THE GALACTIC CLUSTERS NGC 6649 AND NGC 6694

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ABSTRACT

Red color indices have been obtained for 528 stars in and near the heavily obscured galactic clusters NGC 6649 and NGC 6694 in Scutum. The relations between color and apparent magnitude show that NGC 6694 contains a well-defined main sequence and a slight indication of a giant branch. For NGC 6649 the color-magnitude diagram resembles that of h and χ Persei or of Messier 7, shifted to the red by $1^{m}.65$. A zone of low star density 3′ from the center of NGC 6694 is noted.

The color excesses ($\lambda\lambda$ 4300–6200) and distance moduli derived are: NGC 6649, $1^{m}.65$ and $12^{m}.1$; NGC 6694, $0^{m}.55$ and $11^{m}.1$.

The ratio between general and selective absorption is estimated from the available data on red color indices in obscured clusters. Although uncertain in many cases, the results tend to confirm the ratio $A_r/(A_b - A_r) = 2$, predicted by the $1/\lambda$ law of scattering. The moduli for NGC 6649 and NGC 6694 have accordingly been corrected for the general red absorption, and the distances are 570 and 1000 parsecs, respectively.

The Milky Way between Sagittarius and Scutum is a beautifully complex structure, characterized by rich star clouds and sharply accentuated by dense lanes of obscuration. The obviousness of the absorption makes this area of the Milky Way simpler for analysis than many other galactic fields, in which gradual changes of star density across the regions are almost inextricably intermingled with the slowly thinning-out borders of large obscuring clouds. It is for this reason that the galactic clusters NGC 6649 and NGC 6694 are of great interest; for they, more certainly than any other clusters in the northern Milky Way, are seen through heavy obscuration whose borders are well defined and easily recognizable. Reference to the *Ross-Calvert Milky Way Atlas*, Plate 7, will show the situation of the clusters with respect to the absorption; NGC 6649 is seen through the central and densest part of the cloud which separates the Scutum star cloud from the rich star fields in Sagittarius, and NGC 6694 through a less dense part of the absorption near Scutum.

The co-ordinates and other data for the clusters are as tabulated (p. 304).

OBSERVATIONAL DETAILS

A photometric study, based upon polar comparisons made with the 36-inch reflector of the Goethe Link Observatory, has resulted in photographic and red magnitudes for 528 stars. Cramer Hi-Speed

Special plates and Agfa Super Pan Press films with a Ciné Red filter (Eastman No. 28) were used. In addition, several plates of longer exposure, taken with the 36-inch reflector at the Steward Observatory in Tucson, have been used for measuring the faint stars. A summary of the observational material is given in Table 1. The probable errors of the color indices are $\pm 0^{m}.066$ for most of the cluster stars in NGC 6649 and $\pm 0^{m}.065$ for those in NGC 6694.

The red exposures made in Tucson are on Eastman I-C Special plates. However, no measurable color equation between the red

1900	Diam.	Class*	Spectra*	Distance (Parsecs)	
				Trumpler*	Shapley†
NGC 6649 $\left\{ \begin{matrix} 18^{h}28^{m} - 10^{\circ}.5 \\ 349^{\circ} \quad - 2^{\circ}.3 \end{matrix} \right\}$	8′	I2m	.....	1830	2090–3310
NGC 6694 $\left\{ \begin{matrix} 18^{h}40^{m} - 9^{\circ}.5 \\ 352^{\circ} \quad - 4^{\circ}.4 \end{matrix} \right\}$	9′	II2m	16B8–A2	1610	1910–3020

* *Lick Obs. Bull.*, **14**, 154, 1930. † *Star Clusters*, Appen. B, 1930.

magnitudes given by the plates and those given by the Afga films could be found. Apparently, the effective wave lengths of the two emulsions, when used with the No. 28 filter, are nearly the same, namely, 6200 A.

While the polar comparisons were being made, the mirror, being mounted in an unsatisfactory cell which was later discarded, gave astigmatic images. Since the polar plates were, in general, more astigmatic than the plates of the clusters, it was necessary to estimate the seriousness of scale errors introduced into the magnitudes by the astigmatism. Plates taken at one astigmatic focus were compared with those taken midway between the two astigmatic foci in order to obtain as symmetrical an image as possible. The measurements indicate that the scale errors caused by the astigmatism are less than $0^{m}.2$ from the eleventh to the sixteenth magnitudes. However, the astigmatism, combined with the coma, led to an asymmetrical distance correction which varied with the orientation of the mirror in hour-angle as well as with the direction and distance of the image

from the plate center. It is, therefore, possible that further work on the magnitude sequences with a large photographic refractor situated in a lower latitude would be profitable.

The Tucson plates were taken with a Ross coma corrector and have a field 30′ in diameter, free from distance correction. There should be, therefore, no photometric errors in the colors depending upon distance from the center of the cluster.

All measurements were made with scales having intervals between images of approximately $0^{m}.5$.

