THE ABSOLUTE MAGNITUDES AND PARALLAXES OF 410 STARS OF TYPE M[1]

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ABSTRACT

Spectroscopic absolute magnitudes of M stars.—Magnitudes and *spectral types* have been determined for 410 M-type stars (Table I). Nearly all Boss stars north of $-30°$, several stars from the Selected Areas, and about 100 dwarf stars of this type have been included. The stars were classified from M0 to M7 on the basis of the titanium bands.

The *absolute magnitudes* were determined according to methods previously employed with the aid of additional lines and *new reduction curves.* λλ 4077, 4207, 4215, 4258, $H\gamma$, 4389, 4489, and $H\beta$ were used for *giants* and λλ 4318, 4435, 4454, 4535, 4586, and 4607 for *dwarfs.* The reduction curves were calibrated with the aid of mean parallaxes derived from *peculiar motions* for the giants and *trigonometric parallaxes* for the dwarfs.

Twenty-eight stars are brighter than -1.0 mag. and are called "super-giants." The ordinary giants show very little dispersion in absolute magnitude. The dwarfs vary with advancing type from $+7.0$ to $+12.5$ mag. Figures 1 and 2 indicate the relationship between type and absolute magnitude.

The mean difference between the spectroscopic and the trigonometric parallaxes is less than 0".001 for 71 giants. For dwarfs the mean difference is 0".002. The absolute magnitudes of 165 giants average 0.4 mag. brighter than those previously published in a list of 1646 stars. A comparison with Young and Harper, and with Rimmer, shows the Mount Wilson values to be fainter by 0.8 and 0.7 mag., respectively.

During the past few years we have made a special study of the absolute magnitudes and spectral types of the stars of type M, including those with either giant or dwarf characteristics of spectrum. We have now completed observations of essentially all the stars of this type in Boss's *Catalogue* north of $-30°$ of declination. In addition we have included in our investigation numerous stars listed as K5 in the *Henry Draper Catalogue,* but classified as of type M according to our system, several stars observed in the Selected Areas, and about one hundred dwarf stars of the eighth and ninth magnitudes, visually. The dwarf stars were, of course, selected on the basis of proper motion, but no selection was made in the case of the giant stars except that of apparent magnitude.

The system of classification employed is that adopted by the International Astronomical Union on the recommendation of the Committee on the Spectral Classification of Stars. It is based almost entirely on the intensities of the bands of titanium oxide, only minor consideration being given to other features of the spectrum. The

[1] *Contributions from the Mount Wilson Observatory,* No. 319.

stars are listed as M0, M1, M2, etc., according to increasing intensities of these bands. It is well known that many of the long-period variable stars of class M show a much more advanced type of spectrum than the normal stars of this class. Accordingly, since the system of classification is designed to include these variables, no stars of type more advanced than M6 or M7 are found in our list. The great majority of the stars are of types M0–M4. In the case of the dwarf stars it seems probable that those of type later than M5 would be so faint apparently that they could hardly be observed under present conditions.[1]

The method of deriving the absolute magnitudes of the giant M-type stars listed in the catalogue of 1646 stars[2] published several years ago was described as a provisional one based on the comparison of the intensities of two or three pairs of lines with those of certain standard stars. With the increase in the amount of observational material it has become possible to calibrate new reduction curves for the separate spectral subdivisions by the aid of mean parallaxes derived from peculiar and parallactic motions. An examination of the spectra of some of the stars of exceptional absolute magnitude, such as α Orionis for example, has increased the list of lines suitable for determinations of absolute magnitude and should add materially to the accuracy of the values. For giant M stars the low-temperature lines of iron at $\lambda\lambda$ 4207, 4258, 4389, and 4489, together with the hydrogen lines $H\gamma$ and $H\beta$, and the ionized strontium line at λ 4077, have proved most useful. The ionized strontium line at λ 4215 has been used occasionally but is complicated by the presence of a low-temperature iron line nearby. For dwarf stars calcium lines at $\lambda\lambda$ 4318, 4435, 4454, and 4586, the titanium blend at λ 4535, and the low-temperature strontium line at λ 4607 have been used successfully. The calibration of the reduction curves for the dwarf stars has been made by the aid of trigonometric parallaxes which give by far the most accurate values for such stars.

The determination of the preliminary reduction curves for the individual lines in the spectra of giant stars was made about a year ago and was based upon mean parallaxes derived from the paral-

[1] *Publications of the Astronomical Society of the Pacific*, **37**, 157, 1925.

[2] *Mt. Wilson Contr.*, No. 199; *Astrophysical Journal*, **53**, 13, 1921.

lactic and peculiar motions of the stars observed up to that time. Since the radial velocities of these stars are fairly large on the average, the values derived from the peculiar motions were assigned a much higher weight in the solution. Trigonometric parallaxes were not used in this calibration. Preliminary values of the absolute magnitudes of all the stars in the list were determined from the reduction curves obtained in this way, and then the entire material was rediscussed and the corrections to the preliminary system were calculated. The method is simply one of successive approximations. In nearly all cases the corrections were found to be a few tenths of a unit in absolute magnitude, the largest values applying to the brightest stars or "super-giants," for which the material available for calculating mean parallaxes is necessarily scanty. The corrections derived from the final computation were then applied to the preliminary values, and the resulting absolute magnitudes are those listed in our Table I. The extensive calculations involved in the determination of the mean parallaxes were carried out by Dr. Strömberg, to whom we are indebted most deeply.

The method used by Strömberg in deriving the corrections to the provisional system of absolute magnitudes was to divide the stars into groups of different absolute magnitude (as based on the provisional values) and different spectral subdivisions, and to calculate the average peculiar radial velocity θ and the solar motion from the radial velocities of the stars in each group. The peculiar motions were found to give very consistent results for the mean parallaxes computed from the proper motions in right ascension and declination as well as from the τ-component. The values of θ vary but little, in general less than 0.5 km/sec., so that the mean parallaxes derived from the peculiar motions appear to be very reliable. They have been corrected for a mean error of $\pm 0''.004$ in the proper-motion components, but even were the error twice as great, the effect upon the absolute magnitudes would be small.

On the other hand, the mean parallaxes of these groups of stars derived from parallactic motions are very uncertain, the results from proper motion in right ascension and declination differing by as much as $0''.004$ in some cases. The mean parallaxes from parallactic motions are systematically smaller than those derived from peculiar motions, the difference being 0".0022 for the group of brightest stars, and 0".0016 for the ordinary giants. These would correspond to differences of 1.0 and 0.5 in mean absolute magnitude. No explanation can as yet be given for this discrepancy which has been found to exist in the case of some other stars, such, for example, as the long-period variables. Because of the uncertainty in the values derived from parallactic motions, the mean parallaxes and absolute magnitudes calculated from peculiar motions have been used exclusively in calibrating our final reduction curves, and this consideration should be borne in mind in making comparisons between our results and those of other observers who have used mean parallaxes based largely upon parallactic motions.

The successive columns of Table I give the data for the stars observed. Those listed in Boss's *Preliminary General Catalogue* are given by number with no further designation. Because of the convenience and accessibility of Porter's "Catalogue of Proper Motion Stars," *Publications of the Cincinnati Observatory*, No. 18, most of the dwarf stars have been listed according to their numbers in this catalogue. The visual apparent magnitudes are given under m, the values being taken, where possible, from the *Henry Draper Catalogue*. The spectral types are the means of our own determinations, and the total proper motions μ are mainly from the catalogues of Boss and Porter. The remaining columns give the absolute magnitudes M, the corresponding parallaxes, and the trigonometric parallaxes compiled by Schlesinger in his *Catalogue of Parallaxes*, 1924.

