OBSERVING OPEN CLUSTERS

Why Observe Open Clusters?

- Observing Open Clusters will improve your observing skills.
- You will learn how to classify Open Clusters.
- You will learn more about these fascinating objects.

Facts about Open Clusters

- An open cluster is a group of up to a few thousand stars that were formed from the same giant molecular cloud and have roughly the same age. More than 1,100 open clusters have been discovered within the Milky Way Galaxy, and many more are thought to exist. They are loosely bound to each other by mutual gravitational attraction and become disrupted by close encounters with other clusters and clouds of gas as they orbit the galactic center, resulting in a migration to the main body of the galaxy as well as a loss of cluster members through internal close encounters.

Facts about Open Clusters

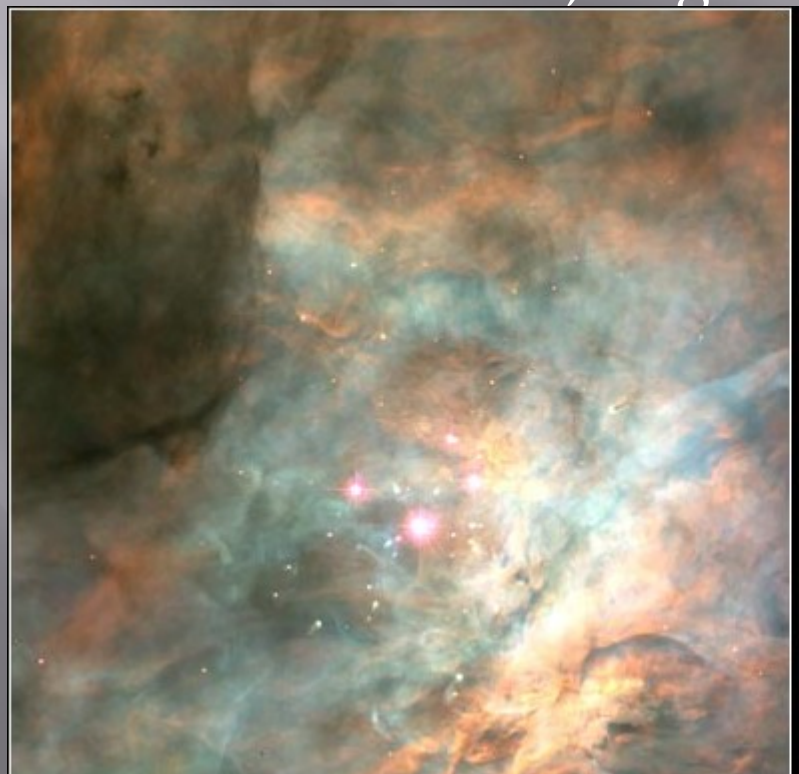
- The prominent open cluster Pleiades has been recognized as a group of stars since antiquity, while the Hyades forms part of Taurus, one of the oldest constellations. Other open clusters were noted by early astronomers as unresolved fuzzy patches of light. The Roman astronomer Ptolemy mentions the Praesepe, the Double Cluster in Perseus, and the Ptolemy Cluster, while the Persian astronomer Al-Sufi wrote of the Omicron Velorum cluster. However, it would require the invention of the telescope to resolve these nebulae into their constituent stars. Indeed, in 1603 Johann Bayer gave three of these clusters designations as if they were single stars

Facts about Open Clusters

- The first person to use a telescope to observe the night sky and record his observations was the Italian scientist Galileo Galilei in 1609. When he turned the telescope toward some of the nebulous patches recorded by Ptolemy, he found they were not a single star, but groupings of many stars. For the Praesepe, he found more than 40 stars. Where previously observers had noted only 6-7 stars in the Pleiades, he found almost 50. In his 1610 treatise *Sidereus Nuncius*, Galileo Galilei wrote, "the galaxy is nothing else but a mass of innumerable stars planted together in clusters." Influenced by Galileo's work, the Sicilian astronomer Giovanni Hodierna became possibly the first astronomer to use a telescope to find previously undiscovered open clusters. In 1654, he identified the objects now designated Messier 41, Messier 47, NGC 2362 and NGC 2451.