TABLE 1

	Number of Comparison Exposures of Cluster 5–20 Min. Exp.		Number of Long Exposures 30–40 Min. Exp.		Mean Numerical Extinction Correction	
	Red	Blue	Red	Blue	Red	Blue
NGC 6649	6	8	3	3	$0^{m}.04$	$0^{m}.05$
NGC 6694	8	6	3	3	0.03	0.11

PROBABLE ERRORS

	Red	Blue
NGC 6649	$8^{m}.0$–$10^{m}.5 \pm 0^{m}.068$	$10^{m}.0$–$13^{m}.5 \pm 0^{m}.085$
	10.5–13.2 .045	13.5–16.0 .049
	13.2–15.0 .091	16.0–16.7 .053
NGC 6694	9.0–11.0 .072	9.0–13.0 .162
	11.0–13.5 .040	13.0–15.0 .088
	13.5–14.5 0.054	15.0–16.5 0.037

RESULTS AND CONCLUSIONS

NGC 6694.—The relations between color and apparent red magnitude (Figs. 1*a*, 1*b*, 1*c*) show that NGC 6694 has a well-defined main sequence and a slight indication of a giant branch. An unusual number of stars with high color indices (m_r, 12–14; C_r, 2.3–3.5) have been measured; but they are field stars, since they are contributed mainly by the outer zones of the cluster. The color-magnitude array for the field stars in an area of the sky equal to that included by ring 5 and situated 10′ from the center of the cluster (Fig. 1*c*) con-

firms this conclusion. Inasmuch as the galactic center lies only 25° from the cluster, these stars may be distant red giants, seen through

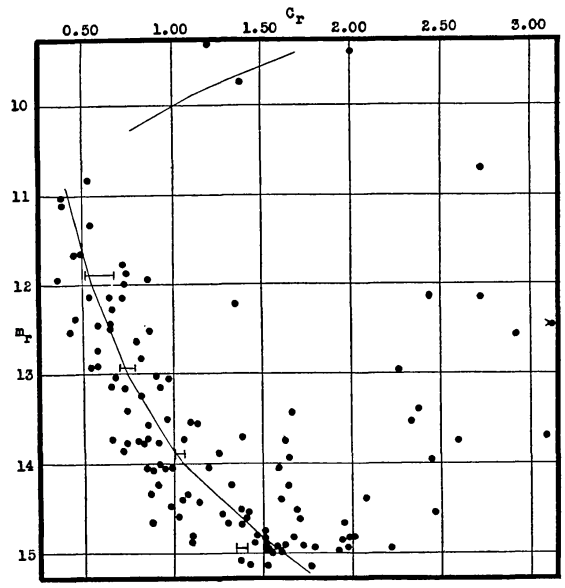

FIG. 1*a*.—NGC 6694; rings 1, 2, 3

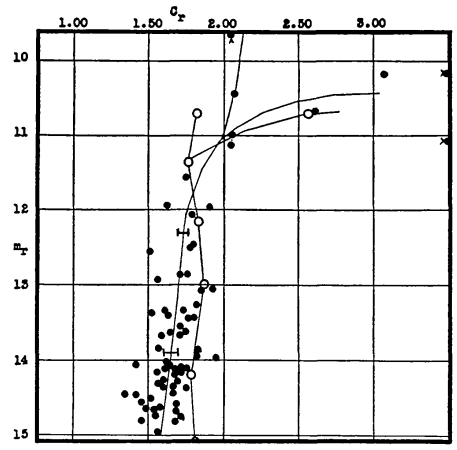

FIG. 2*a*.—NGC 6649; rings 1, 2, 3

selective obscuration. Thus, G or K giants with intrinsic colors of $1^{m}.5$, and distant between 2000 and 3000 parsecs, would give apparent magnitudes similar to those observed.

A striking feature of NGC 6694 is the well-defined zone of low

star density immediately surrounding the nucleus.[1] The boundaries of the zone appear somewhat more sharply defined on the blue-sensitive than on the red-sensitive plates. Figure 3 shows the areal density in stars per 0.494 square minutes as a function of the distance from the center of the cluster; in a zone 3′.1 from the center of the cluster the areal density is 13 per cent less than that in adjacent regions. The position and width of the zone, as estimated by inspection before the star counts were made, are also indicated.

The explanation of the ring has two possibilities: it may represent a spherical shell in which the star density is low, or it may result from a shell of obscuration. The latter alternative, however, is unlikely in the case of NGC 6694, since an obscuring shell would cause the distance modulus obtained from the center of the cluster, where most of the stars are obscured by the shell, to be greater by the amount of the absorption than the modulus given by the stars in the outer zones of the cluster, in which the stars lie predominantly outside the obscuration. Comparison of Figures 1*a* and 1*b*, however, shows a slight effect in the opposite direction. It seems probable, therefore, that the zone represents a spherical shell of low stellar space density in the cluster.

The star counts indicate a diameter of 11′.0 for the cluster, and a total of 150 cluster stars brighter than $m_r = 15.3$.

A comparison of the color-magnitude diagram for NGC 6694 with that of Messier 38 leads to the estimates of color excess, $0^{m}.55$, and of distance modulus, $11^{m}.1$. The modulus, corrected for general absorption equal to twice the color excess, is $10^{m}.0$. The corresponding distances are 1660 parsecs, uncorrected, and 1000 parsecs, corrected for absorption.

NGC 6649.—NGC 6649 is a remarkable cluster, for the color indices are all very nearly the same ($1^{m}.7$) from the eleventh to the fifteenth red magnitude. The color-magnitude diagram (Fig. 2) resembles that of h and χ Persei, the Pleiades, and, perhaps most

[1] A feature found by Klauder and Siedentopf (*A.N.*, **268**, 13–14, 1939) in several clusters appears to be of a somewhat different nature. In the case of NGC 6694 the zone of low star density is only 3′ from the center of the cluster, while the regions of low density found by Klauder and Siedentopf are, for clusters whose apparent diameters are similar to that of NGC 6694, distant from the centers by five or more times this distance.

