 39.0	−10 52	9.0	sgG8	.....	1	.....	....	34
MHα 257-7	4 41.2	+16 47	13.5	dM0e	.....	15	.....	....	
MHα 257-8	4 41.4	+16 46	13.5	dK3e	.....	40	.....	....	
MHα 259-2	4 41.6	+29 14	12.5	dK4e	.....	30	.....	....	
BD+20°823	4 42.7	+20 56	8.9	dK0	.....	3	.....	....	
BD+24°692	4 43.1	+24 38	9.1	dK2	.....	15	.....	....	1
HD 30505	4 43.2	+18 27	8.8	dK1	.....	2	.....	....	
HD 30572	4 43.7	+23 14	8.6	dG4	.....	2	.....	....	
HD 30676	4 44.6	+17 2	7.2	dF8	.....	1	.....	....	
HD 30712	4 44.9	+14 55	8.2	dG5	.....	1	.....	....	

TABLE 1—*Continued*

Star	α(1900)	δ(1900)	Mag.	Spectrum	Em. Int.			Abs. K3 Int.	Notes
					V Comp.	Single	R Comp.		
UY Aur A	4h45m4	+30° 37′	11.6–14.0	dG5e	.....	50 var.	.....	....	35
Wolf 1539	4 46.7	+ 6 19	11.8	dM4e	.....	1	.....	....	
HD 30957	4 46.9	+64 15	8.6	dK0	.....	4	.....	....	
MHα 259-1	4 48.6	+30 11	12	dK6e	.....	20 var.	.....	....	
Boss 1167	4 50.5	+33 0	2.9	gK3	3	.....	3	2	
Boss 1181	4 53.4	+ 1 34	4.7	cK3	.....	2	.....	....	
AC+2°2283-259	4 54.4	+ 1 36	10.0	dM0	.....	5	.....	....	36
HD 32347	4 57.4	+13 35	9.3	dK0	.....	2	.....	....	
RW Aur A	5 1.4	+30 16	9.0–12.0	dG5e	20 var.	.....	30 var.	10	29
RW Aur B	5 1.4	+30 16	11.5	dM0e	.....	25	.....	....	29
α Aur	5 9.3	+45 54	0.2	gG1	.....	3	.....	....	16
HD 35171	5 17.8	+17 14	8.2	dK5	.....	5	.....	....	
CO Ori	5 22.1	+11 20	10.0–13.0	gF3	.....	1	.....	....	10
MHα 265-2	5 23.5	+11 47	9.2	dK5e	.....	10	.....	....	
MHα 265-3	5 23.8	+11 46	11.5	dK3e	.....	40	.....	....	
MHα 265-5	5 23.9	+12 50	14.5	dM0e	.....	40	.....	....	
MHα 265-6	5 24.5	+12 9	13	dK3e	.....	10	.....	....	
MHα 265-9	5 25.3	+12 6	14	dK5e	.....	10	.....	....	
MHα 265-16	5 25.8	+12 7	14	dK0e	.....	40	.....	....	
