

THE OPEN CLUSTER NGC 4609 BEHIND THE COALSACK

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Photoelectric observations in the *UBV* system are given for stars in and near the open clusters NGC 4609 and Hogg 15. NGC 4609 is at a distance of 1320 pcs and it is 6×10^7 years old. The spread of stars around its main sequence is larger than in other clusters and this may be related with the absorbing material of the Coalsack.

Key words: star cluster — photometry

The open cluster NGC 4609, close to the bright Be star HD 110432, is an inconspicuous group of stars near the center of the dark cloud known as the Coalsack. The cluster is well behind the

Coalsack according to Rodgers (1960), as he derived a distance of 174 pcs for the Coalsack and 1520 pcs for NGC 4609.

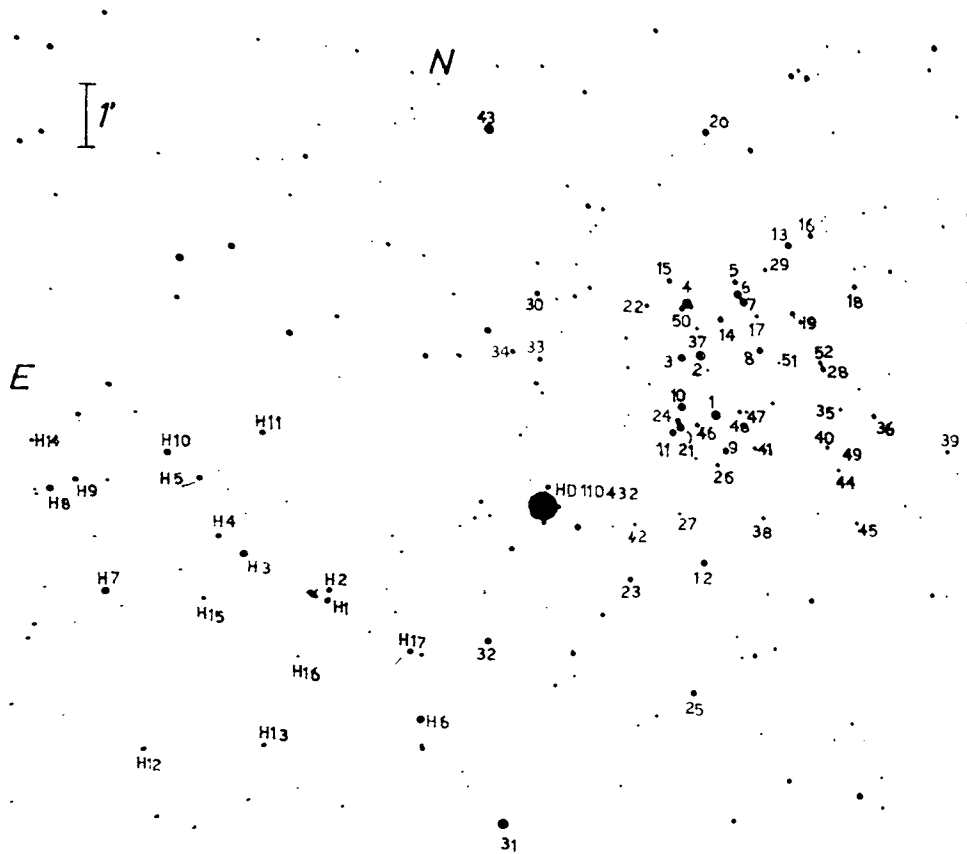


FIG. 1 — The identification chart for NGC 4609 and Hogg 15. The star HD 110432 is also indicated.

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This cluster was measured photoelectrically during 1967 at La Plata with the 80-cm reflector, at the European Southern Observatory at La Silla in May 1969 with the 1-meter reflector, and at Cerro Tololo Inter-American Observatory in April 1970 with the 90-cm reflector. In these three places a 1P21 photomultiplier and standard filters for the *UBV* system were employed.

These measures include 52 stars in and near the cluster, and also 17 stars in and around the open cluster Hogg 15 located 5' south following from NGC 4609 (Fig. 1). All the observed photometric data are given in Table I, and the (*V*, *B-V*) and (*B-V*, *U-B*) diagrams are presented in Figures 2 and 3. In both diagrams the Be star HD 110432 (Feinstein 1968) is included.

It was found that 33 stars are surely members of the cluster. The stars around Hogg 15 are not connected with NGC 4609 and some of them seem to be high-luminosity, early-type stars with color excesses of about 1 magnitude.