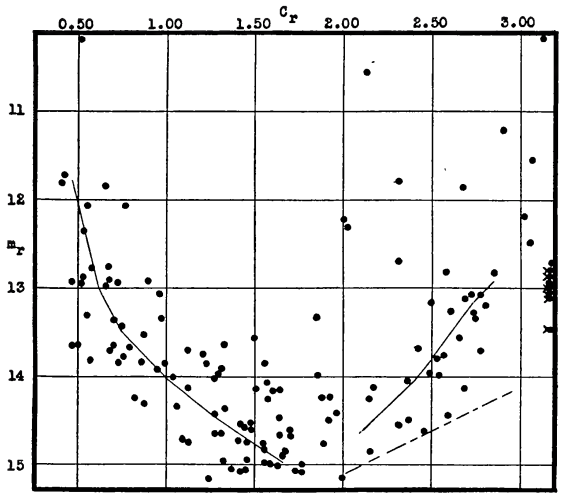

FIG. 1*b*.—NGC 6694; rings 4, 5, 6

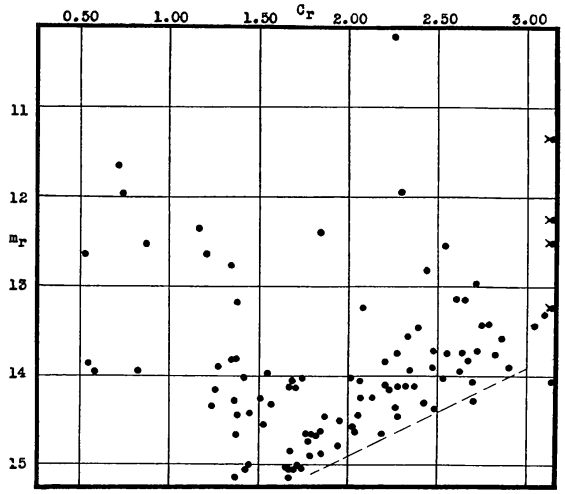

FIG. 1*c*.—NGC 6694; exterior regions (dashed line shows observational limit).

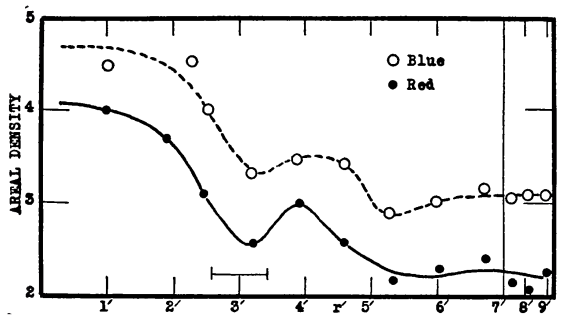

FIG. 3.—NGC 6694, areal density (stars per 0.494 sq. min.) against distance from center of cluster. Limiting magnitudes; red, 15.3, blue, 17.4.

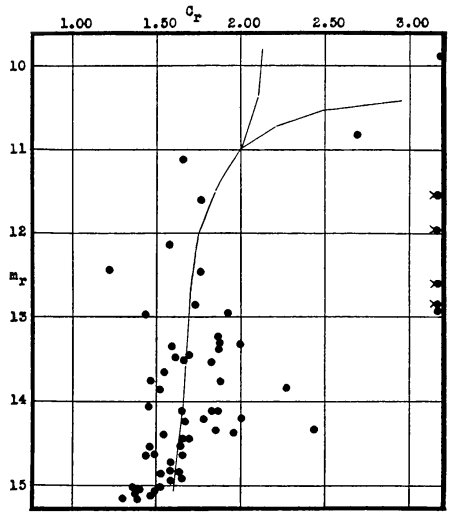

FIG. 2*b*.—NGC 6649; rings 4, 5, 6

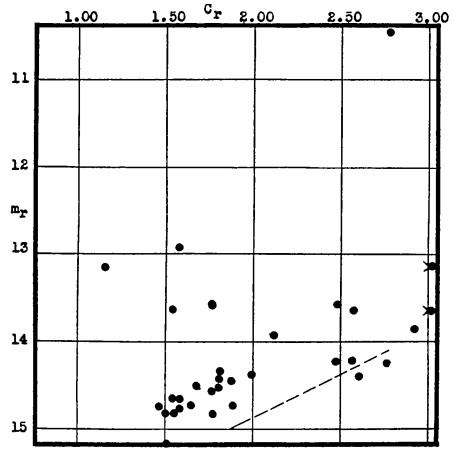

FIG. 2*c*.—NGC 6649; exterior regions

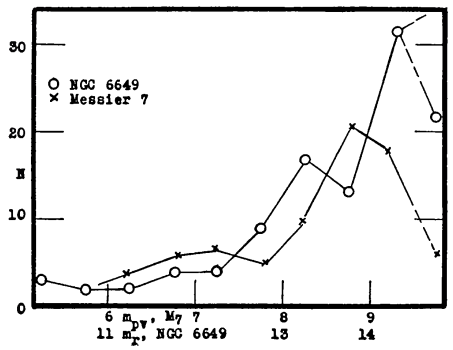

FIG. 4.—Luminosity-curves for NGC 6649 and Messier 7.

closely, Messier 7[2]. In all these clusters the stars have approximately zero color indices for the four brightest magnitudes. The color excess indicated by the redward shift of the color-magnitude diagram for NGC 6649 is thus $1^{m}.65$. Again, as in NGC 6694, an unusual number of very red stars are noted, three of them having color indices over $4^{m}.0$.

The lack of dependence of color upon apparent magnitude makes an accurate determination of the distance of NGC 6649 difficult. The close resemblance of the color-magnitude array for NGC 6649 to that of Messier 7, however, suggests that a reliable value for the distance may be obtained by comparing the luminosity-curves of the two clusters. Although this method of estimating distances is unreliable when applied indiscriminately to clusters in general, it should be satisfactory in the present case. For the distance of Messier 7, a mean of Wallenquist's and Trumpler's values, 230 parsecs was used. Allowance was made for the difference between the photovisual and the red-magnitude scales. Thus, the stars in NGC 6649, had they been measured on photovisual plates like those used on Messier 7, would have appeared approximately $0^{m}.3$ fainter, because of the smaller yellow indices ($C_r = 1.2C_v$).

