

Table of Contents

1.	DISTRIBUTION OF COMMON STARS IN THE GALACTIC PLANE	1
	<i>S. W. McCuskey</i>	
1.	Introduction.	1
2.	The General Stellar Population	1
3.	Distribution of Stars According to Spectral Type	4
3.1.	Large-Scale Investigations	4
3.2.	Stellar Distributions of Spectral Groups	8
3.2.1.	The B Stars	8
3.2.2.	The A Stars	13
3.2.3.	The F Stars	18
3.2.4.	The G and K Giants.	18
3.2.5.	The Main-Sequence G and K Stars	22
	References	25
2.	CLASSICAL METHODS FOR THE DETERMINATION OF LUMINOSITY FUNCTION AND DENSITY DISTRIBUTION	27
	<i>P. J. van Rhijn</i>	
1.	Determination of the Density Distribution	27
2.	The Luminosity Function for All Spectral Classes Combined	29
2.1.	Methods	29
2.1.1.	Trigonometric Parallaxes	30
2.1.2.	Spectroscopic Parallaxes.	31
2.1.3.	Method of $\pi_{m, \mu}$	32
2.1.4.	Comparison of Distributions of Proper Motion Components and Tangential Velocities	33
2.2.	Results	34
3.	Luminosity Function for a Given Spectral Class	36
4.	The Effect of Interstellar Absorption	37
5.	Concluding Remarks	38
	References	38

3.	DISTRIBUTION OF COMMON STARS IN INTERMEDIATE AND HIGH GALACTIC LATITUDES	41
	<i>T. Elvius</i>	
1.	Introduction.	41
2.	The Coordinates and the Sun's Position	42
3.	Methods for the Density Analysis	43
4.	Some Early Determinations of $D(z)$	44
5.	Modern Determinations of $D(z)$	46
5.1.	Late-Type Giants	46
5.2.	The A Stars	50
5.3.	The F Stars	52
5.4.	Late-Type Dwarfs	53
5.5.	Variation of $\varphi(M)$ with z .	54
6.	Three-dimensional Distribution	54
	References	59
4.	SOLAR MOTION AND VELOCITY DISTRIBUTION OF COMMON STARS	61
	<i>J. Delhaye</i>	
1.	Introduction, Definitions, List of Recent Analyses	61
2.	Solar Motion	70
2.1.	Solar Motion with Respect to Circular Velocity: Peculiar Motion	70
2.2.	Standard Solar Motion	73
2.3.	Basic Solar Motion	74
3.	Dependence of Kinematic Properties on Stellar Type and Age	74
3.1.	Parento's Discontinuity; the Work of von Hoerner	75
3.2.	Kinematic Heterogeneity of Certain Spectral Groups	78
	References	82
5.	MOTIONS OF THE NEARBY STARS	85
	<i>Richard Woolley</i>	
1.	General Remarks	85
2.	Galactic Orbits of Nearby Stars	87
3.	The Velocity Ellipsoids	89
4.	Color-Magnitude Arrays and Orbital Characteristics	94
5.	The Moving Cluster in Taurus (the Hyades)	95

6. Stellar Groups	100
7. The Motion of Stars Perpendicular to the Galactic Plane.	104
References	109
6. MOVING GROUPS OF STARS	111
<i>Olin J. Eggen</i>	
1. Introduction.	111
2. Young Groups	114
3. Older Groups	121
References	128
7. DISTRIBUTION OF ASSOCIATIONS, EMISSION REGIONS, GALACTIC CLUSTERS, AND SUPERGIANTS	131
<i>Stewart Sharpless</i>	
1. Introduction.	131
2. O-Associations	134
3. H II Regions	137
4. Galactic Clusters	143
5. Supergiants	146
5.1. The OB Stars	146
5.2. Supergiants of Types A5-K	148
5.3. Supergiants of Type M	148
6. Conclusion	151
References	154
8. DISTRIBUTION OF CLASSICAL CEPHEIDS	157
<i>Robert P. Kraft</i>	
1. Introduction.	157
2. The Space Distribution of Galactic Cepheids	158
3. Comparison with Other "Young" Galactic Matter	161
3.1. Long-Period Cepheids and OB Associations	161
3.2. Long-Period Cepheids and Young Galactic Clusters	161
3.3. Long-Period Cepheids and Interstellar Matter	163
3.4. Discussion	164
4. The Comparative Usefulness of Cepheids and Galactic Clusters as Distance Indicators	164
References	165