The color excesses of the cluster's stars were obtained by running them back along the red-

TABLE I (Continued)

Star	<i>V</i>	<i>B-V</i>	<i>U-B</i>	<i>n</i>	Notes
25	11.66	1.19	0.02	1	1
26	13.08	0.68	0.34	1	1
27	13.69	0.41	—	1	
28	11.98	0.43	0.32	1	1
29	13.05	0.38	0.20	2	
30	12.09	0.24	0.05	1	
31	9.02	0.27	-0.31	1	1 HD 110433, B8
32	11.23	1.35	0.16	1	1
33	12.58	0.31	0.12	2	
34	12.54	0.32	-0.04	1	
35	13.49	0.39	0.44	1	
36	12.44	0.32	0.06	1	
37	13.44	0.83	0.38	1	1
38	13.40	0.52	0.25	2	1
39	13.18	0.33	0.22	1	
40	13.47	0.42	0.34	3	
41	13.29	0.43	0.25	1	
42	13.64	0.39	0.21	1	
43	9.34	1.43	1.48	1	1 HD 110478, K5
44	13.52	2.55	1.8	2	1
45	13.41	1.21	1.33	1	1
46	13.02	0.33	0.26	1	
47	13.67	0.42	0.36	1	
48	13.21	0.37	0.24	1	
49	14.62	0.96	0.45	1	1
50	12.88	0.24	0.08	1	
51	14.11	1.98	2.59	1	1
52	13.10	0.60	0.38	1	

TABLE I

UBV OBSERVATIONS OF NGC 4609 AND HOGG 15

Star	<i>V</i>	<i>B-V</i>	<i>U-B</i>	<i>n</i>	Notes
1	9.60	0.70	0.26	6	1
2	9.81	0.17	-0.33	4	2
3	10.66	0.19	-0.20	4	
4	9.54	0.15	-0.39	4	
5	12.09	0.21	-0.04	4	
6	10.42	0.17	-0.44	4	
7	10.54	0.13	-0.44	4	
8	11.46	0.19	-0.22	5	
9	11.38	0.22	-0.16	3	3
10	10.42	0.21	-0.34	6	
11	11.28	0.22	-0.19	3	
12	11.33	1.46	1.61	3	1
13	11.12	0.27	-0.05	5	
14	11.82	0.64	0.28	3	1
15	12.12	0.30	0.12	2	
16	12.42	0.60	0.14	4	1
17	13.37	0.30	0.08	2	
18	12.22	0.34	0.28	2	
19	13.00	0.35	0.16	2	
20	10.71	0.69	0.34	1	1
21	10.91	0.23	-0.22	3	
22	12.88	0.32	0.25	3	
23	12.13	0.24	-0.02	1	
24	12.17	0.39	0.30	2	4

H1*	11.49	1.13	-0.15	2	
H2	12.19	0.87	-0.12	1	
H3	10.71	0.86	-0.16	2	HDE 311884, O; No. 42 (Roberts, 1962), WN5
H4	12.26	1.05	-0.04	2	
H5	12.04	0.59	0.31	2	
H6	10.54	0.27	-0.22	1	HDE 311885, B9
H7	10.76	0.68	0.15	2	HDE 311883, F8
H8	11.16	0.34	0.08	1	HDE 311882, A0
H9	12.12	0.76	0.22	1	
H10	11.15	1.35	1.14	1	
H11	11.91	0.68	0.26	1	
H12	12.80	0.78	0.60	1	
H13	12.93	1.43	1.08	1	
H14	12.93	0.74	0.33	1	
H15	13.28	0.68	0.28	1	
H16	13.97	0.66	-0.58	1	
H17	11.79	1.58	1.78	1	

*The stars beginning with H are those near the open cluster Hogg 15 and are not members of NGC 4609.

- Notes: 1. Nonmember stars.
 2. Variable 9.69-9.89.
 3. Variable 11.25-11.50.
 4. Possible variable 11.99-12.35.