The luminosity-curves for NGC 6649 and Messier 7 are compared in Figure 4. The resulting modulus for NGC 6649 is $12^{m}.1$; and, corrected for general absorption by means of the observed selective absorption and the $1/\lambda$ law of scattering, this becomes $8^{m}.8$. The corresponding distances are 2650 parsecs, uncorrected, and 570 parsecs, corrected for absorption.

The slight but unusual slope in the color-magnitude diagram for NGC 6649 may be the result of small scale errors in the magnitude systems. The Tucson plates afforded a means of rederiving the magnitudes in NGC 6649 by comparison with those in NGC 6694. Because of the normal appearance of the color-magnitude array for NGC 6694, it was assumed that the magnitude sequences in NGC 6694 are free from errors. This comparison suggests corrections to the magnitudes and colors in NGC 6649 which will give the relation indicated by the circles in Figure 2. Thus, the color-magnitude array for NGC 6649 resembles still more closely that of Messier 7. The

[2] Wallenquist, *Bosscha Ann.*, **3**, Part 4, 1931.

corrections have not been applied to the catalogued magnitudes of cluster stars, however, for the available plates furnish not an independent determination of the magnitudes in NGC 6649 but merely a comparison between the sequences in the two clusters.

THE RATIO OF GENERAL TO SELECTIVE ABSORPTION

The color excesses observed in obscured clusters furnish a relatively direct means for evaluating the ratio of general to selective absorption. The general absorption may be estimated in a manner similar to that used by Trumpler in deriving the photographic absorption. The linear diameters of the obscured clusters are assumed to be equal to those of clusters of similar type in unobscured regions, and the angular diameters of the clusters are assumed to be unaffected by the absorption. Both assumptions may lead to uncertain results when applied to individual clusters, the first because of the dispersion in size of clusters even of the same type and the second, in most instances, because of the greater concentration of the bright stars to the centers of the clusters. The moduli obtained from the diameter-distances may be compared with the photometric moduli, and the general red absorption obtained directly.

In Table 2 the photometric moduli, uncorrected for absorption, are taken from the present paper and from *Harvard Annals*, **106,** No. 2. The moduli based on diameter-distances are from Trumpler's data.[3]

The mean, if we omit the discordant values, which may be due to irregular structure in the clusters as well as to a real variation in K_r $[K_r = A_r/(A_b - A_r)]$ in different obscuring clouds, is 1.6. A smaller value for K_r than the factor 3 adopted in *Harvard Annals*, **106,** No. 2, is indicated.

Schalén has estimated the general photographic absorption in the direction of NGC 6649 to be at least 3 mag., beginning in the immediate vicinity of the sun.[4] His data, however, are not sufficiently detailed to give a good estimate of the absorption in the direction of

[3] *Lick Obs. Bull.*, **14,** 154, 1930.

[4] *Medd. Upsala Obs.*, No. 58, 1934.

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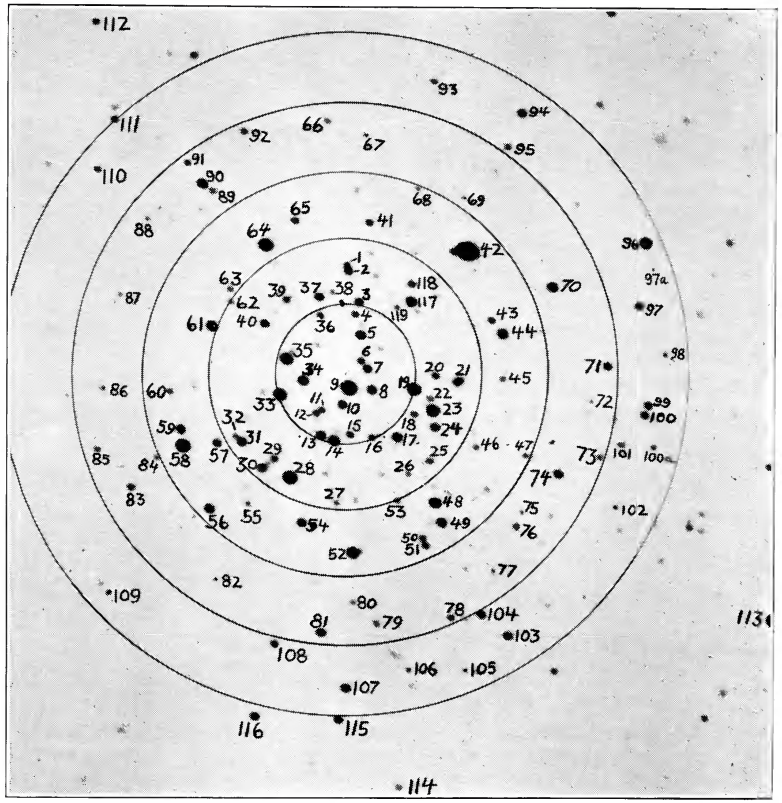
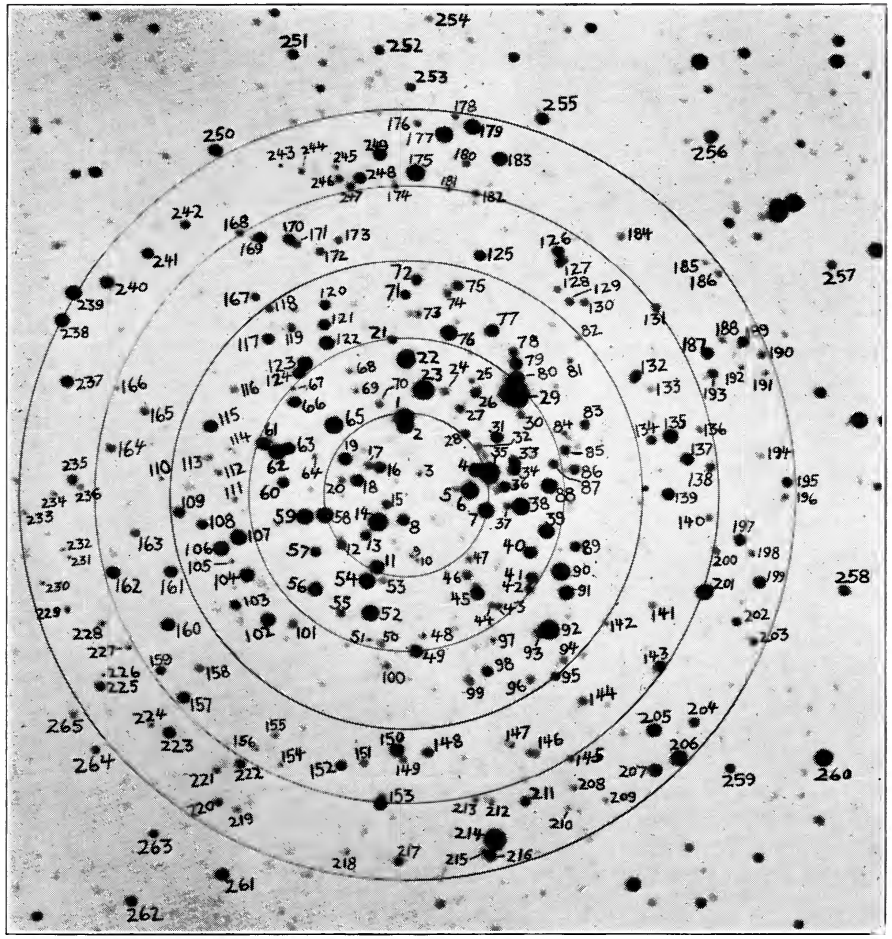
PLATE VII