Although for the sake of uniformity all the spectroscopic parallaxes have been given to three places of decimals, attention should be called to the very marked difference in the influence of an uncertainty in the absolute magnitude on the parallaxes of giants as compared with dwarf stars. As an illustration, if we select two adjacent stars in the list, Boss 40 and Cin. 25, we find that an error of 0.3 in the absolute magnitude would affect the parallax of Boss 40 by 0".0005 and that of Cin. 25 by 0".043. The apparent magnitudes of the fainter dwarf stars, and especially of the components of visual binaries, are also subject to serious uncertainties which enter directly into the calculation of the spectroscopic parallaxes. Additional photometric observations of these stars would be of great value.

TABLE I

Name	α 1925	δ 1925	*m*	Sp.	μ	*M*	Spec. π	Trig. π
Comp. Lal. 47231.	0h 0m.7	+45° 23′	10.2	M2	0″.856	+10.6	0″.120	0″.097
Cin. 3161....	0 0.8	−37 43	8.3	M3	6.112	+10.0	.219	.220
Lal. 47231 Br.	0 1.2	+45 24	8.6	M0	0.858	+ 8.7	.105	.097
B.D. +61°8....	0 5.6	+62 14	9.2	M2ep	......	− 1.3	.001	....
B.D. +75°4....	0 9.8	+75 37	7.6	M4	......	− 0.2	.003	....
30....	0 10.6	− 8 12	5.4	M4	.060	− 0.2	.008	....
31....	0 10.7	+19 47	4.9	M1	.094	+ 0.7	.014	− .009
33....	0 10.8	−19 21	4.7	M1	.068	− 0.1	.011	....
40....	0 12.8	+ 1 26	7.3	M5	0.022	− 0.2	.003	....
Cin. 25....	0 14.0	+43 36	8.1	M2	2.890	+10.4	.288	.282
Comp. Cin. 25....	0 14.0	+43 36	10.5	M5	2.890	+12.4	.240	.282
64....	0 19.3	−16 22	6.6	M3	0.041	− 0.1	.005	....
B.D. +30°59....	0 23.2	+30 46	7.6	M1	......	0.0	.003	....
81....	0 24.1	+17 29	5.3	M3	.117	− 0.6	.007	....
90....	0 26.2	− 4 22	6.0	M0	0.011	+ 0.2	.007	....
B.D. +66°34....	0 27.6	+66 51	9.5	M3	1.775	+ 8.7	.069	....
βG.C. 368 Ft..	0 37.0	− 7 38	10.0	M1	0.022	+ 7.6	.033	....
B.D.+45°181....	0 38.7	+45 31	7.4	M0	......	+ 0.2	.004	....
161....	0 42.6	+15 4	5.6	M4	0.064	+ 0.1	.008	.013
168 Ft..	0 44.5	+57 25	7.4	M0	1.242	+ 8.2	.145	.182
191....	0 49.2	− 1 33	4.9	M0	0.017	− 0.2	.010	....
217....	0 55.9	+ 6 5	6.3	M1	0.023	− 0.9	.004	− .002
B.D.+63°137....	1 1.9	+63 32	8.7	M1	1.55	+ 8.5	.091	.078
259....	1 5.5	+35 13	2.4	M0	0.216	+ 0.3	.038	.045
274....	1 8.2	+44 56	6.6	M1	.042	+ 0.2	.005	....
B.D.+55°290....	1 14.7	+55 56	8.9	M6	......	0.0	.002	....
306....	1 18.7	+ 1 20	6.5	M0	.069	0.0	.005	....
342....	1 30.7	+18 5	6.0	M2	.088	+ 0.3	.007	....
Cin. 238....	1 38.5	+63 28	8.2	M0	.70	+ 8.2	.100	0.082
B.D.+55°394....	1 39.3	+56 9	9.0	M0	......	− 0.5	.001	....
Cin. 251....	1 49.2	−22 49	8.9	M1	.857	+ 9.0	.105	....
451....	1 56.2	−21 11	5.7	M1	.014	+ 0.1	.008	....
453....	1 56.5	−21 26	4.2	M1	.130	+ 0.2	.016	....
455....	1 56.7	− 8 53	5.7	M5	.086	0.0	.007	....
491....	2 6.5	+19 9	5.9	M3	.092	− 0.1	.006	....
502....	2 8.9	+14 56	6.0	M1	.100	+ 0.1	.007	....
B.D.+56°547....	2 15.3	+56 39	8.2	M3	......	− 1.4	.001	....
B.D.+56°551....	2 15.8	+56 49	8.2	M0	......	− 1.4	.001	....
B.D.+57°550....	2 16.5	+57 31	8.6	M2	......	− 1.4	.001	....
B.D.+55°597....	2 16.9	+56 16	8.2	M4	......	− 1.3	.001	....
B.D.+56°583....	2 17.2	+56 46	7.0	M6	......	− 0.7	.003	....
B.D.+56°595....	2 18.0	+56 51	8.5	M1	......	− 1.8	.001	....
539....	2 18.1	+ 0 3	5.9	M1	0.006	0.0	.007	....
B.D.+56°597....	2 18.2	+56 52	8.6	M0	......	− 1.7	.001	....
B.D.+56°609....	2 20.1	+57 6	8.5	M4	......	− 1.1	0.001	....