20 C 334	5 26.4	− 3 42	8.1	dM2	.....	.....	.....	....	9
Ross 42	5 26.7	+ 9 45	11.8	dM4e	.....	15	.....	....	
AN Ori	5 30.8	− 5 32	11.3–12.0	dK1	.....	1	.....	....	37
BD−6°1253	5 31.6	− 6 47	9.7–10.1	dAe	.....	30	.....	....	38
BD+62°780	5 36.3	+62 15	9.2	dK5	.....	5	.....	....	
α Ori	5 49.8	+ 7 23	0.9	cM2	3 var.	.....	3 var.	8	39
Boss 1479	5 52.5	+45 56	4.6	cM3	2	.....	3	3	
HD 41593	6 1.0	+15 34	7.6	dK0	.....	5	.....	....	
20 C 377	6 6.4	−21 49	8.2	dM2.5	.....	.....	.....	....	40
Boss 1561	6 8.8	+22 32	3.3– 4.2	gM3	2	.....	20	5	11,6
Boss 1604	6 16.9	+22 34	3.2	gM3	2	.....	10	5	11,6
T Mon	6 19.8	+ 7 8	5.8– 6.8	cF8	.....	10	.....	....	2,41
20 C 390	6 24.3	− 2 44	11.3	dM4.5e	.....	12	.....	....	42
R Mon	6 33.7	+ 8 50	9.3–14.0	Pec.	.....	15 var.	.....	....	29
Boss 1704	6 35.0	+28 17	6.5	cG5	2	.....	2	4	
Boss 1717	6 37.8	+25 14	3.2	cG8	3	.....	20	10	11,39
BD+12°1343	6 49.2	+12 18	10.4	dM1	.....	3	.....	....	
Boss 1806	6 56.3	+24 21	5.2	cG2	2	.....	1	5	
ζ Gem	6 58.2	+20 43	3.7– 4.1	cF8	2	.....	0	40	2,43
Z CMa	6 59.0	−11 24	*8.9–11.4*	Bep	.....	2	.....	....	44
BD+27°1311	6 59.5	+27 37	10.7	dM0	.....	6	.....	....	
HD 53532	7 0.3	+22 50	8.1	dG5	.....	5	.....	....	
Ross 986	7 3.3	+38 43	12.4	dM5e	.....	12	.....	....	45
SS Cam Ft	7 4.2	+73 30	10.7	F5	.....	.....	.....	....	46
HD 55178	7 6.8	+59 56	7.3	gG6	.....	2	.....	....	
HD 56168	7 10.9	+67 51	8.6	dK1	.....	4	.....	....	
AR Mon Br	7 15.9	− 5 5	*10.1*	gK0	.....	3	.....	....	47
RY Gem Br	7 21.7	+15 52	*8.4*	A2	.....	.....	.....	....	48
20 C 426	7 25.4	+36 26	11.2	dM3.5e	.....	15 var.	.....	....	40
Ross 989	7 25.4	+36 27	12.2	dM4.5e	.....	10	.....	....	
YY Gem	7 28.2	+32 6	9.5	dM1e	.....	10,10	.....	....	49