NGC 6649



NGC 6694

NGC 6694. A value of $3^{m}.0$, or greater, for A_b, combined with the selective absorption measured in NGC 6649, leads to a ratio of K_b $[K_b = A_b/(A_b - A_r)]$ at least greater than 1.9, which agrees qualitatively with the value $K_b = 3.1$ predicted by the $1/\lambda$ law of scattering.

The moduli for the clusters are, of course, based upon the red-magnitude system, and it is the value of K_r with which we are concerned. In *Harvard Annals*, **106**, No. 2, it was assumed that K_r and K_b were, to a first approximation, equal. In view of the present

TABLE 2

	Photometric Modulus	Diameter-Distance Modulus	Color Excess	A_r	(A_r/A_b-A_r)
NGC 6649	$12^{m}.1$	$10^{m}.8$*	$1^{m}.65$	$+1^{m}.3$	0.8
6694	11.1	11.1	0.55	+0.0	.....
1746	9.4	9.75	0.30	−0.3	.....
1647	9.2	8.8	0.30	+0.4	1.3
1817	11.25	10.7	0.70	+0.55	0.8
Messier 38	9.7	9.8	0.15	−0.1	.....
NGC 1893	10.4	9.8	0.10::	+0.6	6.0::
Messier 35	9.8	9.4	0.15	+0.4	2.7
NGC 2158	14.6	12.6	0.80	+2.0	2.5
2266	12.45	12.0	0.30:	+0.4	1.3
2281	9.45	9.2	0.00	+0.2	.....

* From Messier 7 comparison.

data, however, and also in view of the general acceptance of the $1/\lambda$ law of scattering, it seems best to adopt the predicted value, $K_r = 2$. Most of the distances given in *Harvard Annals*, **106**, No. 2, are not seriously affected by the change, except those for NGC 1817 and NGC 2158, which become 930 and 4000 parsecs, instead of 690 and 2700 parsecs.

It is a pleasure to thank Dr. Goethe Link for the use of the 36-inch reflector of his observatory; Dr. Edwin F. Carpenter for the use of plates taken with the reflector at Tucson; and Indiana University for the postdoctoral fellowship in astronomy, which enabled me to complete the measurement and observation of the clusters.

