Uranometria 2000.0's Stellar Database

In 1997 the European Space Agency [ESA] published the *Hipparcos and Tycho Catalogues* (ESA SP-1200), which provided highly accurate positions and magnitudes for about a million stars to ~11 magnitude. In 2000 ESA published the *Tycho-2 Catalogue* which increased the database to about 2.5 million stars. The Tycho-2 positions and magnitudes are based on the same observations as the Tycho-1 Catalogue collected by the star mapper of the ESA Hipparcos satellite, but Tycho-2 is much bigger and slightly more precise because it used a more advanced reduction technique. To a very close approximation the Hipparcos/Tycho magnitudes match "true" visual (V) magnitudes. This atlas plots 280,035 of these stars to 9.75 magnitude on the 220 double-page charts and to ~11.0 on the 26 "close-up" charts.

Three data sources were used for determining the variability of stars. The Variability Annex of the *Hipparcos Catalogue* was the reference for over half of the stars of this type. The second source was the variability flag in the Tycho Catalogue, which accounts for about 43% of these classifications. Only those Tycho stars which were flagged as having "strong evidence for variability" were classified as variable. The third source was the *General Catalogue of Variable Stars* [GCVS] (Kholopov, et al., 1998). The Tycho data was correlated with the GCVS, using a combination of positional and magnitude criteria. This resulted in about 6% of the variable star classifications.

Preference was given to the Hipparcos data for assigning minimum and maximum magnitudes, since these values are presumably more reliable than Tycho's. For the variable star names, the majority came from the cross-reference information in the Hipparcos Variability Annex. This was found to be somewhat incomplete, however, and an additional 944 variable names were obtained through correlation with the GCVS.

Uranometria 2000.0 is not intended to be a comprehensive atlas of variable stars, even though more than 6,300 of them are plotted and labeled. The serious variable star observer will encounter omissions. The primary reason for an omission is attributable to the scale of this atlas. Denoting variables in areas densely populated by deep-sky objects, or in rich star clusters, would have introduced excessive clutter on the chart. However, no variable star of "significance" was knowingly omitted for this reason. Most will be found to have a relatively small amplitude (less

than 0.2 magnitude), or to reside at the faint end of *Uranometria's* magnitude limit. Our main concern was that we plot those variables which have a large brightness range and a relatively bright maximum to reduce the possibility that an "unexpected" star will alter the star pattern that the observer is using to locate a faint deep sky object.

For example, a star may spend most of its time at 12th magnitude, and then brighten to 7th. An observer who is unaware of the location of such a star may be confused by the new star pattern which this would then present. It is this situation which we have attempted to avoid.

Alternatively, a variable star with a maximum that is near the faint limit of this atlas may decrease in brightness by several magnitudes. In this case, there would be a star missing from the expected pattern. Nominally, the variable star symbol provides a qualitative representation of the minimum and maximum brightness of the star. But for stars whose maximum is 8th magnitude or fainter, the small size of the symbol prevents accurately displaying the star's minimum brightness. In an extreme case, a plotted variable star may decrease to 14th magnitude or fainter. The user should keep this in mind when star-hopping a field containing moderately faint variables.

In order to maintain consistency in *Uranometria 2000.0*, the minima and maxima of variables has been taken from the Tycho and Hipparcos data whenever possible. We would expect that variable star observers will have other sources for this data, and there will no doubt be discrepancies. Compared to most well-studied variable stars, the number of observations made during the Hipparcos mission was relatively small. Therefore this data may not reflect the true extremes of a given star's magnitude range.

Double star classification was based upon both the Hipparcos and Tycho Catalogues. The former contains several indicators of duplicity: "Number of Components," "Double/Multiple Systems Annex Flag," "CCDM Identifier," and "Component Identifiers." All of these were taken into consideration in the double star classification process. For objects not contained in Hipparcos, the classification process was a bit more difficult. The Tycho Catalogue "resolves" many double stars, giving each component a separate entry. While there is a "duplicity flag" in the Tycho Catalogue, it only identifies those entries which are unresolved. Identification of wider doubles had to be inferred from other information, such as the "Proximity Flag" and "CCDM Identifier." This was supplemented by searching the data for pairs of stars with separations of less than 60 arc-

seconds. From this information, additional double star assignments were made. With the exception of these doubles, all of the angular separation and position angle data in *Uranometria 2000.0* came from Hipparcos.