

PHOTOELECTRIC STUDIES OF STELLAR MAGNITUDES AND COLORS

HAROLD L. JOHNSON
LOWELL OBSERVATORY

1. Introduction

The problem of the interpretation of the H-R diagram can be approached from two different directions: one, from the standpoint of the theory of stellar structure, the other, from the standpoint of observations. It is of interest to approach the problem from the second, observational, direction using only enough of the results of theory to insure that the conclusions that are drawn are reasonably consistent with theory.

The distribution of stars in the H-R diagram (or its approximate equivalent, the color-luminosity diagram) should, when properly interpreted, supply us with a great deal of information regarding the physical characteristics of the stars. The basic theory of stellar structure predicts that the positions of stars in these diagrams should be defined primarily by the three parameters, mass, age and initial chemical composition, although there may be others, such as rotation, having significant effect.

That the mass of a star must, on an empirical basis, be one of the principal parameters governing the position of a star in the H-R diagram has been known for some time. The empirical mass-luminosity relation demonstrates this dependence clearly. On the other hand, this relation cannot alone explain the existence of stars of similar mass and luminosity but of greatly different temperature. Furthermore, there are deviations from this empirical relation that, as Strand and Hall [1] point out, are consistent with the theoretical evolutionary tracks computed by Schönberg and Chandrasekhar [2]. A second parameter, which probably is age, obviously is required.

One might expect that these two parameters, mass and age, would be the principal factors determining the positions of stars in the H-R diagram. The effect of a third parameter, initial chemical composition, is now becoming apparent observationally and, if recent ideas are correct, is considerable in certain regions of the diagram.

2. The H-R diagram

The observational results to be discussed here are largely photometric and, as a result, yield color-luminosity diagrams instead of H-R diagrams. The two methods of presentation are, however, quite similar and lead to comparable results. In the following discussions, the term H-R diagram will be used to designate color-luminosity diagrams as well as spectral type-luminosity diagrams.

It appears to be reasonable to assume that the initial chemical compositions of