TABLE 3

CATALOGUE OF STARS IN NGC 6649 AND NGC 6694*

NGC 6649					NGC 6649					NGC 6694				
No.	R	m_{pg}	m_r	C_r	No.	R	m_{pg}	m_r	C_r	No.	R	m_{pg}	m_r	C_r
1	2	15.69	13.86	1.83|	66	4	16.20	14.21:	1.99:s	1	1	11.39	11.02	0.37|
2	2	15.40	13.83	1.57|	67	4	16.51	14.88	1.63	2	1	12.83	11.97	0.86|
3	2	15.40	13.68	1.72	68	4	16.35	15.01	1.34	3	1	16.54	14.97	1.57
4	1	15.89	14.20	1.69	69	4	16.54	14.95	1.59	4	1	13.43	10.71	2.72
5	1	14.92	13.07	1.85	70	4	14.39	12.97	1.42s	5	1	16.49	14.96	1.53c
6	1	15.73	14.12	1.61	71	4	15.22	13.76	1.46s	6	1	12.63	11.89	0.74
7	1	15.37	13.63	1.74	72	4	16.54	14.90	1.64	7	1	12.95	12.52	0.43
8	1	14.94	13.33	1.61	73	4	16.15	14.51	1.64	8	1	14.52	13.78	0.74
9	1	12.51	10.44	2.07	74	4	14.91	13.32	1.59	9	1	16.83	14.88	1.95|
10	1	15.24	13.46	1.78	75	4	16.57	15.11	1.46	10	1	17.00	14.53	2.47|
11	1	15.98	14.29	1.69|	76	4	15.98	14.21	1.77	11	1	13.69	13.02	0.67
12	1	16.01	14.34	1.67|	77	4	16.57	15.08	1.49	12	1	15.45	14.37	1.08
13	1	14.98	13.06	1.92	78	4	15.94	14.40	1.54	13	1	15.23	12.97	2.26c
14	1	14.25	12.45	1.80	79	4	16.13	14.46	1.67	14	1	11.42	9.42	2.00
15	1	15.86	14.12	1.74	80	4	16.41	14.83	1.58	15	1	15.86	13.53	2.33
16	1	15.86	14.30	1.56	81	4	14.90	12.98	1.92	16	1	14.93	14.01	0.92
17	2	14.94	13.09	1.85	82	4	16.46	15.17	1.29	17	1	16.33	14.82	1.51
18	2	15.88	14.28	1.60	83	4	15.52	14.08	1.44	18	1	14.16	13.42	0.74
19	2	13.27	10.66	2.61	84	4	16.26	14.62	1.64	19	1	13.79	13.14	0.65
20	2	15.74	14.09	1.65	85	4	16.08	14.65	1.43	20	1	16.42	14.90	1.52
21	2	15.25	13.54	1.71	86	4	16.53	15.03	1.50	21	2	15.52	14.64	0.88
22	2	16.11	14.44	1.67	87	4	16.39	14.87	1.52	22	2	11.87	11.34	0.53
23	2	13.81	12.02	1.79	88	4	16.45	15.08	1.37	23	2	11.10	9.72	1.38
24	2	15.26	13.61	1.65	89	4	15.99	14.53	1.46	24	2	16.18	14.51	1.67c
25	2	15.87	14.44	1.43	90	4	14.57	12.84	1.73	25	2	16.64	14.92	1.72
26	2	16.28	14.59	1.69	91	4	16.07	12.91	3.16s	26	2	15.54	14.23	1.31
27	2	16.48	14.76	1.72	92	4	15.97	14.12	1.85s	27	2	15.92	14.82	1.10
28	2	13.16	11.11	2.05	93	5	16.19	14.34	1.85s	28	2	15.45	14.48	0.97
29	2	15.64	14.01	1.63	94	5	15.19	13.65	1.54s	29	2	10.50:	9.30:	1.20:
30	2	15.05	13.31	1.74	95	5	15.93	14.11:	1.82:s	30	2	16.31	14.61	1.70c
31	2	14.90	13.38	1.52|	96	5	13.63	12.42	1.21s	31	2	14.38	13.72	0.66
32	2	16.12	14.37	1.75|	97	5	15.39	13.86	1.53s	32	2	16.06	14.69	1.37
33	2	13.33	11.58	1.75	97a	5	16.74	14.32	2.42	33	2	14.78	13.73	1.05|
34	1	14.62	12.86	1.76	98	5	16.46	15.08	1.38	34	2	14.58	13.73	0.85|
35	1	13.57	11.95	1.62	99	5	15.30	13.31	1.99	35	2	11.48	11.11	0.37c
36	1	15.92	14.32	1.60	100	5	15.35	13.54	1.81	36	2	15.11	13.45	1.66
37	2	15.24	13.44	1.80	100a	5	16.10	14.61	1.49	37	2	16.33	14.88	1.45c
38	2	16.49	14.80	1.69	101	5	16.11	14.45	1.66	38	2	12.31	11.96	0.35
39	2	15.86	14.12	1.74	102	5	16.35	14.39	1.96b	39	2	13.07	12.43	0.64
40	2	15.27	13.67	1.60	103	5	15.23	13.37	1.86	40	2	14.05	13.07	0.98
41	3	15.72	14.16	1.56	104	5	15.13	13.45	1.68	41	2	14.91	14.04	0.87
42	3	10.40	8.36:	2.04:s	105	5	16.51	15.14	1.37	42	2	15.94	14.64	1.30
43	3	15.69	14.34	1.35	106	5	16.32	14.74	1.58	43	2	16.27 }	13.47	{ .....
44	3	14.48	12.92	1.56	107	5	15.09	13.23	1.86s	44	2	16.34 }		{ .....
45	3	16.26	14.71	1.55	108	5	15.66	13.79	1.87s	45	2	13.89	13.16	0.73
46	3	16.26	14.80	1.46	109	5	16.53	12.92	3.61	46	2	15.61	14.59	1.02
47	3	16.20	14.63	1.57	110	5	15.96	12.60	3.36	47	2	16.46	15.08	1.38
48	3	14.27	12.49	1.78	111	6	15.72	11.55	4.17s	48	2	16.91	14.98	1.93
49	3	14.78	11.05	3.73	112	6	16.10	11.98	4.12s	49	2	14.09	13.16	0.93
50	3	15.86	14.11	1.75|	113	6	12.77	11.12	1.65s	50	2	16.39	13.94	2.45
51	3	15.80	14.12	1.68|	114	6	16.12	13.86	2.26s	51	2	16.83	.....	.....
52	3	13.83	11.93	1.90	115	6	15.23	13.35	1.88s	52	2	12.66	12.13	0.53
53	3	16.02	14.50	1.52	116	6	15.11	13.45	1.66s	53	2	16.49	14.83	1.66
54	3	15.07	13.25	1.82	117	2	14.56	10.14	4.42s	54	2	12.83	12.38	0.45
55	3	16.53	14.97	1.56	118	2	15.93	13.98	1.95s	55	2	15.80	12.45	3.35
56	3	14.57	12.85	1.72	119	2	16.36	14.67:	1.69s:	56	2	13.47	12.90	0.57
57	3	15.50	14.08	1.42	120†	6	15.11	13.49	1.62s	57	2	15.14	13.89	1.25
58	3	13.05	10.99	2.06	121†	6	15.92	14.26	1.66s	58	2	12.49	11.78	0.71
59	3	15.01	13.39	1.62	122†	6	13.53	10.84	2.69s	59	2	12.85	12.13	0.72
60	3	16.04	14.58	1.46	123†	6	15.76	14.11	1.65s	60	2	14.57	13.86	0.71
61	3	14.04	12.53	1.51	124†	6	13.35	11.60	1.75s	61	2	13.92	13.02	0.90
62	3	16.25	14.69	1.56	125†	6	13.69	12.12	1.57s	62	2	12.72	12.00	0.72
63	3	16.11	14.63	1.48	126†	6	13.09	9.91	3.18s	63	2	14.42	13.56	0.86
64	3	13.24	10.17	3.07s	127†	6	14.21	12.45	1.76s	64	2	16.84	14.83	2.01
65	3	15.78	13.95	1.83s						65	2	12.14	11.66	0.48