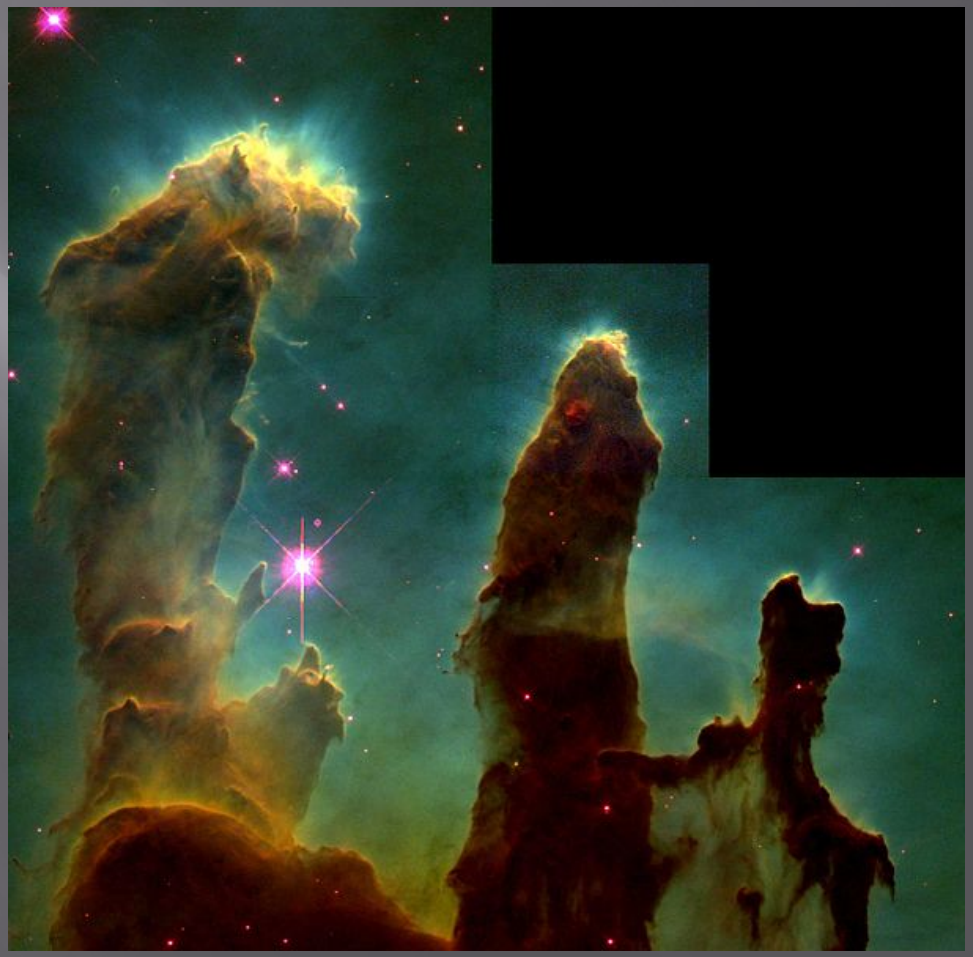
Facts about Open Clusters

- The formation of an open cluster begins with the collapse of part of a giant molecular cloud, a cold dense cloud of gas and dust containing up to many thousands of times the mass of the Sun result in an open cluster. These include shock waves from a nearby supernova, collisions with other clouds, or gravitational interactions.