TABLE I—*Continued*

Name	α 1925	δ 1925	m	Sp.	μ	M	Spec. π	Trig. π
570....	$2^{h}27^{m}2$	−22° 53′	6.4	M2	0″.044	+ 0.1	0″.005	....
582....	2 31.2	+34 22	5.6	M3	.061	− 0.3	.007	0″.012
617 Ft..	2 39.1	+48 55	10.0	M2	.351	+ 8.2	.044	.080
646....	2 46.9	+34 45	4.7	M0	.077	+ 0.3	.013	.009
β G.C. 1490 Ft..	2 51.2	+26 34	9.7	M1	.333	+ 8.7	.063	.060
660....	2 51.6	+18 2	5.9	M6	.018	0.0	.007	.012
669....	2 56.0	+79 7	5.7	M2	.039	0.0	.007	....
691....	2 58.4	+ 3 48	2.8	M2	.078	+ 0.1	.029	.011
698....	3 0.4	+38 33	3.7	M4	.173	− 0.7	.013	.038
B.D. +1°543....	3 2.7	+ 1 42	8.9	M0	.91	+ 8.4	.079	....
707....	3 2.8	− 6 23	5.6	M3	.002	0.0	.008	....
712....	3 4.1	+18 30	6.5	M0	.042	+ 0.5	.006	.028
759....	3 16.2	−22 2	4.0	M3	.065	− 0.3	.014	....
765....	3 18.1	+64 19	5.6	M0	.019	− 1.8	.003	....
Cin. 456....	3 24.4	−20 4	8.2	M0	.603	+ 8.7	.126	....
826....	3 35.6	+62 59	5.3	M4	.022	− 0.6	.007	....
B.D.+68°278....	3 40.5	+68 26	9.2	M1	.30	+ 7.8	.052	.073
868....	3 42.5	−12 20	4.6	M2	.069	0.0	.012	....
864....	3 42.6	+65 18	4.7	M1	.004	− 1.1	.007	....
912....	3 52.9	−13 49	6.7	M2	.010	− 0.7	.003	....
915....	3 54.5	−13 43	3.2	M0	0.130	− 0.2	.021	.018
o Eridani C......	4 11.8	− 7 46	10.8	M6e	4.082	+11.9	.166	.203
993...	4 15.3	+60 34	5.7	M0	0.122	− 0.3	.006	....
1014...	4 17.9	+20 39	6.1	M0	.011	0.0	.006	− .003
1057...	4 26.8	+14 57	6.6	M3	.074	− 0.1	.005	....
1071...	4 30.6	− 8 23	5.4	M3	.035	− 0.6	.006	....
Cin. 594...	4 31.7	+52 45	8.5	M2	.53	+ 9.0	.126	.091
1105...	4 37.2	−19 49	4.5	M3	.094	+ 0.1	.013	....
1128...	4 45.1	+63 23	5.8	M2	.111	0.0	.007	.002
1149...	4 48.3	+14 8	5.2	M4	.059	− 0.4	.008	....
1154...	4 49.5	+ 2 23	5.7	M1	.034	0.0	.007	.006
B.D.+42°1180...	5 3.5	+42 28	8.8	M6	......	0.0	.002	....
1237...	5 7.9	−11 56	5.9	M6	.051	− 0.8	.005	....
Comp. 1246...	5 11.2	+45 55	10.0	M2	.437	+ 9.6	.083	.069
1256...	5 12.9	+42 43	5.9	M4	.049	− 0.4	.005	.004
B.D.+29° 897...	5 22.4	+29 52	8.0	M1	......	− 2.4	.001	....
1309...	5 23.1	+63 0	5.8	M1	.005	− 0.3	.006	....
1327...	5 25.9	− 1 9	5.0	M0	0.028	0.0	.010	....
Cin. 705...	5 27.6	− 3 40	8.8	M3	2.222	+10.2	.190	0.172
1335...	5 27.8	+18 32	4.7	M2	0.013	− 3.0	.003	....
1334...	5 29.7	+75 0	6.4	M0	.019	0.0	.005	....
1348...	5 30.4	+54 23	6.0	M0	.007	− 0.2	.006	....
B.D.+43°1332...	5 38.1	+43 28	8.8	M1	.004	− 0.4	.001	....
1439...	5 45.9	+37 17	5.0	M1	0.052	+ 0.3	.011	....
B.D.+27° 887...	5 46.1	+27 40	7.7	M5	......	+ 0.1	0.003	....

TABLE I—*Continued*

Name	α 1925	δ 1925	*m*	Sp.	μ	*M*	Spec. π	Trig. π
M 37, Br. star....	5^h47^m3	+32° 32′	9.7	M1	0″.007	− 0.1	0″.001	....
1468...	5 51.1	+ 7 24	0.9	M2	.029	− 4.3	.009	0″.017
1479...	5 54.4	+45 56	4.6	M3	.011	− 1.0	.008	....
1531...	6 4.4	−19 9	5.5	M2	.063	− 0.6	.006	....
B.D.+23°1243...	6 7.4	+23 14	7.4	M3ep	......	− 1.3	.002	....
1549...	6 7.8	+22 56	6.3	M2	.027	− 1.4	.003	.000
1561...	6 10.4	+22 32	3.8	M3	.065	− 0.4	.014	.014
1560...	6 11.0	+61 33	5.3	M3	.005	− 0.6	.007	....
1596...	6 15.8	+14 41	6.0	M0	.019	0.0	.006	....
1599...	6 16.2	− 2 55	5.2	M1	.009	0.0	.009	− .004
βG.C. 3319 Br.	6 16.8	+ 5 47	8.1	M4	......	− 0.1	.002	.001
1604...	6 18.4	+22 33	3.2	M3	.128	− 0.4	.019	.016
1606...	6 19.1	+49 20	5.1	M0	.014	− 2.7	.003	.000
B.D.+17°1320...	6 32.9	+17 37	9.5	M1	.88	+ 9.1	.083	.097
B.D.+45°1330...	6 33.2	+45 8	8.8	M2	......	+ 0.2	.002	....
1715...	6 38.4	− 9 6	5.3	M0	.037	+ 0.3	.010	....
1743...	6 44.0	− 8 55	5.3	M1	.036	− 2.1	.003	....
Cin. 837...	6 51.2	+40 11	8.3	M0	.43	+ 7.5	.069	.030
1808...	6 58.3	− 5 37	5.4	M2	.009	− 0.6	.006	....
1810...	6 58.7	−27 50	3.7	M0	.011	− 2.1	.007	....
1801...	7 5.9	+87 10	5.3	M2	.051	0.0	.009	....
1846...	7 7.5	+51 33	5.7	M3	.019	+ 0.2	.008	.003
1856...	7 9.1	+16 17	5.3	M4	.051	− 0.4	.007	.004
1861...	7 10.1	+25 1	6.0	M1	.105	+ 0.3	.007	....
1868...	7 11.3	+28 2	5.9	M1	.020	+ 0.1	.007	.004
1887...	7 13.5	−23 11	4.8	M0	.001	− 2.2	.004	....
1889...	7 13.6	−27 45	4.8	M3	.045	− 0.2	:010	....
B.D.+33°1505...	7 14.6	+32 59	9.3	M1	.57	+ 8.9	.079	....
1871...	7 15.4	+82 34	5.1	M4	.045	− 0.1	.009	....
1918...	7 18.0	−25 45	6.1	M5	.031	0.0	.006	....
Comp. 1979...	7 29.8	+32 3	9.6	M1e	.203	+ 8.8	.069	.076
1985...	7 30.4	−14 22	5.1	M3ep	.016	− 1.5	.005	....
1986...	7 31.1	+46 21	5.8	M1	.047	+ 0.2	.008	....
1987...	7 31.3	+27 4	4.2	M0	.119	+ 0.1	.015	.011
2005...	7 35.1	+17 51	5.2	M0	.004	− 0.3	.008	.000
2020...	7 37.8	+14 23	5.8	M3	.015	− 0.8	.005	.002
2028...	7 39.5	+25 58	5.4	M0	.034	0.0	.008	....
2037...	7 41.7	+37 42	5.4	M3	.030	0.0	.008	....
2049...	7 42.7	+33 36	5.3	M1	.040	− 0.1	.008	.010
2144...	8 1.9	+22 51	6.2	M3	.024	− 0.5	.005	....
2186...	8 12.5	+72 39	6.2	M0	.027	0.0	.006	....
2223...	8 19.8	+10 53	6.3	M2	.021	+ 0.4	.007	....
2245...	8 22.6	+12 54	5.8	M3	.116	− 0.9	.005	.025
2265...	8 27.3	+18 21	5.6	M1	0.087	+ 0.3	.009	....
B.D.+67° 552...	8 29.8	+67 33	9.3	M0	1.101	+ 7.9	0.052	0.085

