Collisions with huge comets are thus the cause of the novae, and this origin is so well supported by the observed and theoretical distribution of the novae, relative to the Milky Way, as to be practically incontestable. Accordingly,

Starlight on Loutre, Montgomery City, Missouri, June 20, 1921.

we may adopt the cometary-collision theory of New Stars with the highest probability that it represents a general law of nature.

T. J. J. See.

The Galactic Distribution of Stars of Spectral Class B. By *H. Shapley.*

(With plate 6).

From studies of the distribution of stars of spectral types Bo-5, which I have published in »Contributions« and »Communications from the Mount Wilson Observatory«, it appears that a local cloud or cluster exists in the solar neighborhood, containing a large percentage of naked-eye stars. Of catalogued stars, only those faint objects that are of high real luminosity are distant enough to be outside the bounds of the local system. Proof of its existence, as a distinct unit of the galactic system, would be important; for example, the rotational and translational motion of such a cluster through the field of galactic stars would undoubtedly account for the major phenomena of star streaming.

The equatorial plane of the local system appears to be inclined about ten degrees to the equatorial plane of the general galactic system, roughly coinciding with the Herschel-Gould belt of bright stars, but the inclination is not readily revealed unless the particular objects under investigation are highly concentrated to one of the two planes, or are peculiar either to the local cloud or to the galactic field.

The »early« B stars are of high luminosity and are strongly concentrated to the galactic planes (a characteristic of nearly all types of highly luminous objects); they can, therefore, be partially differentiated into so-called field stars and cluster stars. This apparent concentration is lacking for stars of faint absolute magnitude, however, and they are not easily differentiated into field and cluster stars.

An interesting consequence of the measurable inclination of the two planes is that in Taurus, Orion, and to the southward a secondary Milky Way can be seen. In that part of the sky it stands out more clearly separated than elsewhere from the much more conspicuous primary Milky Way, because of the position in the sky of the intersection of the two galactic circles and because of the position of the sun with respect to the two galactic planes. The figures accompanying the present note (see plate 6) are designed to illustrate the probable existence of the local system and of its related phenomenon of a secondary Galaxy.

The stars of the first subclasses of Class B, the so-called early B's, have been shown by *Kapteyn*, *Plummer*, *Charlier*, and others, not only to be of high luminosity but also to have a fairly small dispersion around a mean absolute magnitude. All the apparently bright stars of this kind are therefore relatively near compared with the apparently faint stars; and if the local system is limited in diameter, the fainter B's may be too distant to belong to it and will not lie along the projection of its equatorial plane. In the region where the

two planes are distinctly separated, therefore, the distribution should be different for bright and faint stars of the Class Bo-5.

Figure 1, plate 6, shows the distribution in galactic coordinates¹⁾ of individual B's brighter than visual magnitude 5.5; nearly all of them are within a thousand light years of the sun. Each star is represented by a point on the diagram; the spectra from the published volumes of the Henry Draper Catalogue and, for right ascensions greater than 12^h from Harvard Annals 50 are indicated by dots and crosses, respectively. The large open circles are means for successive intervals of 20° in galactic longitude.

Apparently the great majority of these bright B stars show a preference for the secondary galactic circle. They are not concentrated to the primary Galaxy which is defined by faint stars, δ Cephei-variables, O-type stars, and the galactic clouds.

The curve in Figure 1, representing the secondary galactic circle, is taken from Mount Wilson Contributions, Nr. 157, and is based upon brighter and nearer stars than those here considered; the »dip«, due to the sun being north of the plane, was therefore more pronounced for that material than in the present case, as can be seen from the figure. A dip of 4°5 and an inclination of 10° would better fit the present data than the previously derived values of 5° and 12°.

For the present illustration, the B's of magnitude 5.5 to 7.5 have been omitted because they do not serve to distinguish the cluster from the field. Such stars may belong either to the nearer parts of the galactic field or to the outer parts of the local cluster, and there is no way to distinguish one kind from the other.

Figure 2 shows the distribution of distant early B's, fainter than visual magnitude 7.5, and between the limits 0^h and 12^h in right ascension, so far as they are contained in the published volumes of the Henry Draper Catalogue.²⁾ Nearly all these stars are more than a thousand light years from the sun. The dots represent individual stars; the crosses and small circles are equivalent to five and ten dots, respectively. The secondary galactic circle is again shown, and the constellation of Orion is outlined. The large circles³⁾, showing the mean positions for intervals of 10° in galactic longitude, illustrate the well-known dip of the galactic circle; it is -1°8 for these stars, being of course slightly larger than the value of -1° already known for the more distant galactic clouds.

It is clear that a great majority of these fainter B stars show a preference for the primary galactic plane. In the region

¹⁾ *Aitoff's* projection; cf., *Popular Astronomy*, 28, 385, 1920. Ordinates are galactic latitudes, abscissae are galactic longitudes.

²⁾ A later discussion will include the faint B stars of the parts of the sky for which spectra have not yet been published.

