The observational approach to the early stages of stellar evolution has been applied to some problems relating to the formation and dissipation of stellar associations, the origin of OB field stars, and low-mass star formation in OB associations. The OB field stars ejected from parent associations are older on the average than the OB stars in the associations. The average duration of active OB-star formation in associations is evaluated. It is suggested that, under the conditions in OB associations, low-mass stars may be formed from dense protostellar objects.

1. Introduction. The study of the birth and evolution of stars is a most complex problem. This problem is usually studied under the assumption that the birth of stars is due to the compression of diffuse material, gas and dust, with the application of the compression mechanism proposed by Kant and Laplace for the formation of the solar system and the Jeans gravitational instability criterion.

Most investigations in this area are theoretical and cannot be compared directly with observations. This means that the results obtained are not unambiguous and depend on the initial assumptions. Only recently have a few astronomers concerned with the problem of star formation have undertaken the attempt to create a theory consistent with the volume of fundamental observations. External influences acting on diffuse molecular clouds are examined as the cause of the outburst of star formation — pressure of the ionization front of hot giants and supergiants, supernova explosions, spiral density waves, collisions of molecular clouds, etc.

However, in spite of the general acceptance of these directions among the supporters of the condensation hypothesis, it does not pretend to such generality in explaining the observed pattern of star formation. At best, one can explain, but not quite convincingly, only individual details of the overall process or individual special cases.

Moreover, for more than 50 years, there has existed an observational (nontraditional) approach to the early stages of stellar evolution, which was first successfully applied to the study of processes in the regions of the galaxy where vigorous star-formation processes occur. This approach was finally confirmed when, thanks to Ambartsumian [1], it became obvious that our star system, the galaxy, consists of stars and star subsystems of different ages.

A new type of star system was discovered in 1947 — associations, whose life span cannot exceed $10^7$ yr [1]. The study of star associations have made possible the investigation of the problem of the birth and evolution of stars on the basis of the study of very young and, naturally, very unstable stars and star systems, which has been very successful for the understanding of the problem. We examine in this article some aspects of the observational approach to problems of star formation.

2. Dissipation of Associations and the Appearance of OB Stars in the Galactic Star Field. After the discovery of OB associations, it was learned that they are dynamically unstable systems. The stars of associations with relatively high velocities recede from the regions of star formation. As a result, OB associations expand and must dissipate over a time the order of $10^7$ yr [2].

The first direct observational confirmation of the expansion of an OB association was obtained by Blaaauw [3] on the basis of a study of the proper motions of stars of the OB association near ζ Per (Per OB2). The proper motions of stars of OB associations were then used to establish the dissipation of other nearby associations (see, e.g., the investigations cited in [4]).
However, the proper motions of stars of OB associations can be used to establish the expansion of nearby associations only. The accuracy of the determination of the proper motions of stars of OB associations decreases greatly as the distance to the association increases, which leads to erroneous conclusions about the motions of the stars.

The situation is more difficult for T associations. Expansion is established indirectly for them, for example, by the presence of unstable Trapezium systems [5] or the absence of clusters consisting exclusively of dwarf stars.

In contrast to proper motions, the accuracy of determining radial velocities of stars depends little on distance. This fact is the basis of the idea of using radial velocities of the stars of OB associations to confirm the existence of expansion motions in associations. In view of the limited number of OB stars with measured radial velocities and the presence of several nuclei in individual OB associations, it has then been necessary to apply the statistical "synthetic association" method. The synthetic association itself is a mechanical superposition of the subsystems of OB stars of all the known associations with a normalized common center [6, 7].

This idea was implemented in a number of works of one of the authors [4, 6]. It was found that the average space velocity of OB stars in the synthetic association increases with distance from the center of the synthetic association, which implies the expansion of the synthetic association.

3. Association Expansion and the Reaction of Supporters of the Classical Theory. The phenomenon of the expansion and dissipation of OB associations made it necessary for supporters of the classical theory to correct the theory of star formation, resulting in the appearance of works attempting to explain the expansion and dissipation of associations within the scope of the classical theory, but of course, not without additional assumptions and hypotheses.

Opik [8] suggested that supernova explosions in a diffuse medium was the cause of the formation and expansion of associations. As a result, the association must have a central nucleus and expand uniformly in all directions. The morphology of star associations does not confirm this expectation. Star formation in an association continues throughout the life of the association.

Oort [9] and Oort and Spitzer [10] developed another idea about the generation of association expansion based on the hypothesis of condensation of diffuse material into stars. They suggested that an O star exists within a very massive gaseous nebula before the creation of the association. By heating the nebula, this star caused the expansion of adjacent parts of the nebula. Regions of compressed gas are observed at the boundaries between the inner heated and outer cold layers of the nebula, which are transformed into stars because of the Jeans gravitational instability. Apart from the Oort–Spitzer hypothesis starting from already existing O stars, which leaves open the question of the origin of these precursors of the systems forming around the O stars, it contradicts the observations (the extremely young stars comprising Trapeziums, the high velocities of stars, small clusters of young stars, etc.) [11]. Moreover, as Menon has shown, the expansion of the nebula and dispersal of young stars cannot be explained from the energy point of view by the action of the O stars.

Zwicky [13] has suggested that the instability of OB-star systems may be caused by the radiation of the OB stars sweeping out the diffuse material of the association into interstellar space.

These ideas expressed in the 1950s in different variations, sometimes in combined form, are encountered in many of the current theories.

For example, according to Duerr et al. [14], the expansion of the association is a result of the low efficiency of star formation in diffuse molecular material. The formation of OB stars leads to an overwhelming mass of the molecular material being comparatively rapidly swept out into interstellar space by radiation pressure and stellar wind, which leads in turn to instability of the exposed system of OB stars and to its expansion.

A common assumption of these theories is the existence within the future association of a cloud of diffuse material from which the system of OB stars is formed over the course of time. However, observations do not confirm this assumption in any way.

On the contrary, the enrichment and growth of molecular clouds is occurring at present due to strong molecular outflows from protostellar objects. Ambartsumian [15] cited a number of other strong arguments in favor of the hypothesis of the combined formation of stars and molecular clouds and considered that molecular clouds are formed within star associations.

The discovery by Blaauw and Morgan [16] of high-speed OB stars, which recede from the parent association at speeds the order of 100 km/sec, is a serious difficulty for the classical theories. Moreover, according to Ambartsumian [17], the maximum expansion velocities to be expected within the framework of these theories could hardly exceed 30 km/sec.