

70. A CLUSTER OF INTERMEDIATE AGE IN THE LARGE MAGELLANIC CLOUD

SIR RICHARD WOOLLEY
Royal Greenwich Observatory

Some years ago (1960) I discussed the HR diagram of the variable star field investigated at Herstmonceux as the result of Drs. Sandage and Eggen's visit to Pretoria, and found colour-luminosity arrays showing mainly very blue giant stars; and later (1961) I suggested that a second and older population could be seen in the same area of the LMC, showing a rather different x, y distribution. Recently Miss Epps has assisted me to make further investigations into the matter. We are now discussing stars fainter than $V=14.5$ and therefore too faint for us to determine their proper motions. In order to get rid of foreground stars which obscure the HR diagram we have had to make use of the x, y distribution to discriminate between LMC members and foreground stars. Firstly, we examined an open cluster which

TABLE 1
DISTRIBUTION OF STARS IN THREE AREAS

Area No.	General Description	Number of Stars		
		$B - V \leq 0.49$	$0.50 \leq B - V \leq 1.49$	$B - V \geq 1.50$
110	Red population	27	36	30
273	Field stars	5	29	5
380	Blue population	51	31	6

appears as a faint object on the 74-inch Pretoria plates. It is away from the main lane occupied by the bright blue objects, and its appearance on the B and V plates showed it not to be excessively blue. On a Radcliffe plate (74 in. stopped to 44 in.) with an exposure of 20 min, 29 stars can be seen within a circle of diameter of 1' of arc. We have been able to determine V accurately for only 15 of these stars, one of which proved to be a variable of period 4.75 days. The HR diagram shows a gap between $B - V = 0.2$ and $B - V = 1.0$, the variable being in this gap. It is comparable with those of NGC 129, NGC 2287, and NGC 6067, and, by analogy with these objects, the open cluster now described probably has an age of about 10^8 years. The object is of course very different from the young or blue (but tight) cluster NGC 1818 not far away from it.

To investigate the field further, Miss Epps and I isolated three fields in which we expected to find, respectively (i) an old or intermediate red population (area 110),

(ii) very few LMC members (area 273), and (iii) a young or blue LMC population (area 380). In each of these three (equal) areas we measured all the stars down to $V=16^m.5$, with the results given in Table 1.

The consistency in the number of stars with $0.50 \leq B - V \leq 1.49$ suggests that these stars are galactic stars, evenly distributed, and having nothing to do with the structure of the LMC. The HR diagram of Area 110, showing as it does red giants with $V \sim 16^m$, suggests that this population is rather similar in age to that of the open cluster first described. It seems inherently reasonable to suppose that there are objects of a variety of ages in the LMC and that these may well be found in different arms or lanes in the Cloud.

As there is a moment or two left, I will quickly show a slide showing the results of an analysis of proper motions and radial velocities of RR Lyrae stars in the Galaxy, giving considerable weight to Lourens Cape proper motions. This gives an average absolute magnitude of $0^m.83$ pg, illustrating a point made by Dr. Blaauw yesterday.

The open cluster is described in Royal Observatory Bulletin No. 65, and the work on special areas will be extended and will be described in a later Bulletin.

References

- WOOLLEY, R. v. d. R. (1960).—*M.N.* **120**: 214–19.
 WOOLLEY, R. v. d. R. (1961).—*Proc. Roy. Soc. London A* **260**: 189–201.

Discussion

Eggen: Are the cepheids of longer periods concentrated in this region populated by the blue stars?

Woolley: Yes, at least the longest period cepheid is associated with blue stars.

Arp: Have you established the absence of stars between $0.5 \leq B - V \leq 1.5$ as a function of magnitude in the LMC?

Woolley: I think it is complete as far as we have gone, that is to $V = 16^m.5$.

Arp: In the SMC (NGC 330) there is a complete lack of stars in this colour range and the field has been shown to be essentially the same. If the LMC is the same, then Dr. Woolley's results are exactly as expected. But at $V = 16$ mag the SMC cluster NGC 458 shows a concentration of evolved giants just in this colour range. The field of the SMC appears to be similar. The new results on the LMC blue globular NGC 1866 by Thackeray and Arp show the same thing shifted only slightly to the red. If Dr. Woolley can show these stars to be absent in the general field of the LMC at $V = 16$ mag, then we can conclude that the field of the LMC is different from NGC 1866. This is contrary to the result in the SMC. It may be necessary then to consider that NGC 1866 belongs to, or is like, the wing population of the SMC rather than typical of the LMC.

Oort: In connection with Dr. Woolley's remark concerning the determination of proper motions of RR Lyrae variables, I wish to point to the extensive determinations of proper motions of about 100 of these variables which is being made by Dr. van Herk in Leiden. These are based in part on old Mount Wilson plates and are in that case quite accurate. I expect that the discussion will be published in a few months.

Woolley: A procedure examining the colours of the comparison stars similar to the analysis used for ω Centauri and the LMC would improve very greatly the correction from relative to absolute proper motion. We have to be very careful with the transfer from relative to absolute proper motion and the introduction of B and V would be of great importance. I think the Cape material has more weight than most of the northern work so far available.

Bok: Are your blue stars concentrated close to NGC 1763–1769?

Woolley: Not particularly closely — about one quarter of the plate away.