



FIGURE 13.19 A composite color-magnitude diagram for a set of Population I galactic clusters. The absolute visual magnitude is indicated on the left-hand vertical axis, and the age of the cluster, based on the location of its turn-off point, is labeled on the right-hand side. (Figure adapted from an original diagram by A. Sandage.)

contraction phase related to the Schönberg–Chandrasekhar limit is much less pronounced. As a result, color-magnitude diagrams of old globular clusters with turn-off points near or less than $1 M_{\odot}$ have continuous distributions of stars leading to the red giant region.

Relatively Few AGB and Post-AGB Stars

Close inspection of Fig. 13.17 also shows that a relatively small number of stars exist on the asymptotic giant branch and only a few stars are to be found in the region labeled P-AGB (post-asymptotic giant branch). This is just a consequence of the very rapid pace of evolution during this phase of heavy mass loss that leads directly to the formation of white dwarfs.

Blue Stragglers

It should be pointed out that a group of stars, known as **blue stragglers**, can be found above the turn-off point of M3. Although our understanding of these stars is incomplete, it appears that their tardiness in leaving the main sequence is due to some unusual aspect of their evolution. The most likely scenarios appear to be mass exchange with a binary star companion,¹⁴ or collisions between two stars, extending the star's main-sequence lifetime.

¹⁴Mass exchange between close binaries is the subject of Chapter 18.