THE SOMMERS-BAUSCH OBSERVATORY CATALOG OF ASTRONOMICAL OBJECTS

The SBO Catalog is a compilation of all astronomical objects in the Sommers-Bausch Observatory computerized telescope object libraries. The catalog was assembled to assist telescope users in preparing for an instructional observing session or public open house, and to provide the user with some background information for fielding questions about the objects.

The Catalog is principally a combination of the Charles Messier catalog of non-cometary objects, and the Mullaney and McCall catalog of "The Finest Deep-Sky Objects." These two catalogs include virtually all of the most popular and readily visible astronomical subjects. Fifteen additional entries of binary stars and special objects have been added by the SBO staff, plus the thirteen brightest stars north of -40 degrees declination, and twenty-four selected ephemeris stars (approximately +40 degrees declination, spaced at roughly one-hour intervals in right ascension). In all, there are 225 entries not counting catalog duplications.

The Catalog is presented in several discrete sections:

BY RA - All objects, sorted by increasing right ascension, to assist the user in indentifying those objects that are "up" and available for observation on any given night.

BY TYPE - A cross-reference of the same set of objects, but grouped by object type:

Ephemeris Stars - moderately bright stars near +40° declination, useful for stellar initialization.

Bright Stars - Alternate stellar initialization objects in the event that an appropriate Ephemeris Star cannot be found. Also useful to demonstrate how a bright star appears telescopically.

Red and Double Stars - Interesting, and sometimes challenging, examples of single, binary, and multiple star systems, sometimes with striking color combinations.

Open Clusters - Also known as "galactic clusters", the product of relatively recent starbirth regions. Tend to be loosely organized and dominated by blue stars.

Globular Clusters - Ancient, tightly-bound star systems which tend to group around the nucleus of the Milky Way. Contain thousands of component stars.

Planetary Nebulae - The "puffed-off" outer shells of a dying, Sun-like star. Named by Hershel, for their (sometimes) telescopic resemblance to Uranus, which he discovered.

Diffuse Nebula - Glowing gas clouds, primarily due to hydrogen-alpha emission. Starbirth occurs in these regions, ultimately resulting in a new open cluster.

Cataclysmic - Exotic, explosive, highly-energetic sources.

Galaxies - "Island universes" of stars lying outside our own Milky Way Galaxy.

MESSIER - A separate listing of this venerable and historical catalog.

M&M - A separate listing of Mullaney and McCall's catalog of celestial showpieces.

Origins

The SBO Catalog was formulated in 1981, when Sommers-Bausch Observatory was about to acquire its first computer-controlled telescope from DFM Engineering. The 18-Inch Telescope was the first, and prototype, instrument ever built commercially by the DFM firm. Dr. Bruce Bohannan, then director of SBO, was asked to compile a list of objects that could be automatically acquired via the GOTO command of the TCS software control system. The SBO Catalog was the result.

Since its inception, the Catalog has been reproduced within the software of every commercial DFM telescope control system ever produced - appearing not only in subsequent SBO instruments, but also in dozens of other facilities around the world.

Comments: The Messier Catalog

The Messier Catalog was compiled in the latter half of the 18th century by the famous comet-hunter Charles Messier - with extensions contributed by his contemporary, Pierre Mechain. Although the catalog is often described as "Messier's list of non-cometary objects that should be ignored", it includes many of the brightest and best "faint fuzzies" that can be seen through a small telescope. Since Messier was able to spot these objects with a telescope no larger than 3.5 inches aperture, and with a magnification of 120 X or lower - the Messier Catalog is frequently taken to be *the* definitive "hit parade" list of deep-sky objects.

In actuality, Messier never claimed that his objects should be ignored; instead, they were a compilation of nebulae and star clusters that he serendipitously discovered or encountered in his comet searches, or while tracking comet positions. The myth is probably based upon his comment made in 1801 regarding Messier 1 (now famous as the Crab Nebula, and home of the first discovered pulsar):

> "What caused me to undertake the catalogue was the nebula I discovered above the southern horn of Taurus on September 12, 1758, while observing the comet of that year. This nebula had such a resemblance to a comet, in its form and brightness, that I endeavored to find others, so that astronomers would not confuse these same nebulae with comets just beginning to shine."

But few observers would claim that Messier would have confused M42, the Great Nebula in Orion, or M45, the Pleiades star cluster, with a comet. Messier's catalog is simply the first-ever systematic compilation of nebulae and star clusters seen with a small-aperture telescope.

