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VI. STELLAR DISTRIBUTION IN HIGH AND INTERMEDIATE GALACTIC LATITUDES

During the past triennium much work has been done on the stellar distribution in the North Galactic Polar Cap. Special attention has been paid to the distribution of late-type stars. Very useful results have been reported on the basis of analyses of objective prism plates obtained with the Schmidt telescope of the Warner and Swasey Observatory and the Hamburg-Schmidt telescope. Upgren (**1**) has studied the distribution of stars of spectral types G5 to K5 and later, distinguishing between luminosity classes III, IV and V; he was unable to distinguish stars of higher luminosity from class III, nor could he, at the dispersions employed in this work, distinguish weak-line from strong-line stars. All classifications were made from plates extending into the ultra-violet. His catalogue covers 396 square degrees; it contains 4027 stars and appears to be complete to photographic magnitude 12·75. Density functions perpendicular to the galactic plane have been calculated and also percentages of giants and dwarfs at various apparent magnitudes. The Upgren paper provides much basic material for a study of the variation with height above the galactic plane, z, of the force per unit mass perpendicular to the galactic plane, $K(z)$, and certain inconsistencies are noted. The curve for $K(z)$ as a function of z derived by Upgren differs completely from the customary curves (Oort, Hill, Schmidt). Upgren finds at $z = 1000$ pc a value of $K(z)$ equal to one third or less of the average value for 100 to 400 pc, whereas the more traditional curves generally show a value of $K(z)$ at 1000 pc equal to twice the average for the range 100 to 400 pc. The importance of related density and velocity studies cannot be over-stressed. Upgren has recently reported (**2**) the results of an objective prism survey for stars of spectral class F2 to G5 (1127 stars to $B = 12{\cdot}5$). He finds that the density gradient for the main sequence F stars is considerably greater than for the early G stars. Blanco reports that Sanduleak has made a survey of faint M stars for an area of 120 square degrees near the North Galactic Pole, complete to $V \sim 17$. They estimate that less than 5% of the average number of M stars found (10 per square degree) can be giant M stars. Preliminary analysis indicates a marked upward revision of the mass density per pc^3 near the Sun.

Extensive researches on stellar distribution in the North Galactic Polar Cap are under way at the Uppsala Observatory. A paper not previously recorded in the Reports of Commission 33 is that of Malmquist (**3**), which contains spectrophotometric data for 3000 stars to $B = 13{\cdot}5$ (79 square degrees). In a preliminary note (**4**), Malmquist reports that he finds the interstellar absorption for the direction of the North Galactic Pole to be greater than hitherto estimated, about double the value of 0·25 mag. (blue) generally quoted. The problem is under investigation by Ljunggren.

Work on the brighter stars has also advanced considerably. Westerlund (**5**) is publishing U, B, V magnitudes and colours for 110 stars of early spectral type within 15° of the North Galactic Pole and for 110 stars within 12° of the South Galactic Pole. Reddening and blanketing effects are noted. Slettebak, Bahner and Stock (**6**) have obtained slit spectra to $m = 12$ for 84 stars of spectral type F2 and earlier for the purpose of obtaining spectral types, radial velocities and estimates of axial rotation. U, B, V magnitudes and colours are also available for these stars. The majority of these stars are 'Older Population I', but there are ten with decided Population II characteristics; sixteen new metallic line stars have been found. Klemola (**7**) has made a study of the mean absolute magnitudes for 205 stars of spectral type B0 to A5, all except 12 in the North Galactic Polar Cap. most of them in the range $9 < V < 12$. Proper motions are known for all stars and the τ-components have been used for the estimation of mean absolute magnitudes. The basic radial velocity material for the A1 to A5 stars is from Slettebak, Bahner and Stock (**6**) and for the B0–A0 stars from Greenstein (**8**). Derived mean visual

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absolute magnitudes are +2·1 for B0 – B3, + 0·9 for B4 – B7, + 1·5 for B8 – A0 and + 3·6 for A1 – A5. Apparently the high latitude B stars are not unlike horizontal branch stars in globular clusters.

Luyten is pressing on with the search for faint blue stars in both Galactic Polar Caps. The latest reports are by himself (**9**) for the North Cap, a joint paper with Haro (**10**) for the South Cap and another by Luyten (**11**).

The Uppsala and Mount Stromlo studies for the South Galactic Cap are continuing. Basinski, Bok and Bok have colours and magnitudes ready for approximately 1000 stars in an area of 19 square degrees, but lack of Uppsala spectra has held up publication. Elvius reports that spectrophotometric data are being collected by Eriksson, which work includes blue and visual magnitudes for 3000 stars.