TABLE 1—*Continued*

Star	α(1900)	δ(1900)	Mag.	Spectrum	Em. Int.			Abs. K3 Int.	Notes
					V Comp.	Single	R Comp.		
HD 61606	7^h35^m0	− 3° 21′	7.2	dK3	.....	5	.....	....	
Boss 2023	7 37.1	+29 8	4.3	gK1	.....	25	.....	....	1, 33
Boss 2031	7 39.2	+28 16	1.2	gG8	1	.....	1	1	16
Ross 882	7 39.4	+ 3 48	11.6	dM4.5e	.....	20	.....	....	
Boss 2040	7 40.3	+18 45	5.0	gK5	.....	2	.....	....	
U Gem	7 49.2	+22 16	8.8–13.8	Pec.	.....	2	.....	....	10
Boss 2099	7 52.6	−22 37	4.4	cG2	1	.....	1	5	
UX Mon	7 54.4	− 7 14	*8.7– 9.7*	A+G	.....	.....	.....	....	50
Boss 2155	8 3.6	− 2 42	4.4	cG6	3	.....	3	4	
SU UMa	8 3.7	+62 54	11.1–14.5	Pec.	.....	.....	.....	....	10
Boss 2195	8 11.1	+ 9 30	3.8	gK4	1	.....	1	1	
Z Cam	8 14.0	+73 26	10.2–13.4	Pec.	.....	3	.....	....	10
BD+14°1876	8 15.3	+14 23	10.5	dM0.5	.....	4	.....	....	
Boss 2208	8 16.0	+43 31	4.4	gK5	1	.....	3	1	
BD+22°1921	8 17.6	+22 11	9.5	dM0	.....	6	.....	....	
RU Cnc Ft	8 31.6	+23 55	11.5	dG9	.....	.....	.....	....	51
RZ Cnc Br	8 32.9	+32 9	*9.4*	gK2	.....	.....	.....	....	52
Boss 2335	8 38.8	− 6 52	4.7	cG4	1	.....	1	5	
Boss 2434	8 59.6	+67 16	5.3	gK5	1	.....	1	1	
HD 78366	9 2.7	+34 18	6.0	dG0	.....	2	.....	....	
Boss 2507	9 15.0	+34 49	3.3	gM0	1	.....	4	3	
HD 80768	9 16.5	+76 22	9.1	dK5	.....	6	.....	....	
Boss 2533	9 22.7	− 8 14	2.2	gK5	4	.....	4	6	
Boss 2536	9 22.9	+81 46	4.6	gK5	1	.....	1	1	
Boss 2618	9 40.2	+24 14	3.1	cG3	3	.....	2	10	
R Leo	9 42.2	+11 54	4.4–11.6	gM8e	30	.....	0	....	53, 2
HD 86590	9 54.4	+25 2	7.9	dG5	.....	20	.....	....	
BD+75°403	10 1.7	+75 37	9.3	dK6	.....	4	.....	....	
20 C 564	10 5.2	+49 57	6.8	dK5	.....	15	.....	....	
Boss 2706	10 5.7	−11 52	3.8	gG9	2	.....	1	3	
HD 88639	10 8.2	+27 39	6.1	gG2	.....	2	.....	....	
20 C 574	10 14.2	+20 22	9.4	dM4e	.....	20	.....	....	54
Boss 2742	10 14.5	+20 21	2.6	gK1	1	.....	1	4	
Boss 2751	10 16.4	+42 0	3.2	gK5	.....	3	.....	....	
BD+56°1458	10 24.1	+56 30	9.0	dK6	.....	.....	.....	....	40
L 1113-55	10 30.9	+ 5 38	12.2	dM4e	.....	15	.....	....	
Boss 2821	10 31.4	−15 50	6.2	gK2	.....	3	.....	....	
Boss 2829	10 33.1	+32 30	4.8	cG2	1	.....	1	3	
Boss 2899	10 47.7	+34 45	3.9	sgK2	.....	3	.....	....	
Boss 2915	10 50.8	+ 6 43	6.0	gM5	2	.....	5	3	
20 C 600	10 51.6	+ 7 36	13.5	dM6e	.....	40	.....	....	42
Boss 2922	10 54.5	+46 4	5.7	gK5	.....	1	.....	....	
Boss 2935	10 57.9	+36 38	7.3	dM2	.....	5	.....	....	
20 C 606A	11 0.5	+44 2	8.6	dM2	.....	3	.....	....	
20 C 606B	11 0.5	+44 2	14.8	dM5.5e	.....	40	.....	....	55
HD 96813	11 3.9	+36 51	6.0	gM3.5	.....	2	.....	....	1
Boss 2984	11 12.9	+32 6	4.7	dG0	.....	4	.....	....	1
ADS 8175B	11 23.7	+39 53	8.2	dG5	.....	3	.....	....	
RW UMa Ft	11 35.4	+52 33	10.9	G9	.....	.....	.....	....	51
TW Vir	11 40.3	− 3 53	11.8–16	Pec.	.....	.....	.....	....	10