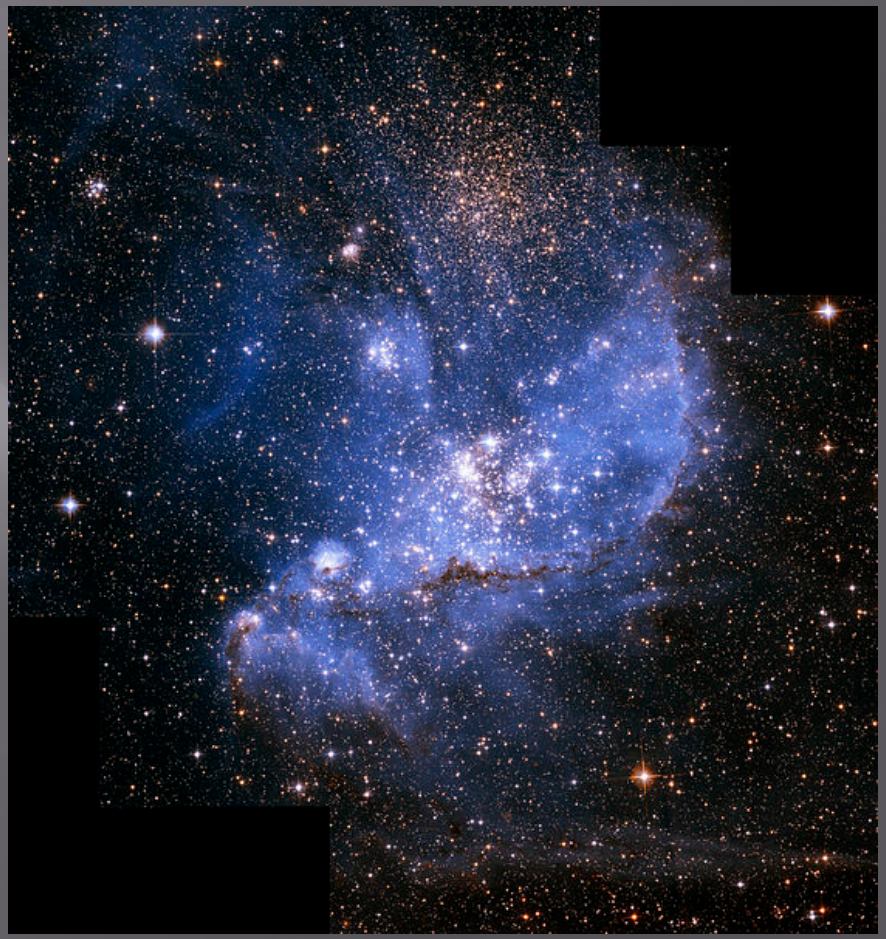
Facts about Open Clusters

- The hottest and most massive of the newly formed stars emit intense ultraviolet radiation, which steadily ionizes the surrounding gas of the giant molecular cloud. Stellar winds and radiation pressure from the massive stars begins to drive away the hot ionized gas at a velocity matching the speed of sound in the gas. After a few million years the cluster will experience its first core-collapse supernovae, which will also expel gas from the vicinity. In most cases these processes will strip the cluster of gas within ten million years and no further star formation will take place. Still, about half of the resulting protostellar objects will be left surrounded by circumstellar disks, many of which form accretion disks.



Facts about Open Clusters

- Because most if not all stars formed cluster, star clusters are viewed to be the fundamental building blocks of galaxies. The violent gas-expulsion events that shape and destroy many star clusters at birth leave their imprint in the morphological and kinematical structures of galaxies. Most open clusters form with at least 100 stars and a mass of 50 or more solar masses.