TABLE I—*Continued*

Name	α 1925	δ 1925	m	Sp.	μ	M	Spec. π	Trig. π
2378...	8h48m0	+28° 33′	6.3	M3	0″022	− 0.5	0″004	−0″003
βG.C. 4815 Br.	8 48.5	+71 5	8.6	M1	1.390	+ 8.4	.091	.086
βG.C. 4815 Ft.	8 48.5	+71 5	8.7	M1	1.390	+ 8.4	.087	.086
2404BC.	8 54.1	+48 20	9.5	M2	0.504	+ 7.8	.046	.070
2410...	8 54.9	+18 26	6.6	M4	.089	0.0	.005	....
2411...	8 55.8	+67 55	5.0	M3	.021	+ 0.1	.010	....
B.D.−32°6877...	9 1.4	−32 8	7.7	M5	......	+ 0.2	.003	....
2434...	9 1.8	+67 11	5.3	M0	.050	− 0.1	.008	....
2450...	9 4.7	−25 33	4.8	M1	0.040	− 0.6	.008	....
2469...	9 9.3	+53 1	8.1	M0	1.677	+ 9.3	.174	.165
2470...	9 9.3	+53 1	8.1	M0	1.686	+ 9.0	.151	.165
2474...	9 10.3	+57 3	5.5	M0	0.036	0.0	.008	....
2507...	9 16.5	+34 43	3.3	M0	.216	− 0.3	.019	.002
B.D.+81° 297...	9 17.6	+80 55	9.0	M0	.442	+ 7.1	.042	.058
2516...	9 18.2	−25 39	4.9	M1	.022	+ 0.4	.013	....
2546...	9 27.0	+35 26	5.5	M1	.130	+ 0.2	.009	....
B.D.+36°1970...	9 27.3	+36 40	9.3	M2	.56	+ 9.0	.087	....
B.D. +8°2243...	9 30.7	+ 8 33	8.1	M3	.019	− 0.3	.002	....
2578...	9 32.3	+31 30	5.7	M2	.044	− 0.1	.007	....
2612...	9 39.7	+14 22	5.6	M2	.014	− 0.1	.007	....
2614...	9 41.2	+57 28	5.4	M3	.025	− 0.9	.005	....
2621...	9 42.2	+ 7 3	6.0	M1	.040	0.0	.006	....
2633...	9 45.6	+39 59	6.8	M2	.016	− 0.2	.004	....
2639...	9 47.0	+13 25	6.7	M0	0.037	− 0.3	.004	....
Cin. 1167...	9 47.4	−11 55	9.4	M2	1.848	+ 9.3	.096	.080
B.D.+63° 869...	9 50.6	+63 9	8.5	M1	0.600	+ 9.0	.126	....
2658...	9 51.3	−18 39	5.2	M1	.050	+ 0.3	.010	....
2680...	9 56.3	+ 8 24	4.9	M2	0.043	0.0	.010	....
Cin. 1218...	10 6.8	+49 51	6.8	M0	1.451	+ 8.3	.200	.178
Cin. 1225...	10 9.1	+52 55	9.0	M0	0.74	+ 7.8	.058	.073
2731...	10 12.7	+14 6	5.7	M2	.035	+ 0.4	.009	....
Cin. 1244...	10 15.6	+20 15	9.0	M4e	.490	+11.2	.275	.207
Cin. 1246...	10 16.9	− 1 5	8.9	M0	.679	+ 7.0	.042	....
2766...	10 21.3	+ 9 10	5.9	M3	.045	+ 0.1	.007	....
2770...	10 22.0	− 6 41	5.8	M2	.189	0.0	.007	....
B.D.+46°1635...	10 27.0	+45 55	8.8	M0	.837	+ 8.2	.076	....
2796...	10 27.2	− 7 15	6.4	M0	.045	+ 0.6	.007	....
2800...	10 28.2	+14 31	5.7	M2	.041	− 0.2	.007	− .004
2821...	10 32.6	−15 57	6.2	M1	.027	− 0.5	.007	....
2847...	10 38.0	+32 5	6.3	M6	.030	+ 0.1	.006	....
2865...	10 41.7	+57 46	6.5	M2	.081	+ 0.5	.006	....
2915...	10 52.1	+ 6 35	6.0	M5	.023	− 0.6	.005	− .009
2921...	10 55.4	+36 30	6.2	M2	.095	+ 0.1	.006	.019
2931...	10 58.0	− 2 5	5.0	M1	0.041	+ 0.2	.011	....
2935...	10 59.3	+36 28	7.6	M2	4.778	+10.4	0.363	0.392

TABLE I—*Continued*

Name	α 1925	δ 1925	*m*	Sp.	μ	*M*	Spec. π	Trig. π
Lal. 21258...	11h 1m.9	+43° 54′	8.9	M2	4″.519	+10.1	0″.174	0″.177
Lal. 21368A..	11 6.9	+30 52	8.8	M1	0.623	+ 8.6	.091	.085
Lal. 21368B..	11 6.9	+30 52	9.8	M2	.623	+10.3	.126	.085
Cin. 1364...	11 7.7	−14 34	9.3	M0	.92	+ 8.0	.055	....
2976...	11 11.2	+23 30	4.9	M2	.018	− 0.8	.007	....
2983...	11 13.4	+ 2 25	5.4	M0	.159	+ 0.6	.011	....
Cin. 1375...	11 13.5	− 1 35	8.8	M0	0.53	+ 7.7	.060	....
Cin. 1383...	11 16.4	+66 15	9.2	M2	2.986	+ 9.0	.091	.126
3002...	11 20.8	−10 27	5.1	M1	0.043	− 0.1	.009	....
3031...	11 27.0	+69 45	4.1	M0	.045	− 0.2	.014	.022
3067...	11 34.6	+ 8 33	5.5	M6	.013	+ 0.3	.009	....
B.D.+45°1955...	11 37.7	+44 37	7.8	M3	.021	+ 0.1	.003	....
3089...	11 42.0	+ 6 57	4.2	M1	.188	− 0.2	.013	.007
3100...	11 44.9	−26 20	5.4	M4	.028	− 0.3	.007	....
3128...	11 54.4	+ 3 54	7.0	M4	.009	− 0.2	.004	....
3136...	11 56.4	+81 16	6.4	M4	.068	− 0.8	.004	....
B.D.+30°2217...	11 59.7	+30 6	7.7	M5	......	0.0	.003	....
Cin. 1551...	12 18.2	+42 33	9.1	M1	.57	+ 8.9	.091	....
3234...	12 21.5	+57 12	6.0	M3	.028	+ 0.4	.008	....
3248...	12 24.0	+56 8	5.8	M2	.031	+ 0.6	.009	....
3252...	12 25.2	− 2 1	7.6	M4	.049	+ 0.1	.003	....
3259...	12 26.4	−23 17	5.9	M0	.030	− 0.5	.005	....
3265...	12 26.8	+69 37	5.2	M4	.084	− 0.3	.008	....
B.D. +9°2636...	12 27.5	+ 9 14	8.8	M1	.96	+ 8.6	.091	....
3294...	12 34.6	+ 2 16	6.0	M3	.090	+ 0.2	.007	....
3295...	12 34.9	− 3 58	6.9	M0	.053	+ 0.1	.004	....
3331...	12 44.0	+ 3 59	6.7	M4	.013	+ 0.3	.005	....
Cin. 1633...	12 46.9	− 0 21	8.7	M0	.393	+ 8.7	.100	....
3348...	12 48.5	+17 29	6.5	M0	.023	− 0.3	.004	.022
3362...	12 50.5	− 9 8	4.9	M3	.032	− 0.3	.009	....
3367...	12 51.8	+ 3 48	3.7	M3	.479	0.0	.018	.010
3374...	12 55.2	+17 49	5.0	M0	.036	+ 0.1	.010	....
Cin. 1661...	12 56.5	− 2 18	9.5	M0	.73	+ 8.3	.058	....
3398...	13 2.7	+23 1	5.9	M5	.066	− 0.2	.006	.032
B.D.+18°2696...	13 5.8	+17 52	8.7	M0	.120	+ 0.0	.002	− .010
3434...	13 10.8	+11 44	5.8	M0	.090	0.0	.007	....
3446...	13 13.8	+ 5 52	5.0	M2	.016	− 0.2	.009	....
Cin. 1719...	13 16.1	+35 31	9.0	M2	.884	+ 9.1	.105	.085
3460...	13 18.2	−12 11	7.1	M2	.027	0.0	.004	....
β G.C. 6476S..	13 20.1	+29 36	9.4	M0	.535	+ 8.4	.063	....
3488...	13 24.2	+72 47	6.1	M1	.030	− 0.5	.005	....
3499...	13 28.1	− 5 52	4.8	M3	.112	+ 0.2	.012	....
3534...	13 37.7	− 8 20	5.2	M2	.108	+ 0.1	.010	....
3536...	13 37.9	+55 4	4.8	M2	0.028	+ 0.1	.011	....
Cin. 1784...	13 41.4	+18 13	9.6	M1	1.86	+ 9.3	0.087	0.079