TABLE 1—*Continued*

Star	α(1900)	δ(1900)	Mag.	Spectrum	Em. Int.			Abs. K3 Int.	Notes
					V Comp.	Single	R Comp.		
Boss 3090	11h40m8	+48° 20′	3.8	gK1	2	.....	2	1	
Boss 3211	12 14.9	+49 32	5.6	gM1	2	.....	8	2	
20 C 697	12 16.9	+42 42	9.1	dM0	.....	3	.....	....	
ADS 8553B	12 22.2	+27 35	8.7	dM0	.....	5	.....	....	
20 C 716	12 28.4	+ 9 34	12.7	dM5.5e	.....	30	.....	....	42
Boss 3280	12 29.1	−22 51	2.8	gG4	1	.....	2	3	
HD 110010	12 34.1	+79 46	7.0	dG2	.....	2	.....	....	
HD 110463	12 37.2	+56 17	8.4	dK2	.....	3	.....	....	
20 C 735	12 39.8	+52 19	7.0	dK0	.....	3	.....	....	
Boss 3326	12 41.3	+10 6	5.9	sgK1	.....	1	.....	....	
20 C 742	12 45.1	+66 40	10.5	dM3	.....	.....	.....	....	9
HD 111631	12 45.6	− 0 13	8.7	dM0	.....	.....	.....	....	40
Boss 3367	12 50.6	+ 3 56	3.7	gM3	2	.....	6	3	
20 C 754	12 55.6	+ 6 13	13.6	dM5e	.....	20	.....	....	
20 C 755	12 55.9	+12 54	9.9	dM2e	.....	15	.....	....	40
Boss 3383	12 57.2	+11 30	3.0	gG6	2	.....	2	3	
Boss 3401	13 2.4	+28 10	4.9	gK5	2	.....	2	1	
RS CVn Ft	13 6.0	+36 28	9.3	dG8	.....	2	.....	....	46
HD 115043	13 9.5	+57 14	6.7	dG2	.....	3	.....	....	
ADS 8862	13 15.4	+48 18	8.8	dM2	.....	4	.....	....	56
R Hya	13 24.2	−22 46	3.5–10.9	gM7e	20	.....	0	....	57, 2
ADS 8929C	13 26.0	+24 45	8.0	gG5e	.....	6	.....	....	1
Boss 3497	13 26.1	+79 10	5.9	gG4	.....	3	.....	....	
AC+18°1204-96A	13 28.1	+17 16	11.0	dM4e	.....	4	.....	....	
AC+18°1204-96B	13 28.1	+17 16	11.5	dM4.5e	.....	1	.....	....	
RW Hya	13 28.8	−24 53	*9.7–10.9*	gK5ep	.....	.....	.....	....	58
20 C 803	13 40.7	+15 26	8.6	dM2.5	.....	8	.....	....	
Boss 3584	13 47.4	+34 56	5.0	gM2	1	.....	3	2	
ADS 9090N	13 58.5	+46 49	9.9	dM3	.....	6	.....	....	
ADS 9090S	13 58.5	+46 49	9.9	dM3	.....	6	.....	....	
20 C 837	14 7.8	−11 33	13.5	dM5.5e	.....	25	.....	....	
Boss 3649	14 9.2	+78 1	5.0	gK4	.....	2	.....	....	
α Boo	14 11.1	+19 42	0.2	gK0	2	.....	3	2	33
Boss 3717	14 27.5	+30 48	3.8	gK3	3	.....	3	3	
Boss 3718	14 27.7	+76 8	4.4	gK4	1	.....	1	1	
HD 129333	14 36.9	+64 43	7.4	dG0	.....	3	.....	....	
Boss 3771	14 40.6	+27 30	2.7	gK0	4	.....	4	3	6
Boss 3798 Br	14 46.8	+19 31	4.8	dG5	.....	5	.....	....	
Boss 3798 Ft	14 46.8	+19 31	6.8	dK5	.....	2	.....	....	
Boss 3809	14 51.0	+74 34	2.2	gK5	2	.....	2	1	16
Boss 3827	14 56.0	+66 20	4.9	gM5	2	.....	4	3	
HD 134319	15 4.1	+64 26	8.3	dG5	.....	4	.....	....	
SS Boo Ft	15 9.8	+38 57	10.5	dG8	.....	5	.....	....	59
Boss 3945	15 27.3	+41 10	5.2	gK5	1	.....	2	1	
Boss 4001	15 39.3	+ 6 44	2.8	gK2	2	.....	2	1	6
R CrB	15 44.5	+28 28	13.8	cG0p	.....	15	.....	....	61, 1
Boss 4024	15 45.4	+26 22	4.7	gG4	2	.....	2	1	
RU Lup	15 50.1	−37 32	*9.0–11.0*	dGe	.....	50	.....	....	62
L 1130-30A	16 1.6	+ 8 38	12.0	dM3e	.....	1	.....	....	
Boss 4134	16 9.1	− 3 26	3.0	gM0	1	.....	8	2	6

