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Historical Astronomical Catalogs

The first star catalog was published by Ptolemy in the second century AD. This catalog appeared in the book that later became known as the **Almagest**. It had 1025 entries, with positions that had been measured by Hipparchos in 128 BC, and precessed forward to 138 AD by Ptolemy. Most of the stars in the Almagest are given proper names, deriving from Babylonian or Arabic origins. The second major non-telescopic catalog included 788 stars with coordinates measured by Tycho Brahe and compiled by Johannes **Bayer**. Bayer introduced the notation of using the letter of the Greek alphabet to identify the stars in a given constellation, ranked in order of visual magnitude, with the brightest star designated as α followed by a 3 letter abbreviation for the constellation. The first catalog based on telescopic meaurements with a meridian transit instrument was prepared in the 17th century by the first Astronomer Royal of Britain, John **Flamsteed**. Flamsteed introduced a new naming scheme for the 3000 stars in his catalog, with stars designated by a number followed by the possessive form of the constellation, such as "61 Cygni".

The first star catalogs of the modern era are based on observations from various observatories during the late 19th century and are collectively known as the **Durchmusterung Catalogs**, abbreviated DM. (Durchmusterung is German for "survey".) These catalogs, prepared under the direction of *Friedrich Wilhelm August Argelander*, are compiled from both visual and photographic surveys, and provide positions and brightnesses of most stars brighter than 9.5 visual magnitude, or some 500,000 stars. The individual DM surveys are the Bonner Durchmusterung (BD), its southern extension (SD), the Cordoba Durchmusterung (CD), and the Cape Photographic Durchmusterung (CP). In each DM catalog the stars are arranged in 1 degree zones of declination with objects numbered sequentially in order of right ascension within each zone. For example, BD+22 1937 is the 1937th star in the zone between a declination of +22 and +23 degrees. At the celestial equator, there are 2 zones, +0 and -0. This venerable numbering scheme has been adopted in various guises for many modern sky surveys, which have re-mapped the sky at different wavelengths. Positions for all DM stars are given for epoch 1855. The positions are recorded to the nearest 0.1 sec in RA and 0.1 arcmin in DEC, and magnitudes are listed to the nearest 0.1 visual mag. More information about the DM catalogs can be found in Appendix 1 of the book Astronomical Data, which is part of the 9 volume compendium Stars and Stellar Systems, published by the University of Chicago Press in the 1960's. Hand drawn BD and CD charts accompany the written volumes, and were widely used by astronomers to identify stars in crowded fields until the advent of the SAO charts in 1969. These yellowing DM charts can still be found at all major observatories and astronomy departments in the world.

Positions of stars must be measured relative to a set of comparison stars whose coordinates are known to a high degree of accuracy. Coordinates of these astrometric reference stars are published in what are known as *Fundamental Catalogs*. The first **Fundamental Katalog (FK1)**, containing accurate positions for 500 stars, was published in Germany in 1879. The fundamental catalogs are revised every few decades. The German Fundamental Katalog (FK) series culminates in **FK5**, published in 1984 and containing 1535 fundamental stars. Mean positional errors for the FK5 positions are $\pm$0.0039 sec in RA and $\pm$0.017 arcsec in DEC. The apparent places of stars in the FK catalogs are published for 10 day intervals in *Apparent Places of Fundamental Stars*.

The first spectroscopic catalog was published early in the 20th century from a collection of objective prism plates classified by Annie Jump Cannon of the Harvard College Observatory. Both the **Henry Draper Catalogue (HD)** and the **Henry Draper Extension (HDE)** include spectral types for 391,000 stars, to a limiting magnitude of approximately m = 8.3.

Modern star catalogs are of course available as searchable databases on the Internet. You will find several good starting points from the Smith Astronomy webpage at *www.ast.smith.edu*, following the hyperlinks to Links and Research. On the Research Links page, take a look at the List of Catalogs at Visier from the CDS website in France – there are over 5000 available online and the list grows almost daily! Stellar catalogs you should know by name include **The Yale Bright Star Catalog**,**The Smithsonian Astrophysical Observatory (SAO) Catalog**, the **Guide Star Catalog** and the **Hipparcos and Tycho Catalog**. Several websites, as well as the *ds9* image viewer, allow you to overlay stellar positions from catalogs on astronomical images retrieved from data archives. Take a look at the *Skyview Virtual Observatory* and the *CDS Aladin Java Applet* in particular. We will explore some of these in homework sets.