9.	DISTRIBUTION OF INTERSTELLAR HYDROGEN	167
	<i>F. J. Kerr and G. Westerhout</i>	
1.	Observations of Hydrogen	167
2.	Hydrogen Velocities	168
3.	Large-Scale Structure	175
4.	The Neutral Hydrogen Layer	183
4.1.	Thickness	183
4.2.	Shape	185
5.	Special Regions	189
5.1.	The Solar Neighborhood	189
5.2.	Galactic Center Region	192
5.3.	The Galactic Halo	195
6.	Ionized and Neutral Hydrogen	195
6.1.	Distribution of Ionized Gas	195
6.2.	Mean Density and Mass	197
	References	200
10.	GALACTIC STRUCTURE AND INTERSTELLAR ABSORPTION LINES	203
	<i>Guido Münch</i>	
1.	Introduction	203
2.	Observational Data	205
3.	Interpretation	207
3.1.	Radial Velocities	207
3.2.	Line Intensities	209
4.	Comparison with 21-cm Results	211
	References	216
11.	CONTINUOUS RADIO EMISSION IN THE GALAXY	219
	<i>J. L. Pawsey</i>	
1.	Introduction	219
2.	Available Observations	221
3.	Recognition of the Thermal and Non-thermal Components	226
4.	The Galactic Disk	231
5.	The Galactic Corona	236
	References	238

12.	DISTRIBUTION AND MOTIONS OF LATE-TYPE GIANTS	241
	<i>Victor M. Blanco</i>	
1.	Introduction.	241
2.	Spectral Classifications; Surveys	242
2.1.	Carbon Stars	242
2.2.	S-Type Stars	242
2.3.	M Giants	242
3.	Intrinsic Properties	244
3.1.	Luminosities and Colors of C and S Stars	244
3.2.	Luminosities and Colors of M Giants	245
3.2.1.	Luminosities of Giant M Stars in General	245
3.2.2.	Luminosity of High-Velocity M Stars and of M Giants near the Galactic Center	246
3.2.3.	M Giants in Galactic Clusters	247
3.2.4.	The Dispersion in Absolute Magnitudes	248
3.2.5.	Intrinsic Colors of gM Stars	249
4.	Space Density and Surface Distribution	251
4.1.	Space Densities in the Solar Vicinity	251
4.1.1.	C and S Stars	251
4.1.2.	M Giants	252
4.2.	Longitude Distributions	253
4.2.1.	Types M5 or Later	253
4.2.2.	Early M Stars	254
4.2.3.	Carbon Stars	255
4.3.	Latitude Distributions	256
4.4.	Surface Distributions	257
4.4.1.	Carbon Stars	257
4.4.2.	S-Type Stars	257
4.5.	Studies in Selected Clear Areas	258
5.	Space Motions	261
5.1.	M Giants	261
5.2.	Carbon Stars	262
6.	Summary	262
	References	263
13.	DISTRIBUTION AND MOTIONS OF VARIABLE STARS	267
	<i>L. Plaut</i>	
1.	Introduction.	267
2.	Types of Variable Stars To Be Considered	268
3.	Observations and Intrinsic Properties	268
3.1.	Physical Characteristics.	268

3.1.1. Apparent Magnitude	268
3.1.2. Period	269
3.1.3. Shape of Light Curve	269
3.1.4. Color Index and Interstellar Absorption	269
3.1.5. Spectral Classification	270
3.2. Completeness of Surveys	270
3.3. Proper Motions and Radial Velocities	271
4. Solar Motion and Velocity Distribution; Methods	272
5. Derivation of Density Distribution; Methods	273
6. Ultrashort-Period Variables	273
7. RR Lyrae Variables	275
7.1. Period-Amplitude Diagrams	275
7.2. Colors and Absolute Magnitudes	278
7.3. Kinematical Properties	279
7.4. Density Distribution	279
7.5. RR Lyrae Variables and Globular Clusters	286
8. W Virginis Variables	287
9. RV Tauri and Semi-Regular Variables	290
10. Long-Period Variables	293
10.1. Introduction	293
10.2. Colors and Absolute Magnitudes	295
10.3. Kinematical Properties	296
10.4. Density Distribution	297
10.5. Long-Period Variables and M-Type Giants	298
11. Variable Stars and Stellar Population Types	300
Appendix I. The Completeness of Variable Star Surveys	302
References	305
14. DISTRIBUTION OF NOVAE IN THE GALAXY	311
<i>L. Plaut</i>	
1. Introduction.	311
2. Classification	311
3. Distribution in the Sky	311
4. Distances	312
5. Space Distribution	315
6. Novae in Other Stellar Systems	317
7. Novae and Population Types	317
References	318

