One recent publication that has come to our attention is by Dr A. Elvius, who has distributed on a limited scale some lecture notes on Galactic Dynamics, prepared in connection with a course presented at Chalmers University in Gotenborg, Sweden.

Perek (**8**) has published a survey article on problems of the dynamics of our Galaxy. It contains a very helpful general discussion on problems relating to models for our own and other galaxies. We record here the publication of the Fourth Fundamental Catalogue (FK4) by the Astronomical Rechen-Institut, Heidelberg (**9**), which provides a new fundamental system of proper motions that should make possible more precise proper motion studies of our Galaxy than in the past. Members of Commission 33 will wish to express their indebtedness to Fricke and his associates.

Three international symposia were held during the period covered by the present Report, which covered material closely related to that of our Commission. The first was at Princeton in 1961 and dealt with Interstellar Matter in Galaxies (**10**). The second was held at La Plata (**11**). The third was held at Bosscha Observatory in Indonesia and it dealt with Standards for Stellar Photometry and Spectral Classification (**12**).

The publication of the Mount Stromlo Atlas of the Southern Milky Way came too late for inclusion in the 1961 Report and is recorded here (**13**).

Material relevant to the work of Commission 33 has appeared in the first volume of the series *Annual Review of Astronomy and Astrophysics* (**14**), notably in the chapters by M. S. Roberts (The Content of Galaxies: Stars and Gas) and D. G. Wentzel (Magnetic Fields and Spiral Structure). Volume II, with chapters by A. Blaauw (Stellar Associations), B. Y. Mills (Radio Radiation from the Galaxy) and D. R. Layzer (Formation of Stars and Galaxies) will be eagerly awaited.

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## II. THE OVERALL STRUCTURE OF OUR GALAXY; THE GALACTIC NUCLEUS

During and after IAU/URSI Symposium no. 20, there was much discussion on the distance scale of our Galaxy and the related problems of the circular velocity of galactic rotation at the

Sun and the law of distribution of circular velocities (**1**). The hitherto generally accepted values of the constants are given side by side with the proposed new versions:

| *Past Values* | *New Values* |
|---|---|
| $R_0 = 8{\cdot}2$ kpc | $R_0 = 10$ kpc |
| $\theta_0 = 216$ km sec$^{-1}$ | $\theta_0 = 250$ km sec$^{-1}$ |
| $A = 19{\cdot}5$ km sec$^{-1}$ kpc$^{-1}$ | $A = 15$ km sec$^{-1}$ kpc$^{-1}$ |
| $B = -6{\cdot}9$ km sec$^{-1}$ kpc$^{-1}$ | $B = -10$ km sec$^{-1}$ kpc$^{-1}$ |

No agreement was reached about changing the adopted value for the standard solar motion of 20 km sec$^{-1}$ toward an apex at $18^h\ 00^m$, $+30°$, and no changes are recommended. There is also, as yet, no general support for a general expansion velocity relative to the galactic centre of 7 km sec$^{-1}$ as recommended by Kerr. Firm recommendations have, however, been made for the adoption in all reductions of a single law of circular velocity, $\theta_0\,(R)$, versus $R$, the distance from the galactic centre, a matter that is especially important for the reduction of 21 cm data.

The increased value of $R_0$ and the lower value of the Oort constant $A$ have received strong independent support. The problem was reviewed in the Joint Discussion on Stellar Motions and Stellar Dynamics held at Berkeley (**2**) and the general tenor of the discussion was clearly in favour of the suggested changes. Kraft and Schmidt's result for cepheid variables (**3**) and those of H. L. Johnson and Svolopoulos for galactic clusters (**4**) support the proposed changes and most recently Weaver and Takase (**5**) have recommended a value $A = 14$ km sec$^{-1}$ kpc$^{-1}$ and $R_0 = 11$ kpc. Brandt (**6**, **7**) has presented additional arguments in favour of a larger value of $R_0$, but the general validity of his approach has been questioned by G. Burbidge (**8**). Petrie (**9**) still supports a large value, $A = 18$ km sec$^{-1}$ kpc$^{-1}$, but he comments that his results agree with the smaller value if his distances based on absolute magnitudes from H-gamma measurements are all increased by 15%. Barkhatova (**10**) has determined $A$ from galactic clusters and finds $A = 20$ km sec$^{-1}$ kpc$^{-1}$. The $K$-term proves to be negative. Thackeray (**11**) speaks in favour of the new value of $A$.