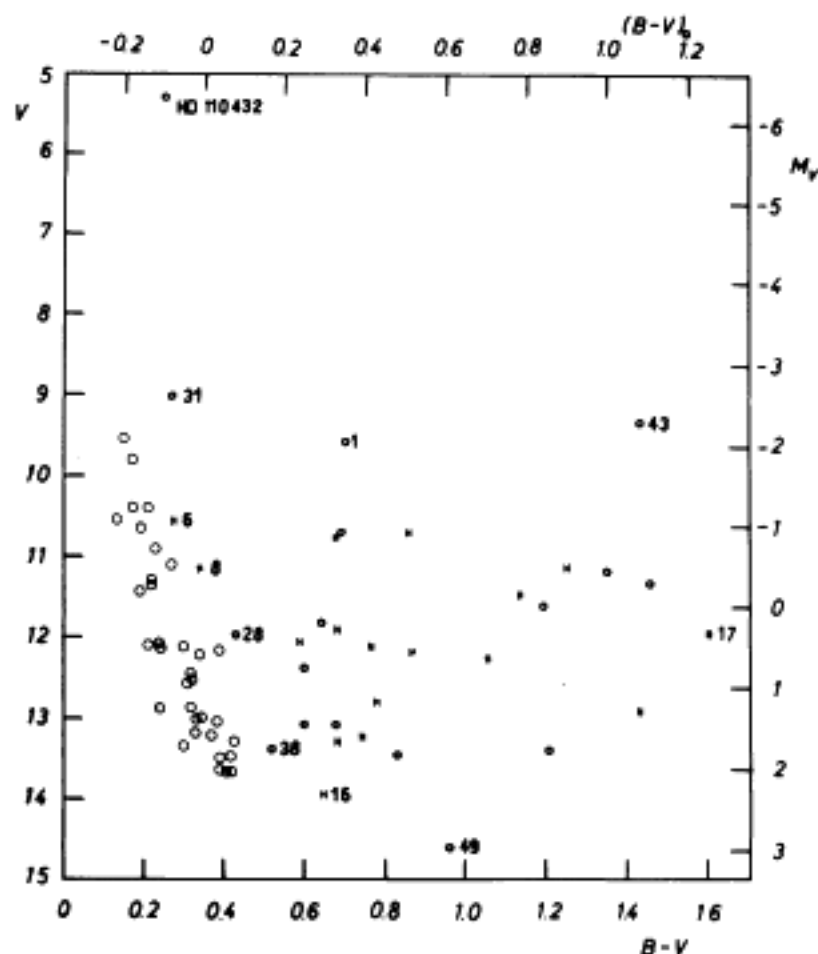


FIG. 2—The observed color-magnitude diagram. The upper and right margins are the intrinsic color $(B-V)_0$ and the absolute magnitude M_V . Stars whose label begins with an H are near Hogg 15 and are not members of NGC 4609. \circ are stars surely members, \circ non-member stars.

dening path to the intrinsic color line. As the ratio of color excesses we used the relation

$$\frac{E_{(U-B)}}{E_{(B-V)}} = 0.70 + 0.05 E_{(B-V)},$$

and for early-type stars the intrinsic color relation

$$(U-B)_0 = 3.68 (B-V)_0 + 0.03.$$

Solving these equations simultaneously, the intrinsic color $(B-V)_0$ or $(U-B)_0$ can be obtained as one of the roots of a second-degree equation.

Following Johnson (1960) we used these excesses to compute the corrected modulus for each member star. The absolute magnitudes were taken from the ZAMS at the corresponding intrinsic color. The corrected visual magnitudes were obtained from assuming the relation of total to selective absorption $R = 3$, that is,