It's also a mistake to automatically assume that an object in Messier's list automatically qualifies it as an excellent target for educational or open-house viewing. Many of Messier's objects are indeed "showpieces" - but many more are not.

For one thing, the skies of 18th century France were considerably darker than the modern, light-polluted skies of Boulder. As a result, many of the low surface brightness galaxies included in the list are disappointing at best, or invisible at worst, for eyepiece viewing at SBO (although most will show up well in 2-8 minute exposures with the CCD camera).

Furthermore, as Messier stated, his list was intended for wide-field (short focal length) telescopes suitable for comet hunting. With larger aperture and longer focal-length telescopes such as those on the SBO Observing Deck, many of Messier's objects are simply too large for the eyepiece field-of-view - so that *everything* within the eyepiece is only a small portion of the total object. The observer is sometimes faced with the situation that "you can't see the forest for the trees". Objects such as M8 (the Lagoon Nebula), M31 (the Great Andromeda Galaxy), M33 (the Pinwheel Galaxy), M42 (the Great Orion Nebula), and M45 (the Pleiades) will often be better viewed through the finder telescopes rather than through the main instuments.

Finally, the plain truth is that, inexplicably, Messier and Mechain missed a few "really good-uns" - such as NGC 253, the second-brightest northern galaxy in the sky, and the famous open clusters "h" and "chi" Persei. And since Messier wasn't attempting to catalog double stars, none of these celestial showpieces can be found in his list. Which brings us to ….

Comments: The Mullaney & McCall Catalog

First-time telescope observers, such as most individuals taking an introductory astronomy class or attending a Friday Night Open house, expect to see objects in the eyepiece that are as striking as the classic long-exposure astrophotos of those objects. Invariably, these folks are disappointed - resulting from a combination of over-expectation, inexperience with observing techniques, light polluted skies, and an imprudent selection of targeted objects.

To increase the probability of viewer satisfaction, James Mullaney and Wallace McCall researched and published in 1966 a collection of "The Finest Deep-Sky Objects" that were well-suited for open-house viewers using telescopes ranging in aperture from 13 to 30 inches.

For the reasons outlined in the previous section, many of the Messier objects were excluded from the M&M catalog - while several of the brighter "faint fuzzies" missed my Messier have been included. In addition, the Mullaney & McCall catalog addresses the need to include, in one's "show and tell" arsenal, several *really* bright stars and good double and multiple star systems.

In general, it's a fairly good bet that if an object is listed in the "Finest" catalog, it will prove to be a rewarding sight for a first-time viewer. There *are*, however, a couple of caveats. First, beware of very close double stars (4 arcseconds separation or less), or doubles encompassing a wide range of magnitudes, unless the "seeing" is excellent. Second, take into consideration an object's sky placement at observing time. For example, M&M 79 (M8, the Lagoon Nebula) and M&M 2 (NGC 253), while both large and bright, become lost in the glow of Denver light pollution when they lie in the southeast sky. And M&M 37 and 38 (Messier 81 and 82) are so far north that they are easily obscured by the Observing Deck's overhanging roof.

But if an object appears in *both* Messier's and M&M's lists - object numbers ranging between 1-109 and 201-305, respectively - well, why not take a look?

References

Data for the catalog were obtained from the following sources, which are also recommended for further information:

The Finest Deep-Sky Objects, Mullaney & McCall, 1978, Sky Publishing

The Messier Album, Mallas & Kreimer, 1979, Sky Publishing Corp.

Burnham's Celestial Handbook, Robert Burnham, 1978, Dover Pub.

The Revised New General Catalog of Nonstellar Astronomical Objects, Sulentic & Tifft, 1973, Univ. of Arizona Press

The Bright Star Catalogue, 4th Revised Ed., Dorothy Hoffleit, 1982, Yale University Observatory

The Astronomical Almanac, U.S. Naval Observatory

Exploration of the Universe, 3rd Ed., George Abell, 1975, Holt

DESCRIPTION OF CATALOG ENTRIES

OBJECT NUMBER --- The one- to three-digit catalog number to be keyed into the GO TO OBJECT field of the Telescope Control System (TCS) software program. In the case of duplicate catalog entries (arising from an object's inclusion in two or more sub-catalogs), any one of the numbers may be entered; the other(s) contain identical pointing information.