TABLE 1—*Continued*

Star	α(1900)	δ(1900)	Mag.	Spectrum	Em. Int.			Abs. K3 Int.	Notes
					V Comp.	Single	R Comp.		
20 C 975	16h10m3	+44°42′	9.3	dK5	.....	3	.....	....	
BD+55°1823	16 14.9	+55 32	10.1	dM1.5e	.....	25	.....	....	63
S and R, No. 4	16 19.9	−24 6	*13*	dK5e	.....	v.str.	.....	....	64
S and R, No. 12	16 21.2	−24 27	*13.5*	dMe	.....	m.	.....	....	64
S and R, No. 9	16 21.6	−24 7	*12.5*	dK2e	.....	str.	.....	....	64
S and R, No. 10	16 21.8	−24 9	*15*	dKe:	.....	v.str.	.....	....	64
S and R, No. 13	16 22.7	−24 13	*12.5–14.0*	.....	.....	wk.	.....	....	64
α Sco	16 23.3	−26 13	1.2	cM1	3	.....	5	12	60
Boss 4201	16 25.4	+42 6	4.6–6.0	gM6	1	.....	2	8	
Boss 4204	16 25.9	+21 42	2.8	gG5	1	.....	1	6	
HD 149198	16 28.1	+67 16	6.7	gM3	.....	3	.....	....	65
HD 150409	16 35.8	+49 4	6.7	gM4	.....	4	.....	....	
WW Dra Ft	16 37.7	+60 54	*10.0*	sgK0	.....	6 var.	.....	....	66
Boss 4255	16 39.5	+39 7	3.6	gG4	.....	3	.....	....	
GC 22805	16 50.1	− 8 9	9.9	dM3e	.....	15	.....	....	42
GC 22892	16 56.6	+68 10	9.5	dG4	.....	2	.....	....	
HD 154734	17 2.1	+ 6 56	9.1	dK3	.....	4	.....	....	
GC 23095	17 2.1	+ 6 56	9.3	dK2	.....	8	.....	....	
Boss 4371Br	17 9.2	−26 27	5.3	dK2	.....	3	.....	....	
α Her	17 10.1	+14 30	3.1– 3.9	cM5	2 var.	.....	5 var.	8	6
Boss 4381	17 11.6	+36 55	3.4	gK5	2	.....	2	2	
Ross 867	17 16.1	+26 36	13.4	dM5e	.....	40	.....	....	
Ross 868	17 16.1	+26 36	11.2	dM4e	.....	15	.....	....	
Boss 4443	17 28.2	+52 22	3.0	cG2	5	.....	2	20	67
HD 159968	17 32.4	+27 39	6.6	gM4	.....	3	.....	....	
XX Oph	17 38.6	− 6 13	*9.1–10.7*	Bep	3 var.	.....	5 var.	20	
CD−27°11944	17 41.9	−27 59	9.0	P Cyg	.....	.....	.....	....	68
Boss 4497B	17 42.5	+27 47	10.2	dM3.5	.....	4	.....	....	
BD+46°2361	17 43.0	+46 53	10.3	dM1.5	.....	3	.....	....	
BD+4°3562	17 53.5	+ 4 29	9.5	dK5	.....	2	.....	....	
Z Her Ft	17 53.6	+15 9	7.9	dF2	.....	.....	.....	....	46
Boss 4541	17 54.3	+51 30	2.4	gK5	3	.....	4	2	16
Boss 4571Br	18 0.4	+ 2 31	4.3	dK1	.....	10	.....	....	6
Boss 4571Ft	18 0.4	+ 2 31	6.0	dK6	.....	12	.....	....	6
W Ser Ft	18 4.1	−15 34	*10.5*	cG2	.....	8 var.	.....	....	69
F 1 (41)	18 7.4	−16 12	12.5	dM1e	.....	15	.....	....	70
HD 167605	18 10.9	+69 40	9.1	dK2	.....	6	.....	....	
BD−1°3474	18 14.6	− 1 58	10.4	dM0	.....	3	.....	....	
AW Her Ft	18 21.3	+18 14	10.9	G4	.....	.....	.....	....	46
AC Her	18 26.0	+21 48	*9.0*	cG5	1	.....	2	4	41
GC 25394	18 31.6	+51 39	8.3	dM1	.....	20	.....	....	63
HD 172393	18 34.9	+42 35	8.7	dK0	.....	3	.....	....	
20 C 1108	18 43.6	−23 57	10.5	dM4.5e	.....	12	.....	....	42
Ross 160	18 47.5	+16 29	10.5	dM1.5	.....	5	.....	....	
HD 175742	18 51.7	+23 26	8.4	dK1	.....	20	.....	....	
Boss 4814	18 52.3	+43 49	4.0– 4.7	gM5	3	.....	4	10	
S CrA	18 54.4	−37 5	9.5–13	dGe	.....	50 var.	.....	....	29
Boss 4823	18 55.1	+14 56	4.2	gK0	2	.....	1	1	
Boss 4833	18 56.3	+62 16	6.4	gK6	.....	2	.....	....	
Boss 4860	19 1.2	+31 36	5.8	gK5	1	.....	2	1	

