THE MILLENNIUM STAR ATLAS

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ABSTRACT

Derived from Hipparcos and Tycho observations, the Millennium Star Atlas is a set of 1548 charts covering the entire sky to about magnitude 11. It stands apart from all previous printed atlases in completeness to magnitude 10 and in uniformity around the sky. The generous chart scale has made possible a number of innovations never before seen in a star atlas: arrows on high-proper-motion stars, double-star ticks conveying separation and postion angle for a specific modern epoch, distance labels for nearby stars, and variable stars coded by amplitude, period, and type. Among the nonstellar objects plotted, more than 8000 galaxies are shown with aspect ratio and orientation.

Key words: star charts, celestial atlases.

1. INTRODUCTION

In 1992, when software was developed by the author to generate star charts for Sky & Telescope, the magazine's editorial staff began discussing the possibility of a comprehensive new star atlas. A set of plotted sky maps can have many features that are missing from photographic charts. These include a precise coordinate grid, better differentiation of star magnitudes, numerous labels, characteristics of variable and double stars, and nonstellar objects much fainter than the magnitude cutoff for stars.

The idea of a collaboration with the European Space Agency was first broached in early 1995, and this led to a signed agreement in February 1996, more than a year before the general release of results from the Hipparcos mission (ESA 1997). For atlas purposes the prime attraction was the Tycho data, which would ensure a completeness for stars to about magnitude 10 over the entire sky. Other celestial cartographers have not been so fortunate. Becvar (1964) and Tirion (1981) had to rely on mid-20th century astrometric star catalogues whose compilers had made no claims of completeness to a particular magnitude limit. Recognizing this shortcoming, Tirion etal (1987) decided to base their Uranometria 2000.0 on the 19th-century visual catalogues of F.W.A. Argelander and colleagues: the Bonner Durchmusterung and its southern-sky counterparts.

Use of the Tycho data would provide more than one million stars, three times as many as are plotted in Uranometria 2000.0, and place our atlas on a thoroughly modern footing. In addition, the charts could present some of the highly refined results of the Hipparcos mission.

2. STELLAR CONTENT

A preliminary scan through the 1 058 332 Tycho stars revealed many thousands lying within 30 arcsec of a brighter companion. Because such pairs would appear nearly concentric on the charts, they have been plotted as single dots augmented in size for the combined brightness. This procedure reduced the total number of stars plotted to 1 041 728.

At the same time, these Tycho companions were cross-checked against the list of double and multiple stars specifically targeted by Hipparcos. This allowed a total of 22 192 tick marks to be added to stars in the atlas to indicate companions lying between 0.1 and 30 arcsec from their primary stars.

Some 9200 variable stars are identified and characterized by amplitude, period (if applicable), and broad type. Among these are 5100 stars whose variability was discovered by Hipparcos. For 6500 stars with proper motions exceeding 0.2 arcsec/yr, arrows show the amount and direction of motion in 1000 years. Distance labels are given for 10 260 Hipparcos stars lying within 61.3 parsecs (200 light-years) of the sun.

3. NONSTELLAR CONTENT

The atlas plots 900 open and globular clusters, 400 bright and dark nebulae, 500 planetary nebulae, 250 quasars and BL Lacertae objects, and 675 galaxy clusters. For 8000 individual galaxies, a major goal was to show the correct orientation on the sky. Position angles for two-thirds of these galaxies were found in the Lyon-Meudon Extragalactic Database (LEDA), as supplied by the LEDA team at the CRAL-Observatoire de Lyon (France); the rest were measured specifically for this atlas from published images and photographs.

We encountered many surprises as the raw charts came out of the computer. For example, Tycho had

provided accurate positions for the brightest stars in a number of open clusters. Sometimes these stars formed a clump that was clearly offset from the dashed circle that was plotted from the cluster's catalogue position. (As data compilers know, some of the brightest and most familiar nonstellar objects have the poorest tabulated positions.) We corrected such anomalies whenever they were noticed.

4. OVERVIEW

The atlas contains 1548 charts, each covering a 5.4° by 7.4° region of the sky. The coordinate grid is that of the International Celestial Reference System, consistent with equinox J2000.0, while star positions and double-star configurations are shown for epoch J1991.25. All stars are sized by V magnitude, as derived from the Tycho B_T and V_T measurements.

The atlas is being issued in two versions at slightly different scales. The three-volume stand-alone edition (Sinnott & Perryman 1997) has a chart scale of 100 arcsec/mm. That appearing as Volumes 14–16 of the Hipparcos and Tycho Catalogues (ESA 1997) has a scale of 88 arcsec/mm. Both are printed with black stars against a white sky.

ACKNOWLEDGMENTS

This atlas would not have been possible without the close involvement of European astronomers working with the Hipparcos data. The atlas's coauthor, M.A.C. Perryman, showed particular imagination in helping to define the atlas's features; he also orchestrated the interactions between R.W. Sinnott and H. Schrijver, E. Høg, and V.V. Makarov.

At Sky Publishing Corp., E.T. Mentall researched the position angles of galaxies and drafted all outlines of large nebulae. He and I. Joson scrutinized the charts to remove labeling ambiguities. L.J. Robinson was the chief technical consultant, while master illustrator G. Dinderman oversaw the clarity of presentation. S. MacGillivray was project manager under the firm's president, R.T. Fienberg.

Many others who played key roles are acknowledged in the Atlas's Introduction.

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