TABLE I—*Continued*

Name	α 1925	δ 1925	m	Sp.	μ	M	Spec. π	Trig. π
Cin. 1786...	13^h41^m9	+15° 18′	8.5	M2	2″.298	+10.2	0″.219	0″.185
3553...	13 43.3	−17 29	5.8	M2	0.065	− 0.7	.005	....
3572...	13 45.9	+16 10	4.3	M0	.106	+ 0.6	.018	....
3581...	13 47.8	+35 2	6.0	M1	.072	0.0	.006	.001
3584...	13 48.5	+34 49	5.0	M2	.044	− 0.3	.009	....
3589...	13 49.3	+65 6	4.8	M3	.004	− 0.4	.009	....
βG.C. 6710N..	13 59.5	+46 42	9.5	M4	.609	+ 9.9	.120	....
B.D.+29°2486...	14 1.1	+29 30	8.2	M3	......	0.0	.002	....
3630...	14 4.9	+44 13	5.4	M4	.037	− 0.7	.006	....
3631...	14 5.5	+49 49	5.4	M2	.068	0.0	.008	....
3632...	14 6.7	−15 57	5.1	M3	.027	− 0.6	.007	....
3656...	14 10.7	+69 47	5.4	M2	.068	+ 0.4	.010	....
B.D.+15°2690...	14 13.9	+15 36	6.0	M3	......	0.0	.006	....
Cin. 1885...	14 18.8	+29 59	8.6	M0	0.727	+ 8.1	.079	.067
Cin. 1894...	14 22.2	+23 59	9.5	M2	1.39	+ 8.7	.069	.053
Cin. 1895...	14 22.3	+24 0	9.6	M2	1.40	+ 9.1	.079	.053
B.D. −7°3856...	14 26.9	− 8 18	9.3	M0	1.26	+ 8.7	.076	....
Cin. 1920...	14 31.9	+34 4	9.0	M0	0.76	+ 8.5	.079	....
3733...	14 32.0	+49 42	5.9	M1	.067	− 0.2	.006	....
3761...	14 40.1	+26 51	4.9	M3	.024	− 0.5	.008	....
B.D.+34°2559...	14 42.1	+34 41	7.8	M2	0.044	− 0.3	.002	....
3812...	14 53.1	−21 4	8.9	M2	1.916	+ 9.4	.126	.182
3827...	14 56.4	+66 14	4.9	M5	0.082	0.0	.010	....
Cin. 1989...	14 56.7	−10 50	10.0	M0	.467	+ 9.0	.063	....
3828...	14 57.4	− 2 28	5.7	M1	.048	0.0	.007	....
3831...	14 58.0	+ 0 9	5.9	M2	.030	− 0.9	.004	....
3837...	14 59.7	−24 59	3.4	M4	.094	− 0.1	.020	....
B.D.+25°2874...	15 4.2	+25 13	9.2	M0	.961	+ 8.3	.066	.070
3867...	15 8.7	+19 15	6.0	M4	.004	− 0.2	.006	− .007
B.D. −3°3746...	15 10.2	− 3 32	9.2	M0	0.69	+ 8.2	.063	....
B.D. −7°4003...	15 15.6	− 7 26	9.2	M5	1.33	+11.8	.331	....
3931...	15 22.3	+15 41	5.5	M1	0.033	− 0.1	.008	....
3938...	15 24.4	+25 22	6.3	M1	.039	0.0	.005	....
3945...	15 28.2	+41 5	5.2	M0	.018	− 0.1	.009	.023
3967...	15 32.5	+39 15	5.4	M2	.029	0.0	.008	....
3969...	15 33.0	+15 21	6.8	M6	.011	− 0.4	.004	....
3990...	15 37.6	−19 26	5.0	M0	.127	+ 0.1	.010	....
4015...	15 45.4	+18 22	4.3	M1	.110	0.0	.014	....
Cin. 2124...	15 49.4	+74 39	9.3	M0	.320	+ 8.4	.066	.034
4048...	15 51.3	+20 32	5.8	M0	.083	− 0.7	.005	.029
4054...	15 52.1	+43 21	5.5	M3	.075	− 0.1	.008	0.022
4096...	16 3.6	−26 8	5.6	M2	.122	− 0.5	.006	....
B.D.+35°2774...	16 3.8	+34 51	9.5	M1	.64	+ 8.8	.072	....
4103...	16 4.8	+ 8 44	5.9	M3	.024	− 0.3	.006	....
4125...	16 8.5	+23 41	6.0	M4	0.028	− 0.3	0.005	....

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TABLE I—*Continued*

Name	α 1925	δ 1925	*m*	Sp.	μ	*M*	Spec. π	Trig. π
4134...	16h10m4	−3° 30′	3.0	M0	0″.161	0.0	0″.025	0″.040
B.D. +75°585...	16 13.1	+74 51	8.4	M5	......	+0.2	.002	....
4159...	16 16.0	+59 56	5.6	M4	.022	−0.6	.006	....
Cin. 2184...	16 16.6	+67 25	8.9	M0	.505	+8.6	.087	.090
4173...	16 19.5	+33 58	5.4	M2	.049	0.0	.008	.017
4188...	16 23.7	−7 26	5.4	M2	.176	−0.1	.008	.012
4193...	16 24.8	−26 16	1.2	M1	0.034	−3.5	.011	.026
B.D.−12°4523...	16 26.2	−12 28	9.5	M5	1.24	+11.8	.288	....
4201...	16 26.2	+42 3	5.0	M6	0.028	0.0	.010	....
4211...	16 28.7	+33 40	6.7	M0	.039	−0.2	.004	....
4212...	16 29.1	+11 39	4.9	M0	.204	+0.1	.011	−.011
4242...	16 36.7	+49 4	5.1	M2	.044	0.0	.010	....
4262...	16 42.0	+15 53	5.8	M3	.054	−0.1	.007	.015
4264...	16 42.2	+8 43	5.4	M1	.016	0.0	.008	....
Cin. 2238...	16 42.3	+33 38	8.6	M0	.37	+8.7	.105	.178
4286...	16 47.7	+27 56	5.9	M1	0.011	0.0	.007	....
Cin. 2251...	16 51.5	−8 12	9.2	M4e	1.234	+10.5	.182	.148
B.D.+25°3173...	16 55.1	+25 53	9.4	M2	0.52	+9.1	.087	....
4318...	16 55.4	−24 59	5.9	M3	.022	+0.1	.007	....
4336...	16 59.7	+14 12	5.1	M3	.070	+0.2	.010	....
4343...	17 0.8	+35 31	6.8	M4	0.058	−0.8	.003	.000
4342...	17 1.2	−4 57	7.9	M0	1.464	+7.8	.096	.091
Wolf 636...	17 1.4	−4 57	9.3	M3	1.465	+10.1	.145	....
4366...	17 8.9	+10 40	5.6	M2	0.036	−0.4	.006	....
B.D.+45°2505...	17 9.9	+45 49	9.6	M4	1.590	+9.9	.115	....
B.D.+42°2810...	17 10.7	+42 26	9.6	M1	1.061	+8.7	.066	.030
4373...	17 11.2	+14 28	3.5	M5	0.030	−1.6	.010	−.002
B.D.−15°4502...	17 12.0	−15 8	6.8	M1	......	−1.1	.003	....
4400...	17 17.0	+18 8	5.2	M2	.051	−0.2	.008	....
4408...	17 18.2	+46 19	5.8	M0	0.050	−0.1	.007	....
Cin. 2347...	17 34.5	+18 36	9.1	M1	1.39	+9.1	.100	.135
Cin. 2354...	17 36.9	+68 25	9.1	M4	1.334	+9.8	.138	.213
B.D.+43°2796...	17 41.7	+43 26	9.5	M3	0.616	+9.5	.100	....
Boss 4497B..	17 43.5	+27 46	9.5	M4	.817	+10.0	.126	.111
4526...	17 52.6	−23 56	6.9	M1	.003	−0.3	.004	....
B.D.+45°2627...	17 54.7	+45 22	6.2	M6	......	−0.2	.005	....
4555...	17 57.8	+45 30	5.9	M0	.044	+0.2	.007	0.018
4578...	18 2.9	+22 13	5.3	M2	.023	−0.2	.008	....
4606...	18 9.1	+31 23	5.0	M3	.018	0.0	.010	....
4617...	18 12.6	−36 47	3.2	M4	.216	+0.2	.025	....
4630...	18 16.9	−24 57	6.4	M5	.011	−0.6	.004	....
4636...	18 17.1	+21 56	5.0	M0	.062	0.0	.010	....
4649...	18 19.0	+23 15	5.7	M0	.076	+0.2	.008	....
4653...	18 19.6	+49 5	5.1	M3	0.058	0.0	.010	....
B.D.+43°2970...	18 21.8	+43 52	7.0	M2	......	−0.5	0.003	....