* Symbols: † = off chart; d = double; b = blend; c = close to bright star; s = sequence star; | = stars close together.

TABLE 3—*Continued*

NGC 6694					NGC 6694					NGC 6694				
No.	R	m_{pg}	m_r	C_r	No.	R	m_{pg}	m_r	C_r	No.	R	m_{pg}	m_r	C_r
66	2	14.58	12.15	2.43	133	4	16.63	15.00:	1.63:	200	5	16.11	14.47	1.64
67	2	16.82	14.83	1.99	134	4	15.81	13.09	2.72	201	5	12.69	10.56	2.13s
68	2	16.79	13.70	3.09	135	4	13.44	12.77	0.67	202	5	15.55	12.50	3.05s
69	2	16.93	15.17	1.76	136	4	16.53	14.86	1.67	203	5	15.83	13.85	1.98ds
70	2	16.36	13.76	2.60	137	4	14.29	13.32	0.97	204	5	15.17	13.32	1.85s
71	3	15.18	14.32	0.86	138	4	15.89	14.62	1.27	205	5	13.41	12.93	0.48
72	3	14.87	12.14	2.73	139	4	14.30	12.29	2.01	206	5	12.62	12.07	0.55
73	3	16.47	14.40	2.07d	140	4	16.40	14.49	1.91	207	5	14.13	11.20	2.93
74	3	16.02	14.61	1.41	141	4	16.19	14.74	1.45	208	5	16.53	14.87	1.66
75	3	15.26	14.06	1.20	142	4	16.66	14.77	1.89	209	5	16.78	15.00:	1.78:
76	3	12.95	12.29	0.66	143	4	14.38	13.82	0.56	210	5	16.88	15.10	1.78
77	3	14.09	13.26	0.83	144	4	15.86	13.26	2.60	211	5	15.21	12.20	3.01
78	3	15.61	13.96	1.65	145	4	16.23	13.58	2.65	212	5	16.34	14.64:	1.70:
79	3	14.47	13.50	0.97	146	4	15.65	14.08	1.57d	213	5	16.31	14.67:	1.64:d
80	3	14.63	13.53	1.10c	147	4	16.50	15.06	1.44	214	5	10.70	10.18	0.52
81	3	16.52	14.99	1.53	148	4	15.00	12.69	2.31	215	5	16.86::	14.55	2.31::c
82	3	16.55	15.12	1.43	149	4	16.06	14.59	1.47	216	5	15.26	13.97	1.29c
83	3	15.60	14.46	1.14	150	4	13.41	12.89	0.52	217	5	15.07	13.57	1.50
84	3	16.63	14.68	1.95d	151	4	15.87	14.75	1.12	218	5	16.40	15.16	1.24
85	3	15.36	13.74	1.62	152	4	14.50	11.83	2.67	219	5	16.21	12.91	3.30
86	3	15.45	14.40	1.05	153	4	14.04	13.07	0.97d	220	5	15.67	14.16	1.51
87	2	15.64	14.07	1.57	154	4	16.82	15.08:	1.74:	221	5	16.11	12.95	3.16
88	2	13.11	12.47	0.64	155	4	16.27	14.10:	2.17:	222	5	14.97	13.64	1.33
89	3	15.17	14.26	0.91	156	4	16.51	13.97:	2.54:	223	5	14.09	13.39	0.70s
90	3	12.15	11.69	0.46	157	4	14.21	12.21	2.00	224	5	16.14	14.27	1.87
91	3	13.43	12.64	0.79	158	4	15.79	14.70	1.09	225	5	15.08	14.26	0.82
92	3	11.36	10.83	0.53	159	4	15.39	13.83	1.56	226	5	16.85	14.16	2.69
93	3	16.00	14.40	1.60d	160	4	13.64	12.98	0.66	227	5	16.51	15.09:	1.42:
94	3	15.99	14.89	1.10	161	4	14.09	11.78	2.31	228	5	16.40	12.89	3.51
95	3	15.52	12.59	2.93	162	4	13.59	12.92	0.67	229	5	16.37	14.81	1.56
96	3	15.86	14.59	1.27	163	4	15.78	14.13	1.65	230	5	17.14	15.15:	1.99:
97	3	16.67	15.15	1.52d	164	4	15.70	14.37	1.33	231	5	16.87	14.50:	2.37:
98	3	15.01	14.06	0.95	165	4	15.79	14.18	1.61	232	5	17.05	14.46:	2.59:
99	3	15.89	14.25	1.64	166	4	17.14	13.42	3.72	233	5	16.94	.....	.....
100	3	16.27	14.81:	1.46:	167	4	15.84	14.26	1.58	234	5	6.47	13.98	2.49
101	3	15.77	13.40	2.37	168	5	15.94	14.52	1.42	235	5	15.12	13.89	1.23
102	3	13.32	12.74	0.58	169	4	14.58	11.52	3.06	236	5	16.37	14.41	1.96
103	3	15.10	13.71	1.39d	170	4	14.82	13.70	1.12	237	5	14.19	13.45	0.74
104	3	13.46	12.92	0.54	171	4	16.10	13.68	2.42	238	5	13.36	12.78	0.58
105	3	16.90	14.93	1.97	172	4	15.92	14.62	1.30	239	5	12.85	12.09	0.76s
106	3	13.05	12.47	0.58	173	4	15.99	14.55	1.44	240	5	13.47	12.95	0.52s
107	3	12.82	12.17	0.65	174	5	16.48	13.71	2.77d	241	5	14.38	13.52	0.86s
108	3	15.06	14.06	1.00	175	5	12.13	11.71	0.42	242	5	15.28	14.01	1.27s
109	3	14.58	13.77	0.81	176	5	16.07	13.33	2.74	243	5	17.08	14.63	2.45
110	4	16.98	14.83	2.15	177	5	12.51	11.85	0.66	244	5	16.33	13.77	2.56
111	3	16.75	14.97	1.78	178	5	16.43	14.29	2.14d	245	5	16.43	15.06	1.37
112	3	16.53	14.92	1.61	179	5	12.88	12.35	0.53	246	5	16.05	13.31	2.74
113	3	16.57	14.97	1.60d	180	5	16.15	14.74	1.41	247	5	15.81	13.12	2.69
114	3	17.18	14.96:	2.22:d	181	5	16.39	14.69	1.70	248	5	14.38	13.68	0.70
115	3	13.56	12.21	1.35	182	5	16.30	12.91	3.39	249	5	13.87	13.32	0.55
116	3	16.30	14.79	1.51	183	5	13.33	10.19	3.14	250	6	13.67	12.95	0.72s
117	3	14.58	13.76	0.82	184	5	16.30	12.92	3.38	251	6	14.83	13.85	0.98s
118	3	15.88	14.51	1.37	185	5	16.58	14.99	1.59	252	6	15.26	14.14	1.12s
119	3	15.98	14.56	1.42	186	5	16.42	14.06	2.36	253	6	15.67	12.81	2.86s
120	3	14.92	14.07	0.85	187	5	14.37	13.70	0.67	254	6	16.29	.....	.....s
121	3	14.68	13.55	1.13	188	5	16.40	14.94	1.46	255	6	14.11	13.62	0.49s
122	3	13.41	12.54	0.87	189	5	14.88	13.93	0.95	256	6	14.48	13.69	0.79s
123	3	13.63	12.81	0.82	190	5	15.99	14.51	1.48	257	6	15.69	14.41	1.28s
124	3	14.69	13.78	0.91	191	5	16.43	12.99	3.44	258	6	14.71	13.86	0.85s
125	4	15.03	13.99	1.04	192	5	16.54	14.99	1.55	259	6	15.23	13.93	1.30s
126	4	15.00	13.79	1.21	193	5	15.42	14.36	1.06	260	6	12.20	11.80	0.40s
127	4	15.82	13.86	1.96d	194	5	16.33	14.78	1.55d	261	6	13.81	12.92	0.89s
128	4	16.33	13.80	2.53	195	5	15.19	14.31	0.88	262	6	14.56	13.83	0.73s
129	4	15.84	13.99	1.85	196	5	16.18	14.25	1.93d	263	6	15.39	12.81	2.58s
130	4	15.85	13.07	2.78	197	5	14.55	13.79	0.76	264	6	15.66	13.16	2.50s
131	5	15.90	12.72	3.18	198	5	16.30	14.97	1.33	265	6	16.01	13.21	2.80s
132	4	15.09	13.06	2.03d	199	5	14.12	13.65	0.47s					

