lie above the ordinary giant sequence but are subluminous for their masses.

J. A. HYNEK

Perkins Observatory,
Delaware, Ohio.
April 15.

[1] Russell, H. N., and Moore, C. F., "The Masses of the Stars" (University of Chicago Press, 1940).

Mixed Types of Stellar Populations

ONE of the most interesting and most mysterious features of the stellar contents of our own and other known galaxies is the fact that there seem to exist two rather distinct types of stellar populations differing between themselves by mechanical as well as by physical properties of individual members. In fact, as was first indicated by Oort[1], the so-called 'high-velocity' stars which describe highly elongated elliptic trajectories around the galactic centre seem to possess rather different physical characteristics as compared with the 'ordinary' stars predominating in the neighbourhood of our sun and moving along regular, almost circular, orbits. This distinction was amplified by the recent work of Baade[2], who has shown that the ordinary type of stellar population (which he calls type I) is characteristic only for the region of spiral arms, whereas the other type (type II) forms the structure of the galactic nucleus along with the tenuous, almost spherical, 'atmosphere' surrounding the entire system. All elliptical and spherical galaxies seem to be formed entirely from stars of type II.

The physical differences between the two stellar populations, as evidenced by the study of the corresponding Hertzsprung – Russell diagrams, can be summarized as follows: (1) the giant branch of the main sequences is completely absent in stellar population II; (2) the red giants of population II are different from those in population I, and are distributed along a continuous band which starts from the middle of the main sequence (the upper part of which is absent in this case) and is about one to three magnitudes above the ordinary red giant branch of population I; the number of type II red giants (relative to the number of dwarfs of the same spectral clan) is smaller in type II as compared with type I; (3) the lower part of the main sequence seems to be identical in both populations.

It has been also noticed that the percentage of double stars is two to three times lower among the stars of type II.

The understanding of physical differences between the two types of stellar population, and their relation to the difference of their motion and distribution within the galactic system, will undoubtedly throw much light on the general problem of stellar and galactic evolution. It is, therefore, especially annoying that hitherto we have not had any reliable theory of the internal structure of red giant stars capable of representing one of the principal differences between two types of stellar populations. For the same reason it is extremely important to collect all possible information concerning these stars and their possible relation to one of the two accepted types.

The results published by Dr. Hynek in the preceding letter seem to permit some interesting, though highly hypothetical, conclusions in this direction. Whatever may be the model on which the ordinary red giant stars are built, it seems very improbable that it could lead to the mass-luminosity relation, in which the doubling of the mass will increase the luminosity only by a factor of two. In fact, thermonuclear reactions which are responsible for the entire energy balance of the star must be expected to be much more sensitive to the internal temperature changes which would result from the larger total mass of the star. It seems, therefore, more reasonable to assume that the observed difference between the single red giants and those which are the members of a pair must be connected with the difference of their chemical constitution, their internal structure (model), or both. Since the same assumption must also probably be made to understand the difference between red giants of the types I and II, we could ask ourselves whether it is at all impossible to explain the facts stated by Dr. Hynek by assuming that red giants in the binary systems are essentially the stars belonging to the stellar population II? Indeed, the mean luminosity difference of about one magnitude between the single and double giants is comparable with the mean difference between the red branches of the two populations. Also the discrepancies between the spectroscopic and trigonometric parallaxes of single and double red giants which led Dr. Hynek to his conclusions are similar to the discrepancies observed by Morgan and Keenan[3] in the case of 'high-velocity' stars, inasmuch as they state that "high-velocity stars appear to be the only stars likely to cause serious trouble in using the method of spectroscopic parallaxes".

It must be remembered, however, that the binaries studied by Russell and Moore and by Hynek are, as a rule, the ordinary slow-moving stars which would be classed normally as type I. Thus, in making the above statement, we would be forced to accept the possibility of a mixed type of stars (type II_I) which possess the physical characteristics of type II but the motion of the type I. There may be also stars (type I_{II}) which look like those of type I but move as type II. Remembering that the correlation between physical properties and the type of motion of any individual star must be due to some events in the early history of its existence (formation process), and that the motion (as well as the family status) of a star may be changed by a number of external causes, such an assumption does not look at all unreasonable.

G. GAMOW

George Washington University.
May 4.

[1] Oort, T. H., *Groningen Pub.*, No. 40 (1926).
[2] Baade, W., *Astrophys. J.*, **100**, 137 (1944).
[3] Morgan, W. W., and Keenan, P. C., "An Atlas of Stellar Spectra" (Astrophysical Monographs) (Chicago, 1943).

New Localized Interference Fringes

IN this note a description is given of a simple method for producing a new type of sharp localized interference fringes with interesting properties. These sharp fringes are best formed by multiple-beam interference, although a broadened variant can be obtained with two beams. They arise when a plane parallel sheet of flexible material silvered on both sides is bent into a curve (suitable radii of curvature are 1–5 cm.) and illuminated with strictly parallel monochromatic light from a point source, such collimation of light being essential. The simplest