15.	PLANETARY NEBULAE	321
	<i>R. Minkowski</i>	
	1. Introduction	321
	2. The Distances of Planetary Nebulae	322
	2.1. Parallaxes and Proper Motions	322
	2.2. Individual Planetaries	323
	2.2.1. NGC 246	323
	2.2.2. NGC 6720	323
	2.2.3. The Planetary Nebula in M15	323
	2.2.4. Planetary Nebulae in External Galaxies	324
	2.3. Statistical Distances	324
	2.3.1. Assumption of Constant Absolute Magnitude	324
	2.3.2. Assumption of Constant Mass	326
	2.3.3. Comparison of Distance Scales	330
	3. The Galactic Distribution of Planetary Nebulae	331
	4. The Radial Velocities of Planetaries	337
	References	341
16.	HIGH-VELOCITY STARS	345
	<i>Nancy G. Roman</i>	
	1. Historical Summary	345
	2. Spectra of Normal High-Velocity Stars	347
	3. Subdwarf Spectra	349
	4. A-Type Stars	351
	5. Variable Stars	352
	6. Space Velocities	353
	7. The High-Velocity Star Population	355
	8. Selection Criteria	356
	References	358
17.	SUBLUMINOUS STARS	361
	<i>Jesse L. Greenstein</i>	
	1. Introduction	361
	2. The Weak-Line F and G Subdwarfs	362
	2.1. Correction of Photoelectric Colors	362
	2.2. Spectral Classification of the Subdwarfs	365

2.3. Statistical Results and Spectroscopic Peculiarities	367
2.4. Space Motion and Galactic Evolution	369
2.5. Solar Motions as Determined from Subdwarf Radial Velocities	370
2.6. Moving Groups Containing Subdwarfs	372
3. White Dwarfs	374
3.1. Discovery of Individual White Dwarfs	374
3.2. Use of Reduced Proper Motions	376
3.3. Binaries	377
3.4. An Astrophysical Hertzsprung-Russell Diagram	378
3.5. Frequency in Space	378
4. Hot Subluminous Stars	380
4.1. Types	380
4.2. The Evolution and the Luminosity Function of the Blue Subdwarfs	382
4.3. Hot Subdwarfs Discovered in Color Surveys	384
4.4. Spectra of Blue Stars Selected by Proper Motions	384
4.5. Properties of Brighter Blue Stars Near the Galactic Poles	386
5. The M Subdwarfs	386
5.1. The Frequency of High-Velocity M Dwarfs	387
5.2. The Color-Magnitude Diagram	388
References	391
18. BLUE STARS AT HIGH GALACTIC LATITUDES	393
<i>W. J. Luyten</i>	
1. Historical	393
2. Methods of Search	393
3. Surveys	394
4. Colors	395
5. Spectra and Radial Velocities	396
6. Proper Motions	396
7. Frequency in Space	397
8. Possible Uses	398
9. Suggestions for Future Work	398
References	399
19. GLOBULAR CLUSTERS IN THE GALAXY	401
<i>Halton C. Arp</i>	
1. Introduction	401

2. The Completeness of the Known Sample	403
2.1. Completeness at High Latitudes	403
2.2. Completeness at Low Latitudes	405
3. Intrinsic Properties and Distances	408
3.1. Photometry	409
3.2. Reddening and Normal Colors	413
3.3. Variation of Intrinsic Properties	414
3.4. Distance Criteria and Distances	419
3.4.1. Absolute Magnitudes of RR Lyrae Cepheids	419
3.4.2. Bright-Star Criteria	421
3.4.3. Other Distance Criteria	421
3.5. Physical Properties of Globular Clusters	423
3.5.1. Absolute Magnitudes	423
3.5.2. Absolute Diameters	424
3.5.3. Masses	424
3.6. The Globular Cluster System	425
3.6.1. Distance to the Center of the Galaxy	425
3.6.2. Density of Globular Clusters in the Galaxy	428
4. Kinematics and Rotation	428
References	431
20. THE CONCEPT OF STELLAR POPULATIONS	435
<i>A. Blaauw</i>	
1. Introduction; History	435
2. Basic Data Bearing on Space Distribution and Motions	437
3. The Scheme of Population Types of the Vatican Conference (1957)	442
4. Modern Work on the Relation between the Kinematical and Distributional Properties and Chemical Parameters	446
4.1. Roman's Classification into Strong-Line and Weak-Line Stars	446
4.2. Some Currently Used Metal-Abundance Parameters	448
4.2.1. Ultraviolet Excesses	448
4.2.2. Strömngren's Metal-Abundance Parameter, m_1	450
4.2.3. Van den Bergh's Criteria	450
4.2.4. Preston's Quantity ΔS in Cluster Variables	451
4.3. Conclusions	451
References	452
21. STELLAR DYNAMICS	455
<i>J. H. Oort</i>	
1. Aims of Dynamics of the Galactic System	455
2. Dynamical Equilibrium	456
2.1. Introduction	456
2.2. The Distribution Function; Liouville's Theorem; Equation of Poisson	458