NOTE ADDED IN PROOF

Spectral types for several stars in NGC 6649 have been obtained at the writer's request by Dr. Struve and Dr. Elvey with the slitless spectrograph of the McDonald Observatory. The brightest star in the cluster, No. 42 (m_{pg} = 10.40, C_r = 2.04:), shows the hydrogen lines clearly, but they are considerably weaker than in A0–A2 stars. Dr. Struve is inclined to estimate the spectrum as about B8, possibly of supergiant characteristics. Star No. 117 (m_{pg} = 14.56, C_r = 4.42) is definitely of late type; it may be K or M. Star 9 (m_{pg} = 12.51, C_r = 2.07) has emission at $H\alpha$ and is probably of class Be. Star 58 (m_{pg} = 13.05, C_r = 2.06) may be an F or a very early B. Two spectrograms taken with the slit Cassegrain arrangement tend to confirm the estimate of spectral type for No. 42; the spectrum shows practically no features in the red region, and the hydrogen lines in the violet are definitely weak. The spectrum for No. 9 definitely shows a bright line at $H\alpha$ and is therefore of spectral class Be. Unfortunately, the stars are so exceptionally red that they require long exposures even with small dispersion. The spectra confirm the conclusion that NGC 6649 is intrinsically similar to h and χ Persei, which contain B and A stars in long extensions of their main sequences to bright absolute magnitudes. They indicate also, that the color excess for NGC 6649 ($1^{m}.65$) may have been somewhat underestimated and that it may lie closer to $1^{m}.9$. For a more precise determination of the color excess from spectra, however, spectral types for somewhat fainter stars, whose intrinsic colors are probably more normal than those of the very brightest stars in clusters of this type, would be desirable. It is a pleasure to thank Dr. Struve and Dr. Elvey for the above data.

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