Independent confirmation of the smaller value of $A$ has come from several sides, notably as a result of studies by Sinzi (**12**) and by Howard and Kirk (**13**). The problem of the galactic distance scale and the related one of galactic rotation have been reviewed by Stibbs (**14**), who has concluded independently that Petrie's preferred higher value of $A$ can be reconciled with a smaller value if the Petrie distance scale is adjusted.

The angular velocity of rotation for the system of globular clusters decreases with distance from the galactic centre by 10 or 11 km sec$^{-1}$ kpc$^{-1}$ for the regions near the Sun, according to Sharov and Pavlovskaya (**15**). The observed increase in velocity dispersion for globular clusters with increasing distance from the centre can be explained either by different places of origin for different clusters or by the infiltration of extra-galactic clusters, moving with close to parabolic velocities in the outer regions of the galaxy.

The larger value of $R_0$ is supported by Arp's analysis of the distribution of RR Lyrae variables (**16**), in which the mean value $M_B = +0{\cdot}5$ has been used. Fernie (**17**) has developed an approach depending upon the distribution of globular clusters relatively near the Sun, which leads to a value of 9·7 kpc for the distance from the Sun to the galactic centre.

In recent years much new information has accumulated for the nuclear regions of our Galaxy. We draw attention to the Report of Commissions 34 and 40 and also to the papers presented at IAU/URSI Symposium no. 20 for summaries of the new evidence of radio astronomical origin. We note that at the same Symposium G. Courtès presented results obtained optically by interference techniques which apparently refer to emission nebulae in the central regions of our Galaxy. An attempt by Moroz (**18**) to observe directly in the infra-red (1·0–2·5$\mu$) the radio source Sgr A did not, however, yield a positive result.

Several astronomers have examined the probable stellar content of the galactic nucleus. Plaut reports good progress on the Palomar-Groningen variable star programme (**19**); the first published results for Fields 1 and 2 may be expected in 1964.

The astronomers associated with the Warner and Swasey Observatory have given much attention to the central region of our Galaxy. McCuskey and Melhorn (**20**) have completed a search for late M-type stars near the galactic centre and for an area surrounding Selected Area 158. The search plates were taken by Pik-Sin The at Bosscha Observatory. The number of late M stars per $10^6$ pc$^3$ remains constant at 0·2 in a stratum 1 kpc thick south of the galactic plane. At approximately 6 kpc from the Sun, the concentration rises to five or six times the basic value. The line of sight appears to penetrate regions associated with the galactic nucleus even at 1500 pc from the galactic plane. Mavridis and Blanco are continuing the study of the distribution of M stars in the four Plaut areas. $V$ magnitudes are being determined for all M stars found to the limit of the survey (13·5 infra-red). We note in passing that McCuskey and Blanco have under way a parallel study of the distribution of late M-type stars in the anti-centre region ($l^{II} = 188°$). Blanco (**21**) has published the results of an H-alpha survey of the regions surrounding the galactic centre. Since publication, 47 additional H-alpha objects have been found (Pik-Sin The) and many new definite or suspected planetary nebulae. McCuskey and Purbosiswojo (Bosscha) have in progress a study of the space distribution of stars, according to spectral-luminosity class and photographic magnitude for an area of 70 square degrees centred upon $l^{II} = 0°$, $b^{II} = 0°$, complete to $B = 11·5$ (3000 stars). They find a total $B$ absorption of 3·6 mag. at 2 kpc from the Sun. The space density of the Bo – B5 stars and OB stars remains constant to 2·2 kpc from the Sun, that of the B8 – Ao stars drops to one half at 600 pc from the Sun. Perek (**22**) has made a preliminary determination of the distances of 345 planetary nebulae and finds that there are no major density fluctuations between the Sun and the galactic centre.