³⁾ The twenty stars within the Orion trapezium are not included in these means.

from Taurus to Canis Major they appear to be unrelated to the local cluster which contains the brighter B stars.

The presence of these field stars just outside the limits assigned to the local cloud supports the conclusion that the local system is not spatially separated from the Galaxy; the stars that form the general Milky Way apparently are not distinct encircling clouds separated from the local system by unpopulated regions of space. These faint B's, in the same manner as the δ Cephei-variables¹⁾, show the continuity of the general galactic star fields in the solar neighborhood.

Formerly it was believed that there were few if any B stars fainter than the seventh magnitude, an inference based on the observed rapid decrease in number with increasing distance of the bright B-type stars of the local cluster. On Mount Wilson photographs, however, I have found many B

Harvard College Observatory, Cambridge Mass., 1921 August.

stars of the tenth to fifteenth magnitudes, not only in the distant globular clusters, but also among the Milky Way fields; and the Henry Draper Catalogue shows the frequent occurrence of such stars of the seventh to tenth magnitudes along a narrow mid-galactic belt.

The almost complete absence of faint B-type stars in high galactic latitude is one of the conspicuous results of this study. Nearly a thousand stars are shown in Figure 2; only fourteen of them are in the half of the sky for which the galactic latitude exceeds 30° , and five of those fourteen stars fall in the region of the small Magellanic Cloud. That only one out of a hundred of these highly luminous stars occurs outside the galactic region suggests, that as far as B-type stars are concerned, we have reached the limits of the Milky Way system in the directions of least thickness.

H. Shapley.

¹⁾ Mt. Wilson Contr., Nr. 157, Fig. 5.

Librationen und periodische Ejektionsbahnen im allgemeinen Dreikörperproblem, nebst einem Beispiel periodischer Bahnen im Vierkörperproblem. Von E. Strömgren.

In der in diesem Artikel angewandten Klassifikation bedeutet:

- I: Probleme restreint,
- II: Das allgemeine Dreikörperproblem (alle Massen von derselben Größenordnung),
- III: Das Vierkörperproblem,
- IV: Das n -Körperproblem,

und ferner:

- a: Problem der *Lagrangeschen* Librationspunkte,
- b: Problem der infinitesimalen Librationen,
- c: Problem der endlichen Librationen,
- d: Problem der Ejektionsbahnen (Grenzbahnen der endlichen Librationen).

Wo im folgenden von der Erweiterung eines Resultates oder eines Problems die Rede ist, kann das zweierlei bedeuten: entweder eine Erweiterung im Sinne I, II, III, IV, oder eine Erweiterung im Sinne a, b, c, d.

Lagrange fand:

II, a. Die Gesetze des relativen Gleichgewichts dreier Körper, die sich unter gewissen Bedingungen in einem bestimmten Zeitpunkt auf einer Geraden oder in den Eckpunkten eines gleichseitigen Dreiecks befinden.

Andoyer hat (BA 1906 pag. 50 ff.):

IV, a. diese Gesetze auf das n -Körperproblem erweitert.

Es kam später das neue Problem hinzu: Gibt es in der Umgebung der *Lagrangeschen* Punkte periodische Lösungen?

I, b. Für infinitesimale Distanzen von den *Lagrange*-schen Punkten wurde diese Frage zunächst für das spezielle Problem, das sogenannte problème restreint, von mehreren Verfassern behandelt.

II, b und IV, b. Untersuchungen über die Erweiterung auf das allgemeinere Problem, wo die Massen von derselben Größenordnung sind, liegen vor von: *Gascheau* (in einer mir nicht zugänglichen Abhandlung), *E. J. Routh* in den Proceedings of the London Mathematical Society 1875, *H. Andoyer* in BA 1906 pag. 129 ff., *E. Strömgren* in den MN Nov.-Heft

1919 (Publ. der Kopenhag. Sternwarte Nr. 34) und *P. Pedersen* AN 5043 (Publ. Kop. Nr. 35).

I, c. Für das problème restreint, wo die eine der drei Massen den Wert Null hat, stellte *Thiele* die Aufgabe, die theoretisch gefundenen infinitesimalen periodischen Lösungen ins endliche Gebiet zu erweitern. Mit Hilfe der mächtigen Methode der numerischen Integration fand er die endlichen Librationen um den Librationspunkt L_2 , die nachher:

I, d. von *Burrau* bis zur Ejektionsbahn verfolgt wurden (AN 3251).

Fig. 1. Die *Thiele-Burrauschen* Librationen um den Librationspunkt L_2 , bis zur Ejektionsbahn verfolgt. Rotierendes Achsensystem.

Links von S in der Fig. 1 liegt der Librationspunkt L_3 , um den ein entsprechendes System Librationen, mit einer Ejektionsbahn in S abschließend, konstruiert werden kann. Wenn, wie es in den Kopenhagener Arbeiten der Fall ist, die zwei endlichen Massen gleich sind, werden die zwei Systeme von Librationen ganz symmetrisch.