TABLE I—*Continued*

Name	α 1925	δ 1925	*m*	Sp.	μ	*M*	Spec. π	Trig. π
Cin. 2456 Br.	18h42m0	+59° 30′	8.8	M4	2″.307	+10.9	0″.263	0″.287
Cin. 2456 Ft.	18 42.0	+59 30	9.3	M5	2.307	+11.9	.331	.287
Cin. 2463...	18 45.6	+17 22	9.0	M0	0.579	+ 8.5	.079	....
4800...	18 51.9	+36 48	4.5	M4	.010	− 1.4	.007	....
4971...	18 52.9	+89 2	6.6	M4	.029	− 0.4	.004	....
4814...	18 53.1	+43 51	4.4	M5	0.077	− 0.6	.010	.006
Cin. 2475...	18 54.3	+ 5 50	9.7	M2	1.247	+ 8.9	.069	.074
B.D.+30°3409...	19 2.1	+30 37	6.4	M2	......	0.0	.005	....
B.D.+29°3472...	19 2.9	+29 48	6.6	M1	......	0.0	.005	....
4877...	19 5.7	+39 2	7.6	M6	0.007	− 0.6	.002	....
4966...	19 22.6	+50 6	7.1	M7	.016	− 0.3	.003	....
4976...	19 25.6	+24 31	4.6	M1	.170	+ 0.3	.014	.013
4983...	19 26.7	− 2 57	5.2	M1	.016	− 0.2	.008	....
4993...	19 30.0	−24 1	6.7	M0	.004	0.0	.005	....
Cin. 2556...	19 30.9	+ 4 25	10.5	M1	.58	+ 8.6	.042	....
5043...	19 41.3	+41 36	6.0	M0	.017	0.0	.006	.000
5052...	19 44.0	+18 21	3.8	M2	.009	− 1.0	.011	.003
B.D.+44°3242...	19 44.1	+44 53	9.2	M2	......	+ 0.1	.002	....
5069...	19 47.9	+38 32	5.4	M2	.098	− 0.4	.007	....
5106...	19 53.5	+60 37	7.3	M1	.012	+ 0.3	.004	....
5118...	19 55.4	+19 17	3.7	M0	.062	− 0.2	.017	.010
5125...	19 56.7	+17 19	5.6	M4	.015	− 0.4	.006	....
5129...	19 58.0	−27 55	4.6	M4	.037	0.0	.012	....
5149...	20 0.7	+64 37	5.4	M1	.015	0.0	.008	....
5154...	20 1.8	+76 16	6.4	M3	.059	+ 0.2	.006	....
B.D.+36°3883...	20 4.7	+36 21	7.4	M2	......	− 0.5	.003	− .003
B.D.+76° 785...	20 13.1	+77 0	9.3	M0	.495	+ 8.6	.072	.059
5234...	20 19.8	+68 38	6.0	M5	.042	0.0	.006	....
5231...	20 20.1	+40 47	6.1	M0	.054	− 0.5	.005	....
5248...	20 25.1	−22 39	6.2	M1	.029	− 0.1	.005	....
5271...	20 29.0	+48 58	5.6	M2	.037	+ 0.6	.010	....
Cin. 2676...	20 35.8	+ 4 42	8.4	M0	.844	+ 7.9	.079	.063
5306...	20 35.8	−18 24	5.3	M2	.035	− 0.3	.008	....
5338...	20 43.8	− 5 18	4.6	M3	.039	0.0	.012	....
5363...	20 47.3	−27 12	4.2	M1	.017	− 0.3	.013	....
B.D.+61°2068...	20 51.8	+61 53	8.6	M3	.77	+ 9.2	.132	.141
5409...	20 57.0	+19 2	6.0	M3	.075	+ 0.3	.007	.006
Furuhjelm 54...	20 57.1	+39 47	9.7	M3e	.671	+10.1	.120	.081
5430...	21 2.7	−25 18	4.6	M0	0.059	0.0	.012	....
5434...	21 3.6	+38 22	6.3	M0	5.157	+ 8.4	.263	.300
5458...	21 10.9	+59 47	7.1	M2	0.012	− 1.6	.002	....
5457...	21 11.6	−15 29	5.5	M3	.019	0.0	.008	....
5462...	21 12.3	− 9 32	6.8	M4	0.012	0.0	.004	....
Cin. 2757...	21 13.0	−39 9	6.6	M1	3.532	+ 8.4	.229	0.253
5479...	21 17.4	+ 7 2	6.0	M3	0.044	0.0	0.006	....