Considerable attention is being paid to the nuclear bulge. McCuskey and also Bok, Bok and Basinski are concentrating on the region of Selected Area 158, where McCuskey finds an absorption of less than 1 mag, over 8 kpc. Reference should be made to a general discussion of the problem of the stellar composition of the nuclear regions by van den Bergh (**23**) and especially of the useful paper by Wallerstein (**24**), whose results for a field at $b^{II} = +10°$ indicate no maximum of star density for the stars redder than $B - V = 1·5$ at the distance of the galactic centre, suggesting that the bulge does not extend to $z = 1800$ pc.

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### III. CALIBRATION PROBLEMS: THE VICINITY OF THE SUN

A most significant contribution to the all-important problem of the calibration of criteria for absolute magnitude has been published by Blaauw (**1**). The chapter is in two parts, each subdivided into three sections. For stars of spectral class A to M, Blaauw shows how the Mount Wilson absolute magnitudes may be adapted to modern use and he provides (his Table 3, p. 401) also mean visual absolute magnitudes for each MK spectral-luminosity class. He discusses calibration procedure used in the work of Oke, of Hossack and Halliday, and of Wilson and Bappu. For O and B stars and for supergiants, Blaauw presents first a summary of fundamental data on absolute magnitudes using the main sequence fitting procedure, starting from the Hyades and leading to a zero-age main sequence of H. L. Johnson and others. He then gives special attention to the Scorpio-Centaurus Association, with results that confirm the Johnson values, and lists his recommended values in his Table 3 (page 401). There is a brief discussion of the work of Petrie and others and Blaauw notes especially the promise for the future of work on H-beta intensities.

A further comprehensive survey of luminosity criteria has been published by Voigt (**2**). The first part of this survey article describes the principal features of the MK system and of the classifications and luminosity systems developed at Paris and in Sweden. The systems employed by Strömgren and Gyldenkerne are described and also the basis for multi-colour photometry. We note here that colour studies in the far infra-red are becoming increasingly important for future work on galactic structure. The article has a listing of normal colour indices and it contains a tabulation of the absolute magnitudes recommended by Schmidt-Kaler. At the same meeting of the Astronomische Gesellschaft, Schmidt-Kaler (**3**) presented a new calibration of the MK system in which the conclusion is drawn that the most luminous supergiants in the range O to F8 have identical constant absolute magnitudes $M_{pg} = -8{\cdot}4$. We note that in the Large Magellanic Cloud, there are eight stars with values of $M_v < -9$; in other words, there exist supergiants with absolute magnitudes approximately one magnitude brighter than the value quoted by Schmidt-Kaler.

Much work is under way on the calibration and interpretation of multi-colour indices. Strömgren (**4**) has published a comprehensive summary of his work and that of his associates. We note here especially the work of Gyldenkerne, who has established three independent astrophysical parameters, which may give useful clues with regard to the ages and past evolution of the G and K giant stars. Gyldenkerne has completed H-beta photometry for stars classified as A0 in the Bright Star Catalogue, north of $-10°$, and four-colour measurements $u$, $b$, $v$, $y$ are under way. Three-dimensional classification in the $K$, $N$, $M$ system of Gyldenkerne (**5**) has been extended to G5 to K3 of selected stars.

Extensive work on multi-colour photometry is in progress at Kitt Peak Observatory (Crawford, Strömgren) and at Mount Stromlo Observatory (Graham, Gascoigne, Westerlund, Walraven). The Walravens are completing the analysis of their material gathered at the Leiden Southern Station. Crawford (**6**) has published $U$, $B$, $V$ data and H-beta indices for 501 stars of spectral types B8 and B9 brighter than $V = 6{\cdot}5$, north of $-30°$, and Graham (**7**) has provided a considerable body of data for stars of the southern hemisphere.