TABLE 1—*Continued*

Star	α(1900)	δ(1900)	Mag.	Spectrum	Em. Int.			Abs. K3 Int.	Notes
					V Comp.	Single	R Comp.		
HD 178450	19h 3m6	+30° 5′	8.1	dG6	.....	6	.....	....	
HD 179094	19 6.1	+52 16	5.9	sgK0	.....	30	.....	....	71
20 C 1143	19 12.0	+ 5 1	9.2	dM3	.....	4	.....	....	
BF Cyg	19 20.0	+29 29	9.3–13.4	Bep	.....	1	.....	....	72
ADS 12882A	19 41.0	+ 4 0	7.0	dG0	.....	2	.....	....	
ADS 12882B	19 41.0	+ 4 0	11.4	dM2e	.....	20	.....	....	73
Boss 5047	19 41.5	+10 22	2.8	gK4	2	.....	5	5	6
Boss 5052	19 42.9	+18 17	3.8	cM2	1 var.	.....	3 var.	2	74
CI Cyg	19 46.5	+35 26	*10.8–13.0*	Bep	.....	10 var.	.....	....	13
χ Cyg	19 46.7	+32 40	2.3–14.3	gM+S	.....	20	.....	....	75, 2
η Aql	19 47.4	+ 0 45	3.7– 4.4	cF6	6	.....	1	40	2
HD 189087	19 53.2	+29 33	8.2	dG7	.....	2	.....	....	
Boss 5118	19 54.3	+19 13	3.7	gM0	4	.....	4	4	
HD 190007	19 57.8	+ 3 2	7.8	dK4	.....	4	.....	....	
HD 190073	19 58.1	+ 5 28	7.9	A0ep	5	.....	5	10	76
Boss 5157	20 2.6	+35 42	5.5	dG3	.....	4	.....	....	
20 C 1191	20 2.7	+54 10	12.2	dM3e	.....	10	.....	....	
Boss 5187	20 10.5	+46 26	4.0	cK1	1	.....	1	3	
Boss 5197	20 12.1	−12 49	4.6	cG5	2	.....	3	25	
Boss 5200	20 12.4	+47 24	4.5	cK5	2	.....	2	2	
Boss 5279	20 30.0	+34 54	4.8	cK4	4	.....	4	6	
Boss 5299	20 34.0	+12 58	6.1	cK4	2	.....	3	3	
HD 196794	20 34.5	+ 9 43	8.9	dK0	.....	2	.....	....	
AE Aqr	20 35.0	− 1 14	9.7–11.7	Pec.	.....	50 var.	.....	....	77, 1
HD 196982A	20 35.6	−32 47	10.9	dM4.5e	.....	25	.....	....	42
HD 196982B	20 35.6	−32 47	11.1	dM4.5e	.....	30	.....	....	42
20 C 1225	20 39.0	−31 42	8.7	dM2e	.....	20	.....	....	42
BD+56°2471	20 39.0	+57 4	10.3	dM0	.....	4	.....	....	
X Cyg	20 39.5	+35 14	7.0– 8.2	cF7–G8	6	.....	1	6	78, 2
20 C 1226	20 39.8	+19 24	10.5	dM1.5	.....	3	.....	....	
20 C 1227	20 40.5	+54 57	15.3	dM5e	.....	30	.....	....	42
Boss 5336	20 42.2	+33 36	2.1	gK0	.....	1	.....	....	6
Boss 5346	20 43.3	+61 37	3.6	sgG7	.....	2	.....	....	
HD 199251	20 50.9	+33 22	7.4	gM3	.....	3	.....	....	
HD 199803	20 54.4	+ 0 43	8.9	dG4	.....	2	.....	....	
20 C 1250A	20 56.2	+39 41	10.2	dM3e	.....	25	.....	....	42
Boss 5431	21 1.3	+43 32	3.9	cK5	1	.....	8	20	6
Boss 5433	21 2.4	+38 15	5.6	dK6	.....	10	.....	....	6
Boss 5434	21 2.4	+38 15	6.3	dM0	.....	15	.....	....	6
Boss 5507	21 21.0	−22 51	3.9	cG4	1	.....	2	2	
20 C 1285	21 24.8	+17 12	10.4	dM4	.....	2	.....	....	
GC 30083	21 25.7	+63 57	8.8	dK0	.....	3	.....	....	
20 C 1288	21 25.9	−10 14	11.5	dM4.5e	.....	4	.....	....	
Boss 5527	21 26.3	− 6 1	3.1	cG1	2	.....	2	15	
Boss 5543	21 30.2	+45 9	4.2	gG5	.....	2	.....	....	
SS Cyg	21 38.8	+43 8	8.2–12.1	Pec.	.....	50 var.	.....	....	1,10
Boss 5584	21 39.3	+ 9 25	2.5	cK0	2	.....	15	4	67
GC 30443	21 39.8	+14 19	6.1	dG0	.....	3	.....	....	
Boss 5590	21 39.8	+16 53	4.5	cG5	1	.....	1	5	
AG Peg	21 46.2	+12 10	6.4– 8.2	Bep	.....	3 var.	.....	....	79