While data on stellar velocities are strictly reserved for the sections to follow, we should mention here briefly the special studies and analyses on radial velocities that bear directly on the problems of stellar distribution in high galactic latitudes. Odgers and Petrie report good progress with their work on F stars in the North Galactic Polar Cap. Radial velocities are now available for 202 stars of types A0 to F5, apparent magnitude 9·0 and brighter. Their analysis is being held up by difficulties with the assignment of absolute magnitudes to the stars in question and the expectation is that absolute magnitudes correct to within ± 0·3 mag. will be obtained. Wayman (**12**) has published radial velocities for 120 stars of types A0 to A4, $m < 9{\cdot}5$, for a region near the South Galactic Pole. The velocities perpendicular to the galactic plane, which refer to stars within 400 pc from the plane, can be represented by a Gaussian distribution with a dispersion $\sigma = \pm 9{\cdot}2$ km/sec. There is no suggestion of an increase in velocity dispersion with distance from the plane. Jones (**13**) has developed a simple dynamical theory for the density variations of objects perpendicular to the galactic plane. He has applied the theory to A0 stars and concludes that the average density of gravitating matter near the Sun amounts to 0·14 solar masses per pc^3, which agrees very well with Oort's value of 0·15 solar masses per pc^3 (**14**).

The work on stellar distributions in high galactic latitudes is of course intimately related to studies of stellar distribution at intermediate latitudes and, more broadly, to research on the galactic halo. McCuskey reports on work in progress by Philip, who has photometric and spectral data for a region of 33 square degrees at $l^{II} = 75°$, $b^{II} = -29°$; at this longitude 5 fields with latitudes $-29° < b^{II} < +32°$ are under investigation (D. A. MacRae and R. Fleischer collaborating). Upgren (**15**) has published a paper on the variation of the luminosity function with distance from the galactic plane. The useful range of absolute magnitudes is −2 to +5 and the survey reaches to distances of 500 pc from the plane. For distances between 100 and 200 pc from the plane, the young and old stars are equally represented, but at greater distances the stars of the oldest groups seem to prevail. The new results agree quite well with earlier work by Bok and MacRae (**16**). W. Becker reports that the work on three-colour photometry now under way at Basel should lead to important new data on the distribution of galactic halo stars of Population II, which are readily recognizable in the two-colour diagram. The paper by Tammann (**17**) for two fields in Cancer shows the power of the *R*, *G*, *U* approach. The studies by Kinman and Wirtanen (**18**) of faint RR Lyrae stars will, for high and intermediate galactic latitudes, give us much new information about the extent of the halo and its population characteristics. The mean distance of the faintest group of high-latitude RR Lyrae variables found by them is approximately 25 kpc, indicating the vast extent of the halo of our Galaxy.

Work on interstellar matter in the halo is reported to Commission 34. We note, however, that the work of Münch and Zirin (**19**) on interstellar absorption lines found in stars at intermediate and high galactic latitudes shows that gas clouds exist to a probable height of 1 kpc —far in excess of the average height suggested by the effective half-thickness of 120 pc often quoted for the gaseous layer in our Galaxy. Oort, Müller and Raimond (**19a**) have reported evidence for high-velocity (120 to 175 km/sec) clouds of H I in the galactic corona. We note

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here that Burbidge and Hoyle (**20**) have suggested that the galactic halo may be a highly transient phenomenon. Belton and Brandt (**21**) have discussed the interpretation of the rotation curve of our Galaxy obtained from 21 cm observations. They indicate that there must be an excess of unknown matter in the Galaxy, distributed like halo Population II objects, if the data from $K(z)$ are to be brought into line with 21 cm results. They suggest the presence of large numbers of intrinsically faint stars with high velocity dispersions perpendicular to the galactic plane.

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VII. STELLAR MOTIONS

Theory

Filin (**1**) found that random errors of the distances and radial velocities do not affect the reliability of the Camm function. A method for the determination of the vertex from proper motion was proposed by Rudnicki (**2**). Strömberg's formula for the asymmetric shift of the centroids was modified by Einasto (**3**). The new formula fits better the observations and leads to the rotational velocity of the Sun of 250 km sec^{-1}. Przybylski (**4**) has suggested a simple method of computing galactic components of stellar velocities by means of a Cracovian formula avoiding an intermediate computation of galactic co-ordinates. A table of nine direction cosines for the conversion of the observed velocity components into galactic components is being prepared by Perek.

Neutral Hydrogen

The outflow of neutral hydrogen from the galactic nucleus raises the question of whether it is replenished by some inward motions. Pariskij (**5**) found that only ionized gas can flow inwards. The velocity is about 10 km sec^{-1} and the radius of the area is 1 to 1·5 kpc.

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