TABLE I—*Continued*

Name	α 1925	δ 1925	m	Sp.	μ	M	Spec. π	Trig. π
5487...	21h18m.7	−22° 59′	5.7	Mo	0″.041	− 0.3	0″.006	....
5490...	21 18.9	− 9 38	6.2	Mo	.050	0.0	.006	....
5522...	21 26.6	+23 19	4.8	M1	.017	0.0	.011	0″.010
5567...	21 37.3	+42 56	5.4	M1	.054	+ 0.4	.010	....
5572...	21 38.5	+ 5 20	5.6	M2	.022	− 0.3	.007	....
5583...	21 40.1	+40 49	5.5	M2	.026	+ 0.1	.008	....
5593...	21 41.2	+58 26	4.4	M2	.002	− 3.0	.003	.011
5595...	21 42.3	− 9 37	6.2	M3	.016	− 0.2	.005	....
5614...	21 45.2	+60 21	5.6	M1	.006	+ 0.5	.010	.020
5647...	21 53.1	+79 12	6.8	M2	.029	− 0.3	.004	....
5650...	21 54.5	+63 16	5.4	M2e	.012	− 2.0	.003	....
5645...	21 54.6	−21 33	6.2	M4	.015	− 0.2	.005	....
5678...	22 1.6	+62 45	5.5	M5	.052	+ 0.1	.008	....
5686...	22 3.0	+44 39	5.3	Mo	.017	+ 0.1	.009	.004
B.D.+14°4772...	22 15.7	+15 10	7.2	M1	......	0.0	.004	....
Cin. 2922...	22 25.4	+57 19	9.2	M3	.870	+10.4	.174	.257
5797...	22 25.4	+ 8 45	5.8	Mo	.062	− 0.1	.007	....
5804...	22 26.4	+47 19	4.6	Mo	0.021	− 2.1	.005	.005
B.D.+52°3240...	22 29.6	+53 21	9.5	M5	......	− 0.2	.001	....
B.D.+53°2911...	22 29.7	+53 25	9.5	M1	1.482	+ 8.6	.066	.030
5820...	22 30.8	+ 0 13	7.0	M1	0.089	− 0.1	.004	....
5843...	22 35.7	+56 24	5.5	M4	.056	− 0.3	.007	....
5855...	22 38.2	−29 45	6.4	M5	.030	− 0.1	.005	....
B.D.+43°4305...	22 43.6	+43 56	9.5	M5e	.86	+11.4	.240	....
5884...	22 45.6	−13 59	4.2	Mo	.039	− 0.4	.012	....
5897...	22 48.6	+42 55	5.2	Mo	.106	+ 0.2	.010	....
5895...	22 48.7	− 7 59	3.8	M2	.036	− 0.1	.017	....
Cin. 3001...	22 56.3	−22 55	7.6	M1	.899	+ 8.8	.174	....
5934...	22 58.7	− 6 59	6.5	M2	.039	0.0	.005	....
5940...	23 0.1	+27 41	2.6	M2	0.234	− 0.4	.025	.016
Cin. 3014...	23 0.8	−36 18	7.4	M2	6.900	+ 9.4	.251	.292
5952...	23 3.2	+ 9 0	4.7	M2	0.016	+ 0.6	.015	− .003
5962...	23 5.7	+ 8 16	5.4	M4	.004	− 0.9	.005	....
5978...	23 10.4	− 6 27	4.4	M2	.193	+ 0.6	.017	.005
5986...	23 13.0	− 8 8	5.1	M5	.022	0.0	.010	....
5993...	23 14.3	+48 36	5.0	M2	.038	0.0	.010	....
6003...	23 16.3	+41 40	6.0	Mo	.044	+ 0.4	.008	....
6006...	23 17.2	+30 0	5.8	Mo	.102	+ 0.4	.008	....
6025...	23 21.5	+61 52	5.2	M2	.014	− 0.7	.007	....
6058...	23 29.7	+22 5	5.5	M5	.036	0.0	.008	....
6089...	23 39.6	+ 9 55	5.4	M2	0.007	0.0	.008	....
Lal. 46650...	23 45.3	+ 2 0	8.7	M2	1.393	+ 9.1	.120	.171
6121...	23 47.5	+ 8 54	6.1	M2	0.063	− 0.1	.006	....
6125...	23 48.6	+21 15	6.3	M2	.055	+ 0.5	.007	....
6127...	23 48.7	+18 42	5.2	M3	.047	0.0	.009	0.014
6137...	23 50.9	− 0 17	6.0	M5	.057	− 0.5	.005	....
6143...	23 52.3	−22 24	7.4	M2	.050	0.0	.003	....
6150...	23 53.9	+24 43	4.8	M3	.056	− 0.1	.010	....
B.D.+45°4378...	23 54.8	+46 19	9.2	Mo	.64	+ 9.2	.100	....
6171...	23 58.1	− 6 26	4.7	M3	0.053	− 0.5	0.009	....

An examination of the absolute magnitudes of the giant stars listed in Table I shows that the mean value is about −0.2, with some of the brightest stars ranging nearly to −4.5. The faintest of the giant M stars of early type is +0.7, and the brightest of the dwarf stars +7.0, thus leaving an interval of 6.3 mag. within which no stars are found. For stars of class M5 or later this interval increases

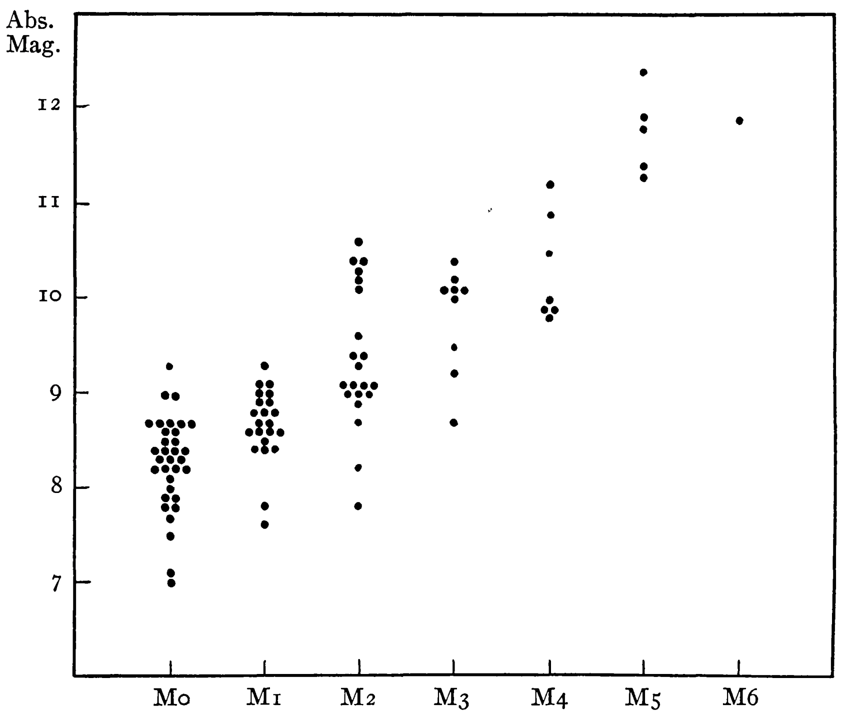

FIG. 1.—Absolute magnitudes and spectral types of dwarf M stars

to 11.0 mag. The mean absolute magnitude of the long-period variables as determined by Merrill and Strömberg is in good agreement with our values for the M stars of advanced type.