2.3. Steady State	459
2.4. General Solution of the Equation of Dynamical Equilibrium for an Axially Symmetrical Case	461
2.5. Hydrodynamical Equations	463
2.6. Particular Solutions of the Equation of Dynamical Equilibrium; Ellipsoidal Velocity Distributions	464
3. Small Deviations from Circular Motion	467
3.1. Motions Perpendicular to the Galactic Plane	467
3.1.1. Dynamical Equilibrium; Velocity Distribution	467
3.1.2. Conditions Imposed by the Equation of Poisson; the Total Density of Matter near $z = 0$	469
3.1.3. Mass Density in the Galactic Plane	470
3.1.4. Relation between Velocity and Density Distribution in the z -Direction; Period of Oscillation	472
3.1.5. Mass-to-Light Ratio	473
3.2. Motions in the Galactic Plane	474
3.2.1. Epicyclic Motion; Ellipsoidal Velocity Distribution	474
3.2.2. Deviation of the Vertex	476
3.2.3. Dispersion Orbits	477
3.2.4. General Orbit of a Low-Velocity Star in the Galactic Plane	478
4. Large Deviations from Circular Motion	479
4.1. Motions Approximately in the Galactic Plane	479
4.2. Velocity Distribution of Types of Stars with Large Random Motions; Remarks on the Evolution of the Galaxy	482
4.3. Dynamics of the Halo Population II	488
4.4. Moving Groups in the Halo	492
4.5. Density Gradient and Asymmetrical Drift	493
4.6. Distribution of the Motions of Nearby Stars; Some General Characteristics of High Velocities	495
4.7. Considerations concerning a Model of the Galactic System	499
5. Three-dimensional Orbits of High-Velocity Stars	501
<i>A. Ollongren</i>	
5.1. Statement of the Problem	501
5.2. Exact Solutions	504
5.3. Numerical Solutions	506
General References	509
References	509
22. ROTATION PARAMETERS AND DISTRIBUTION OF MASS IN THE GALAXY	513
<i>Maarten Schmidt</i>	
1. Introduction	513
2. Techniques on Model Construction	514

3. The Motion of Interstellar Gas	518
4. Fundamental Data	519
4.1. Rotation Constant A	519
4.2. Rotation Constant B	521
4.3. Distance R_0 to the Center	522
4.4. The Ratio of A and B	522
4.5. The Product AR_0	523
4.6. The Density Gradient	525
4.7. The Circular Velocity	525
4.8. Discussion	526
5. A Simple Model of the Distribution of Mass	527
References	529

23. DYNAMICS OF GAS AND MAGNETIC FIELDS; SPIRAL STRUCTURE 531

L. Woltjer

1. The Dynamics of Gaseous Systems with Magnetic Fields	532
1.1. Basic Equations	532
1.2. Equilibrium	535
1.3. The Virial Theorem	536
1.4. Cylindrical Equilibria	537
1.5. Toroidal Equilibria	538
1.6. Angular Momentum	540
2. Physical Parameters in the Interstellar Gas.	541
3. The Strength of the Galactic Magnetic Field	544
3.1. The Zeeman Effect	544
3.2. The Faraday Effect	546
3.3. Synchrotron Radiation	547
3.4. Optical Polarization	554
3.5. Cosmic-Ray Confinement	554
3.6. The Virial Theorem	555
3.7. Star Formation	556
3.8. The Solar Wind	556
3.9. Conclusion	556
4. The Galactic Halo	557
4.1. Interstellar Gas Clouds in the Halo	557
4.2. The Hot Halo	559
4.3. The Cool Halo	561
4.4. The Magnetic Halo	563
5. The Galactic Disk, Spiral Structure	563
5.1. The Galactic Nucleus	564
5.2. Radial Flow in the Central Region	565

5.3. The Distribution of Gas in the z -Direction	567
5.4. Spiral Structure	568
5.4.1. Kinematical Problems	569
5.4.2. Radial Flow with Magnetic Fields	573
5.4.3. Other Hydromagnetic and Hydrodynamic Theories	576
5.4.4. Gravito-Gas Dynamic Considerations	577
5.4.5. The Equilibrium in a Spiral Arm	582
6. Conclusion	582
References	583
APPENDIX	589
THE PLAN OF SELECTED AREAS	589
<i>A. Blaauw and T. Elvius</i>	
INDEX	599