TABLE 1—*Continued*

Star	α(1900)	δ(1900)	Mag.	Spectrum	Em. Int.			Abs. K3 Int.	Notes
					V Comp.	Single	R Comp.		
HD 208313	21^h50^m4	+31° 52′	7.6	dK0	.....	1	.....	....	
20 C 1331	21 57.1	+ 0 56	9.2	dK6	.....	2	.....	....	9
RT Lac Br	21 57.5	+43 25	8.8	sgG9	.....	5 var.	.....	....	46
RT Lac Ft	21 57.5	+43 25	9.6	sgK1	.....	5 var.	.....	....	46
Boss 5676	22 0.6	− 0 48	3.2	cG1	2	.....	5	10	
AR Lac Br	22 4.6	+45 15	7.3	sgG5	.....	4	.....	....	80
AR Lac Ft	22 4.6	+45 15	8.2	sgK0	.....	20	.....	....	1, 41
Ross 271	22 6.6	+17 55	10.3	dM2.5	.....	3	.....	....	
Boss 5714	22 7.4	+57 42	3.6	cK5	2	.....	4	4	6
20 C 1344	22 7.6	+31 5	10.0	dM0	.....	5	.....	....	
RU Peg	22 9.2	+12 12	10.0–13.1	Pec.	.....	5 var.	.....	....	1, 10
Wolf 1561A	22 12.1	− 9 18	13.5	dM4.5e	.....	20	.....	....	
Wolf 1561B	22 12.1	− 9 18	14.5	dM5e	.....	15	.....	....	
HD 212047	22 16.4	+26 26	6.5	gM4	.....	2	.....	....	
BD+21°4747	22 20.1	+22 3	9.1	dM0	.....	4	.....	....	
ADS 15972B	22 24.4	+57 12	11.3	dM4.5e	.....	15	.....	....	42
Boss 5804	22 25.4	+47 12	4.6	cM0	5 var.	.....	2 var.	5	
LPM 837	22 33.0	−15 53	12.3	dM5.5e	.....	25	.....	....	42
Boss 5841A	22 34.3	−13 8	8.1	dK0	.....	2	.....	....	
Boss 5841B	22 34.3	−13 8	8.1	dK0	.....	2	.....	....	
20 C 1380	22 41.3	+44 51	10.5	dK6	.....	2	.....	....	
20 C 1382	22 42.6	+43 49	10.2	dM4.5e	.....	20	.....	....	42
AC+24°44-11	22 43.7	+24 13	10.9	dM0	.....	1	.....	....	
BD−7°5871	22 45.1	− 7 38	10.2	dM1	.....	3	.....	....	
AC+31°70565	22 47.2	+31 13	11.2	dM3.5e	.....	20	.....	....	81
20 C 1385	22 47.3	+31 12	9.4	dK5	.....	1	.....	....	
Boss 5895	22 47.4	− 8 7	3.8	gM2	2	.....	6	5	
20 C 1392	22 51.8	+16 2	9.0	dM2.5	.....	4	.....	....	9
MHα 47-30	22 52.5	+58 10	11.5	dK3e	.....	40 var.	.....	....	70
Boss 5940	22 58.9	+27 32	2.6	gM2	2	.....	5	3	12
BD+65°1846	23 0.5	+66 14	9.9	dM1	.....	4	.....	....	
Boss 5954	23 2.2	+24 56	5.0	cK0	12	.....	8	3	82
GC 32493	23 16.2	+78 27	7.7	dK0	.....	15	.....	....	
BD+57°2735	23 20.0	+57 19	10.2	dM2	.....	2	.....	....	
BD+19°5116A	23 26.7	+19 23	10.3	dM4e	.....	15	.....	....	83
BD+19°5116B	23 26.7	+19 23	12.8	dM5.5e	.....	20	.....	....	
HD 221503	23 27.6	−17 23	8.6	dK5	.....	6	.....	....	63
Z And	23 28.9	+48 16	*8.0–12.4*	Pec.	.....	3	.....	....	13
BD+0°5017	23 29.9	+ 1 3	9.5	dM0.5	.....	6	.....	....	
Boss 6071	23 32.7	+45 55	4.3	sgG7	.....	25 var.	.....	....	6
Boss 6078	23 35.2	+77 4	3.4	sgK1	.....	2	.....	....	6
20 C 1445	23 37.0	+43 39	12.2	dM5.5e	.....	10	.....	....	
HD 224085	23 49.9	+28 5	7.3	dK2	.....	30	.....	....	84
HD 224186	23 50.8	+14 41	6.6	gM3.5	.....	3	.....	....	
ADS 48 F	23 59.9	+45 14	9.9	dM2	.....	15	.....	....	3