The following object numbering scheme is used:

CATALOG	OBJECT NUMBER	NUMBERING SYSTEM
Messier	001 - 109	Messier catalog number
Mullaney & McCall	201 - 305	M&M number + 200
Ephemeris Star List	401 - 424	RA to nearest hour + 400
Bright Star List	501 - 513	Brightest star order + 500
Special Objects	514 - 528	513 + next SBO object

COMMON NAME --- Proper names commonly used are given precedence, followed by Bayer (Greek lettering) or Flamsteed (right ascension numbering) star names and catalog designations.

α - Alpha	η - Eta	ν - Nu	τ - Tau
β - Beta	θ - Theta	ξ - Xi	υ - Upsilon
γ - Gamma	ι - Iota	ο - Omicron	φ - Phi
δ - Delta	κ - Kappa	π - Pi	χ - Chi
ε - Epsilon	λ - Lambda	ρ - Rho	ψ - Psi
ζ - Zeta	μ - Mu	σ - Sigma	ω - Omega

OBJECT TYPE

Glob Cl	Globular cluster	Dif Neb	Diffuse gaseous nebula
Ell Gal	Elliptical galaxy	Spl Gal	Spiral galaxy
Irr Gal	Irregular galaxy	BSp Gal	Barred spiral galaxy
Quasar	Quasi-stellar object	Sprnva	Supernova remnant

* * * - STARS. The number of asterisks indicates the number of visible stars in a double or multiple system. Spacing of the asterisks indicates roughly the relative grouping. Generally, stars separated by over 12" (12 arcseconds) are indicated by a space between asterisks, while those closer than 12" are not.

CONSTELLATION --- IAU abbreviation for the constellation containing the object.

COORDINATES --- Right ascension (R. A.) and declination (Dec.) of the objects for the epoch 2000. Stellar coordinates for epoch 2000 were obtained from the Bright Star Catalogue. Non-stellar coordinates for epoch 1975 were taken from the Revised NGC Catalogue and precessed to the year 2000.

VISIBLE MAG --- Visual apparent magnitude of the object(s) from the BS (Bright Star Catalog) and RNGC (Revised New General Catalog) sources. Separate magnitudes are given for each star of a multiple system. For extended objects and clusters, the figure refers to the equivalent stellar magnitude of the entire object. The angular size of an object should be considered along with its magnitude to determine whether the surface brightness is sufficient for viewing on a particular night.

APPARENT SIZE OR SEPARATION

APPARENT ANGULAR SIZE - Given in arc-minutes (') for extended objects. The sizes generally are measured photographically, so that the apparent visual size may be less then half of the indicated figure.

ANGULAR SEPARATION - The angular separation of double or multiple stars is given in arc-seconds (").

DISTANCE IN LIGHT YEARS --- Although modern astronomy tends to use parsecs (1 parsec = 3.26 LY), most people are more intuitively familiar with the concept of light years. Most distances included here are known only to "astronomical accuracy". M = millions of light-years.

DESCRIPTION OR COMMENTS --- A brief and very cryptic set of notes regarding one or more interesting aspects of the object - intended to provide the user with at least *something* of interest to say to a group of students or visitors. Much greater detail can be found in either "The Messier Album", by Mallas and Kreimer, or in the "Finest Deep-Sky Objects" by Mullaney and McCall.

Comments fall into the categories of (1) visual appearance, (2) factual data, (3) linear dimensions, and (4) tidbits (historical information, alternate names, etc.). Abbreviations are used extensively, particularly the use of the asterisk (*) to represent "stars".

Visual appearance at moderate aperture, rather than photographic appearance, is emphasized to assist the user in estimating the visibility of an object, its instructional value at the eyepiece, or in selecting the appropriate equipment. Star colors tend to be eyepiece impressions rather than accurate colors, and depend upon the aggregate effect of all stars present. Descriptions in this category are both observer- and equipment-dependent.

Factual data includes stellar spectral type, star counts, and classification. Occasionally information is given which is of instructional interest but which cannot be visually observed, such as equivalent solar luminosity (L_O), mass (M_O), presence of jets, periods, proper motion, etc.

Linear dimensions for most objects are not accurately known but can be roughly inferred from angular measurements and the estimate of distance. The separation of binary stars is given in astronomical units (AU, the Earth-Sun distance); because of projection effects, this separation is a lower limit for the actual linear distance between the stars.

CATALOG NUMBER --- The New General Catalogue (NGC), Bright Star Catalog (BS), or alternate catalog number.