$$V_0 = V - 3 E_{B-V}.$$

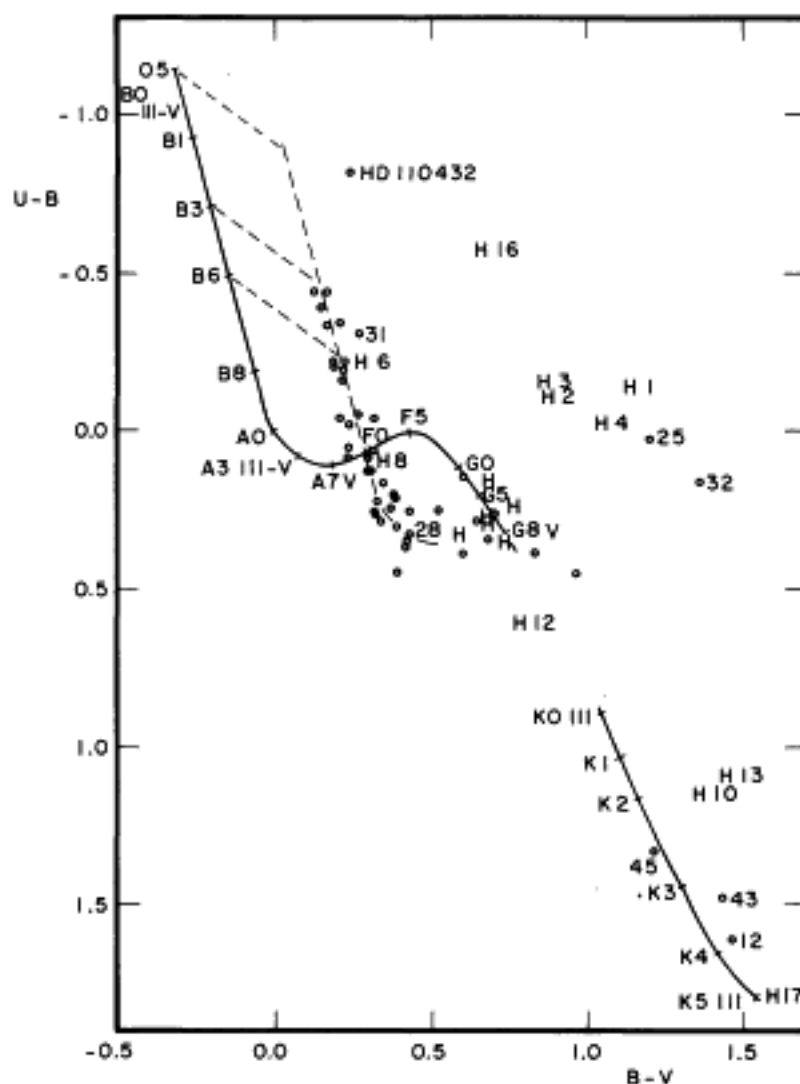


FIG. 3— $(U-B)$, $(B-V)$ diagram. The symbols are the same as in Figure 2. The dashed line shows the sequence for an interstellar reddening of $E_{B-V} = 0.36$.

Then, the corrected modulus for each star was plotted against the corrected visual magnitude, and the standard "evolved main-sequence curve" was fitted both in modulus and in apparent magnitude (Fig. 4). Using this value of the modulus

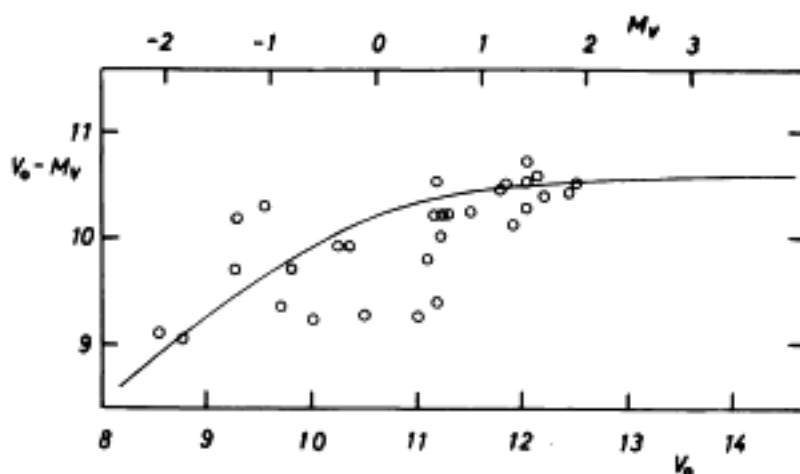


FIG. 4—Corrected modulus versus corrected apparent magnitude diagram. Only stars which are surely members are shown. A corrected modulus of 10.60 can be obtained for this diagram. Using this modulus the upper margin scale was labeled in absolute magnitude.

the corrected apparent visual magnitude was converted into absolute magnitude and the position of the turn-off point could be compared with those shown in Johnson's paper. An age estimation could be made in this way.

We obtained for the corrected modulus and its estimated error $V_0 - M_v = 10.60 \pm 0.15$, that is a distance of 1320 ± 140 parsecs, which is slightly smaller than the one obtained by Rodgers.

The mean value of the excess of the cluster members is $E_{B-V} = 0.36$ which fits well in the plot of zone IV of Rodgers, that is, absorption versus distance modulus for 10.60.

The spread of the stars of NGC 4609 around its main sequence is larger than what we see in other clusters and this may be related to the fact

that the distribution of the absorbing material inside the Coalsack is far from being uniform.

The intrinsic color of the earlier type stars corresponds to a B3 type and the absolute magnitude is -1.8 . Then, the estimated age of the cluster is 6×10^7 years, and it is of a type similar to the Pleiades.

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