NOTES FOR TABLE 1

1. H and K wide.
2. H and K wide, displaced shortward.
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NOTES FOR TABLE 1—*Continued*

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The estimates of intensity in the table were made by Joy from Mount Wilson spectrograms. No precision is possible on account of the difficulty of reducing to any comparable values the intensities of bright lines superposed on wide and often underexposed absorption lines. Several different spectrographs and a variety of dispersions from 3 to 200 A/mm were employed. The intensity of the emission is probably variable to a considerable extent in many stars. Because the region near H is often affected by neighboring lines, a preponderance of weight was given to K. The bright H and K lines in most giant and supergiant stars are double. Separate estimates of the intensities of the violet and red components were made, and the strength of the middle absorption reversal, which is known as K3 or H3 in Hale's terminology, was estimated on an arbitrary scale.

DISCUSSION

From the list of 445 stars having bright lines, certain conclusions may be drawn in regard to the presence of radiating layers in stellar atmospheres. A study of the motions of the gases and of the structure of the spectral lines will be reserved for a future article.

TABLE 2

NUMBER OF EMISSION H AND K STARS OF DIFFERENT SPECTRAL TYPES

Spectrum	Supergiants	Giants	Subgiants	Dwarf
B–A	1	2	.....	2
F	4	1	.....	4
G0–G4	13	7	.....	19
G5–G9	6	15	5	42
K	8	37	9	86
M	5	31	.....	124
	37	93	14	277

Calcium emission, which evidently occurs frequently in the stars, is found in a wide variety of stellar sources. Supergiants, giants, subgiants, and dwarfs are well represented in Table 1. Of the variable stars of low luminosity, such as the T Tauri and SS Cygni classes, all which have been sufficiently observed show bright H and K.

The variables with combination spectra, such as Z Andromedae, show single sharp H and K lines of changing intensity. Other high-luminosity variables seem to have calcium emission only at certain phases, and the lines are usually wide and much displaced shortward. Observations of the bright calcium lines have thus far been reported for only a few

stars of the Mira, RV Tauri, and δ Cephei classes. Whether the phenomenon is general among such stars is not yet known.

Calcium emission is frequently found in eclipsing binaries, where it may originate in envelopes of gas or in streamers moving from one star toward the other. In visual double stars of late types the bright lines often occur, and the question may be raised as to the relationship between emission and duplicity.

The list indicates that, with few exceptions, calcium emission occurs only in the stars of types G, K, and M. The numbers in each type are in Table 2. Further examination of existing spectrograms and additional observations properly adapted to this particular problem will add indefinitely to the list, but probably the general outline of the problem will not be greatly changed.

Within the various groups no correlations of the strength of emission with other physical characteristics of the stars have yet been found. The strongest emission appears in the T Tauri stars and in the dMe dwarfs of extremely low luminosity, but many supergiants, giants, and subgiants also show exceedingly strong bright lines. With the dispersion used, the absorption of H3 and K3 does not appear in dwarfs or subgiants but is readily seen in practically all giants and is wide and strong in supergiants. The greater intensity of the red components of emission as compared with the violet component in most of the stars indicates outward motion of the high absorbing layer.

Nearly one-fourth of the stars of Table 1 are in the Taurus region. This remarkable concentration is due to the presence there of the group of faint stars[1] involved in the Taurus dark nebulosity, the T Tauri variables,[2] and stars of the Taurus moving cluster.[3] The latter group has an extraordinary tendency to show calcium emission. Of 44 stars in this group whose spectra are G5 or later, 31 show bright H and K on the Mount Wilson spectrograms. The spectrograms of most of the remaining stars of the group are insufficiently exposed to determine the presence of bright lines.

[1] A. H. Joy, *Pub. A.S.P.*, **58**, 244, 1946.

[2] A. H. Joy, *Mt. W. Contr.*, No. 709; *Ap. J.*, **102**, 168, 1945.

[3] R. E. Wilson, *Mt. W. Contr.*, No. 741; *Ap. J.*, **107**, 119, 1948.