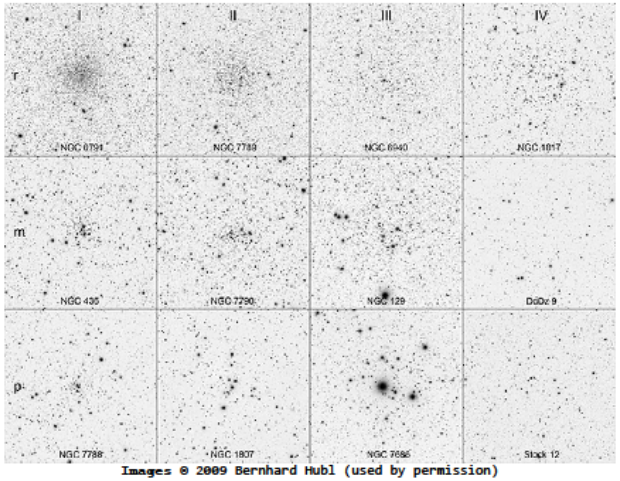


Classifying Open Clusters

- Open clusters are often classified according to a scheme developed by Robert Trumpler in 1930. The Trumpler scheme gives a cluster a three part designation, with a Roman numeral from I-IV indicating its concentration and detachment from the surrounding star field (from strongly to weakly concentrated), an Arabic numeral from 1 to 3 indicating the range in brightness of members (from small to large range), and *p*, *m* or *r* to indication whether the cluster is poor, medium or rich in stars. An 'n' is appended if the cluster lies within nebulosity.
- Under the Trumpler scheme, the Pleiades are classified as I3rn (strongly concentrated and richly populated with nebulosity present),

Classifying Open Clusters

Trumpler Classification System for Open Star Clusters



The Trumpler system requires the observer specify three features of the open cluster, the degree of concentration, the range of brightness (magnitude) of the stars in the cluster, and the number of stars in the cluster.

Degree of Concentration

I Detached clusters with strong central concentration
II Detached clusters with little central concentration
III Detached cluster with no noticeable concentration
IV Clusters not well detached, but has a strong field concentration