The giant stars show little variation in mean absolute magnitude with spectral type, while the dwarfs decrease rapidly in luminosity as the type becomes more advanced. This characteristic of dwarf M stars has been noted by us previously, and reference has been made to the possibility it affords of deriving the parallaxes of faint stars of this type from spectrograms of very low dispersion. A diagram showing the absolute magnitudes of the dwarf stars of Table I plotted against spectral type is given in Figure 1. The corresponding mean curve is given in Figure 2. It seems clear that in the case of dwarf stars of the more advanced types, at least, a very fair approximation to the parallaxes may be derived from the estimation of spectral type and the assumption of a constant absolute magnitude for each type. Among the dwarf stars smaller dimensions appear to accompany lower temperatures and to lead to decreased luminosity,

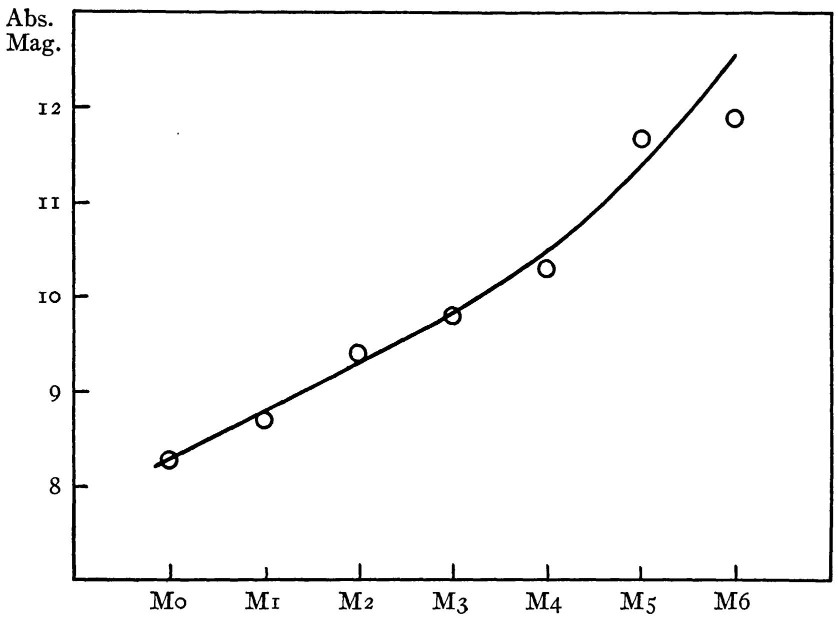

FIG. 2.—Normal points and plot of absolute magnitudes and spectral types of dwarf M stars.

while among the giants the reduction in temperature is compensated by increase in size.

Twenty-eight stars in the list have absolute magnitudes brighter than -1.0, and may for convenience be called "super-giants." Among them are α Orionis, α Scorpii, α Herculis, and several red variables in the h and χ cluster in Perseus. These intrinsically bright stars show a pronounced angular galactic concentration in conformity with the behavior of the brightest stars of other spectral types, although, as is well known, the M-type giants in general show no such effect. The average galactic latitude of these twenty-eight stars is 7°, only five stars having values above 10°.

Three of the super-giants belong to the W Cephei type of variable, and have spectra which show bright lines of hydrogen, as well as certain unidentified emission lines. Seven stars, of which four are irregular variables, are shown by their radial velocities to be members of the double cluster in Perseus. A parallax of between 0\".001 and 0\".002 is indicated by these stars. It is of interest to note that the mean proper motion of the seventeen super-giants for which values are known is only 0\".017, a value considerably smaller than that for the ordinary giants.

An outstanding feature of the absolute magnitudes of the giant stars other than the super-giants is their small dispersion. If this were due to any failure on the part of the spectral criteria to show differences of absolute magnitude among these stars, it would certainly be expected to show for the brightest stars as well. The spectral differences, however, between the ordinary giants and the super-giants are well marked. A comparison of the mean absolute magnitudes of groups of stars of different reduced proper motion H $(m+5 \log \mu)$ shows a fairly regular though small increase in luminosity with decrease in H. A similar comparison of H with mean absolute magnitude derived from trigonometric parallaxes, of which about fifty are available, gives quite comparable results, and shows that trigonometric parallaxes also indicate small dispersion in absolute magnitude among the ordinary M-type giants. Since the reduced proper motion H is a simple function of absolute magnitude and linear cross-motion, it is evident that the observed dispersion in H, which is not very large, may be accounted for by a considerable dispersion in linear cross-motion and little dispersion in absolute magnitude. The large dispersion in radial velocity observed among the normal M-type giants, larger than for any other class of giant stars, would indicate a similar dispersion in linear cross-motion and would be in excellent agreement with this view of a small range in absolute magnitude.

There are seventy-one giant stars in the list for which trigonometric parallaxes have been measured. Of these, sixty-seven are found in Schlesinger's *Catalogue of Parallaxes* and have been corrected for systematic errors on the basis of the system derived by him. The direct comparison of the spectroscopic and trigonometric parallaxes of these stars shows an excellent degree of agreement, the mean difference being less than 0".001, and the average deviation between 0".008 and 0".009. Since the reduction tables from which the spectroscopic absolute magnitudes and parallaxes are calculated were based on results derived from peculiar motions without any use of trigonometric parallaxes, this agreement affords important evidence for the accuracy of the system employed.

In the case of the dwarf stars the trigonometric parallaxes have been used exclusively in the derivation of the reduction curves, and close agreement of the mean results is to be expected. A comparison of sixty-four stars shows a systematic difference of about 0".002, the trigonometric parallaxes being the larger. This would correspond to considerably less than 0.1 in absolute magnitude.

Several stars among the dwarfs for which no trigonometric parallaxes have been measured are found to have values of 0".1 or larger. These are Cin. 251, Cin. 456, B.D.+63°869, Cin. 1633, β G.C. 6710 N, B.D.−7°4003, B.D.−12°4523, Wolf 636, B.D.+45°2505, B.D. +43°4305, Cin. 3001, and B.D.+45°4378. If the spectroscopic parallaxes of B.D.−7°4003 and B.D.−12°4523 are confirmed by observers of trigonometric parallax they will be among the nearest known stars.

There are 155 giant stars in Table I which were included in the list of 1646 stars for which absolute magnitudes were published by us in 1921.[1] The present values are 0.4 mag. brighter on the average, a result which is quite satisfactory in view of the low weight of the earlier determinations. A similar comparison has been made for eighty-six giant stars common to our list and that of Young and Harper.[2] The Mount Wilson values are, on the average, nearly 0.8 mag. fainter than the Victoria results. The agreement is much better for the early than for the later subdivisions of type, the differences becoming progressively greater and amounting to as much as 1.5 mag. for the relatively few stars of classes M5 and M6. The explanation is probably to be found in the variation with spectral type of the intensities of the lines used for determinations of absolute magnitude.

[1] *Mt. Wilson Contr.*, No. 199; *Astrophysical Journal*, **53**, 13, 1921.

[2] *Publications of the Dominion Astrophysical Observatory*, **3**, No. 1, 1924.

A result similar to that obtained from a comparison with the Victoria values is found for the absolute magnitudes published by Rimmer.[1] The Mount Wilson values are slightly less than 0.7 mag. fainter for forty-seven stars observed in common. For stars of classes Mo and M1 the difference is 0.2 mag., but for the more advanced types the average difference is nearly a magnitude.

The present investigation has given no evidence of the existence of stars intermediate in absolute magnitude between the giants and the dwarfs, or of spectral types intermediate between these radically different spectra. In the case of dwarf stars which are observed because of their large proper motions, the effect of selection must necessarily be present, and if dwarf stars somewhat brighter than 7.0 in absolute magnitude exist, they may not have been detected because they are not included on our observing lists. For the giant stars, however, no effect of selection according to proper motion is present. If we may assume that the M stars given in Boss's *Catalogue* are complete to apparent magnitude 6.5, we find accordingly that no star of absolute magnitude 3.0 can be present within a distance from the sun defined by a parallax of $0\overset{''}{.}020$, and no star of absolute magnitude 2.0 within a distance defined by a parallax of $0\overset{''}{.}013$. The results for a considerable number of stars of fainter apparent magnitude, observed mainly in the Selected Areas, add strength to this conclusion, and make the existence in appreciable numbers of stars of intermediate absolute magnitude or spectral type exceedingly improbable.

MOUNT WILSON OBSERVATORY
August 1926

[1] *Memoirs of the Royal Astronomical Society*, **64**, Part 1, 1925.