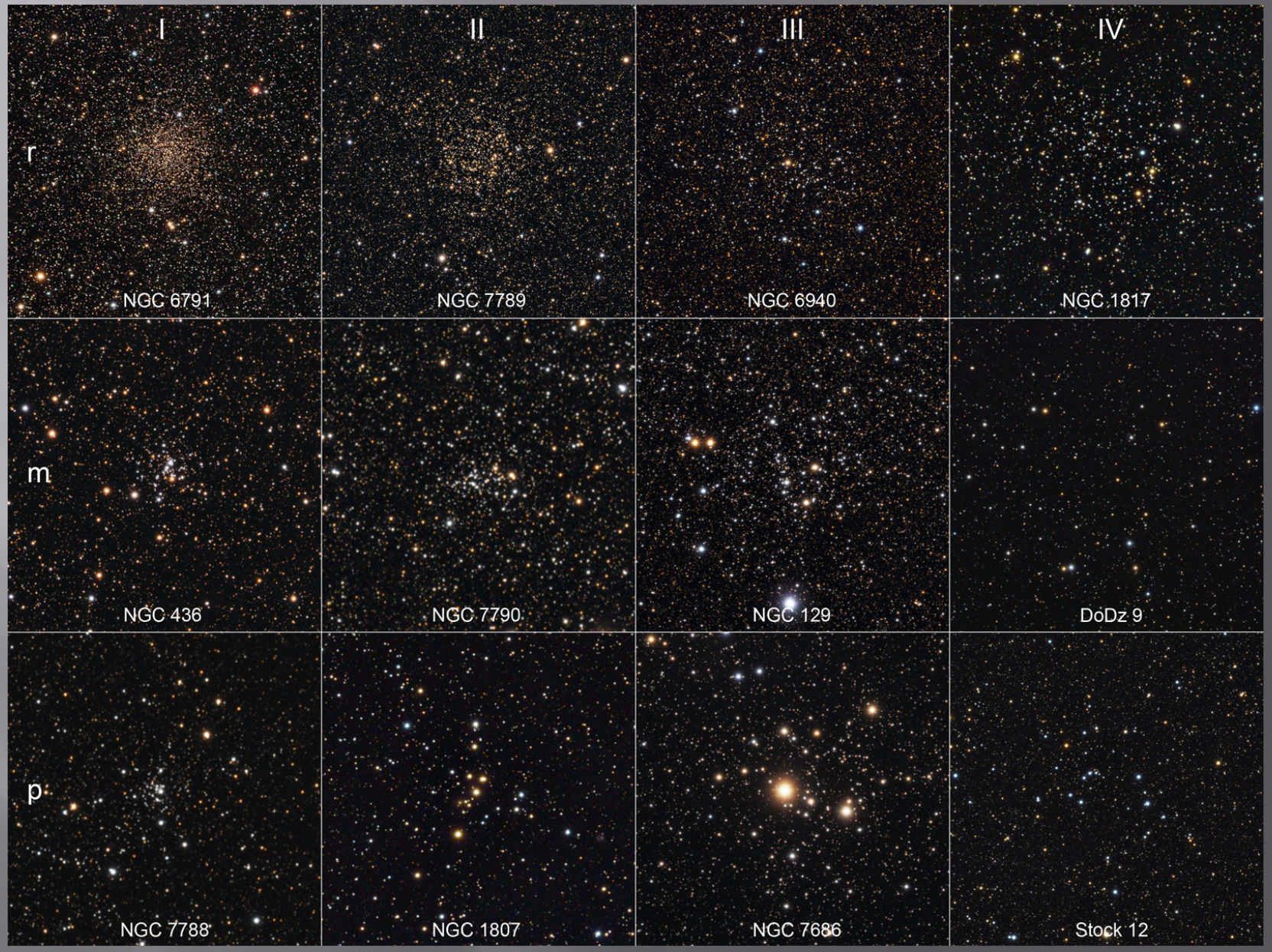
Range of Brightness

1 Most of the cluster stars are nearly the same apparent brightness
2 A medium range of brightness between the stars in the cluster
3 Cluster is composed of bright and faint stars

Number of Stars in the Cluster

p Poor clusters with less than 50 stars
m Medium rich cluster with 50-100 stars
r Rich clusters with over 100 stars

The Trumpler system denotes open clusters with any type of nebulosity (including light and dark nebula) with an "n" at the end of the classification. For example, a nebula surrounds the open cluster NGC 3293; therefore, the Trumpler classification for NGC 3293 is I3rn.


I
II
III
IV
r
NGC 6791
NGC 7789
NGC 6940
NGC 1817
m
NGC 436
NGC 7790
NGC 129
DoDz 9
p
NGC 7788
NGC 1807
NGC 7686
Stock 12

The AL Open Cluster Program

- Open clusters are of tremendous importance to the science of astronomy, if not to astrophysics and cosmology generally. Star clusters serve as the "laboratories" of astronomy, with stars now all at nearly the same distance and all created at essentially the same time. Each cluster thus is a running experiment, where we can observe the effects of composition, age, and environment. We are hobbled by seeing only a snapshot in time of each cluster, but taken collectively we can understand their evolution, and that of their included stars. These clusters are also important tracers of the Milky Way and other parent galaxies. They help us to understand their current structure and derive theories of the creation and evolution of galaxies. Just as importantly, starting from just the Hyades and the Pleiades, and then going to more distance clusters, open clusters serve to define the distance scale of the Milky Way, and from there all other galaxies and the entire universe.

The AL Open Cluster Program

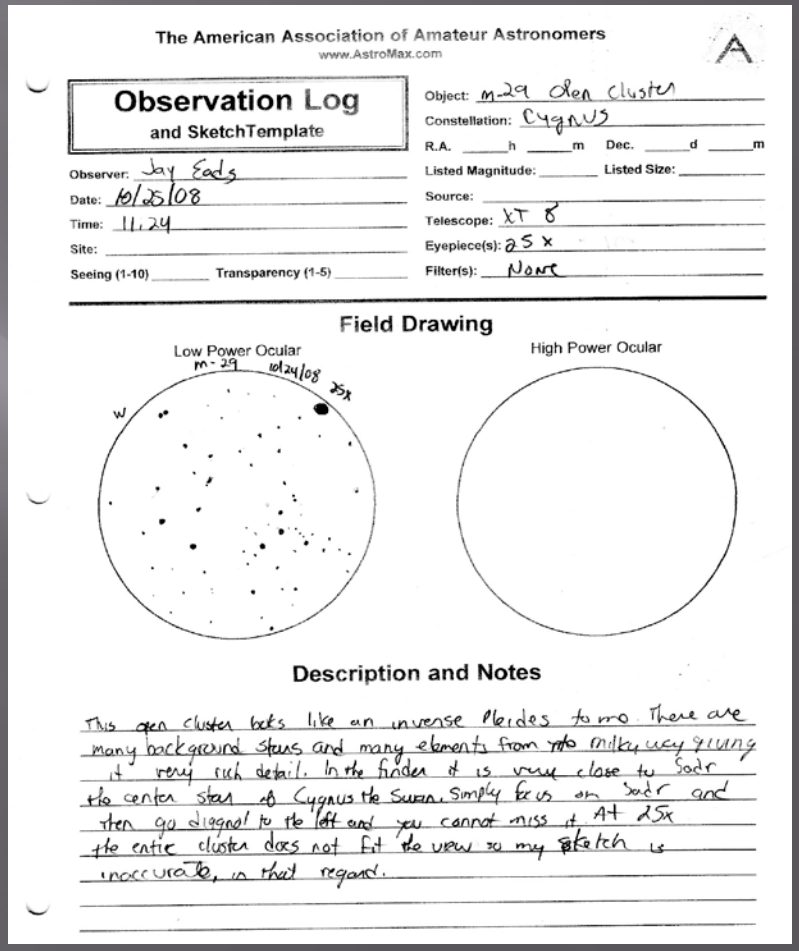
- The nature of this program is not just observation of the selected open clusters, but the ability to classify them based on the Trumpler classification system and the ability to sketch selected clusters. This, overall, enhances the observing experience and allows even the most advanced observer to find detail in these clusters that is normally overlooked.
- There are two levels of programs within the Open Cluster Observing Program, the Basic and Advanced programs. One must complete the Advanced Program to receive the lapel pin. Only the Advanced Program will be considered as a valid choice for the Master Observer Award.

The AL Open Cluster Program

- ***Basic Program:***
  - Observe any 100 of the 125 open clusters on the provided list.
  - Sketch any 25 of the 100 open clusters that you observe.
  - Classify all 100 observed clusters under the Trumpler classification system.
  - All observing techniques may be used under the basic program. Including go-to, computer controlled, star hopping, digital setting circles, etc.
- ***Advanced Program:***
  - Observe all 125 of the open clusters on the provided list
  - Sketch any 50 of the open clusters that you observe
  - Classify all 125 observed clusters under the Trumpler classification system
  - All observing techniques may be used under the advanced program. Including go-to, computer controlled, star hopping, digital setting circles, etc.

The AL Open Cluster Program

- **The Sketch:** The observer is also required to make a sketch of any 25 (the basic program) or 50 (the advanced program) clusters they observe. The sketch does not have to be a work of art, but it does need to accurately depict the cluster. Since open clusters are made of stars, a drawing of small dots in a pattern of the cluster is all that is needed.
- Because the goal of this program is to have the observer see the differences in the clusters, it is highly recommended that the same telescope and similar power be used for all of the clusters. By doing this, it will ensure that the differences that are seen are cluster differences and not power differences.



The American Association of Amateur Astronomers
www.AstroMax.com

Observation Log
and SketchTemplate

Observer: Jay Eads
Date: 10/25/08
Time: 11:24
Site:
Seeing (1-10) ____ Transparency (1-5) ____

Object: M-29 Open Cluster
Constellation: Cygnus
R.A. ____h ____m Dec. ____d ____m
Listed Magnitude: ____ Listed Size: ____
Source:
Telescope: XT 8
Eyepiece(s): 25 x
Filter(s): None

Field Drawing

Low Power Ocular
M-29 10/24/08 25x
W

High Power Ocular

Description and Notes

This open cluster looks like an inverse Pleides to me. There are many background stars and many elements from the milky way giving it very rich detail. In the finder it is very close to Sadr the center star of Cygnus the Swan. Simply focus on Sadr and then go diagonal to the left and you cannot miss it. At 25x the entire cluster does not fit the view so my sketch is inaccurate, in that regard.

The AL Open Cluster Program

- **Observations:** For each object, the observer is required to record the location, date & time, seeing, transparency, aperture, power, a brief description of the observed object, the Trumpler classification, and a sketch for any 25 (basic) or 50 (advanced) clusters from the list. This format follows that of most Astronomical League observing programs. If the format that you use is more detailed, just make sure that the basic requirements are recorded.