The Herschel Objects Project is Complete!

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It is **Done!**
As of May 13th, 2020, I have now completed observing all **2,482** identifiable objects of the Herschel 2500 Catalog.
My last catch was **'H II-840'** a pretty little one-arm galaxy - NGC3978 in the Great Bear - Ursa Major.

The idea for this 'Herschel Objects' project started back at the end of 2012, as I was wrapping up a Constellation survey based on the "*Night Sky Observers Handbook*". I realized that my observations would already include a large number of the Herschel-400 objects. So after identifying all the '400' objects that I had previously observed, it only took me less than a year to finish the 'Herschel 400' list. For this phase of the project, I utilized the Astronomical League's "*Herschel 400 by Constellation*" list and their "*Observe the Herschel Objects"* booklet. I then downloaded the AL's "*Herschel-II*" list of the next 400 objects and began hunting those.
By the fall of 2016, I was down to the last 60 objects and was wondering what my next project should be. Flipping thru some old "*Sky & Telescope*" magazines, I ran across an article from the August 2012 issue by Rod Mollise on observing the entire Herschel Catalog of 2500 objects using a deep-sky video camera. This was the inspiration (and project), that I needed, as I was already a videoastronomer, so I began a multi-year effort to observe the entire Herschel Catalog.

So today, we'll discuss what I've learned during that journey among the Herschel Objects. Hopefully, when we are done, you will find them as interesting to hunt as I do.

First, a little background on the Herschel's:
After the Messier List, the Herschel Object's are the next most observed deep-sky objects.
Most amateur astronomers know them by their NGC numbers, but they started out as a list created by British amateur astronomer William Herschel and his sister Caroline, two of the greatest astronomers from the 'Age of Enlightenment', which marked the birth of modern science.

The Herschel's were originally from Hanover Prussia, with William first moving to England to escape a French invasion during the 'Seven Years War'. There in England, William found employment as a music teacher and once settled in sent for his sister Caroline to join him there where she acquired a reputation of her own as a vocalist and singer.
During this time William became interested in astronomy and designed and built his own telescope, a 7" reflector, which he used to study the night sky and became a noted observer. For his discovery of the planet Uranus on March 13th, 1781, King George in 1782, knighted William Herschel as the "Kings Personal Astronomer" and William was given an annual pension. This allowed William to retire from music and devote himself fulltime to astronomy. Caroline later became the first woman to receive a salary for services to science when she was granted an annual pension by King George III for her work as William's assistant.

From 1782 to 1790, the Herschel's conducted systematic surveys of the night sky, in search of "deep sky" objects, and discovered over 2500. Herschel used two telescopes for his survey, a "20-foot Reflector", which had an 18.5" speculum-metal mirror, and later the great "40-foot Reflector" with a 48" mirror. Both telescope's mirrors were made by the Herschel's and had to be regularly polished, as the metal mirrors were quick to tarnish in the wet climate that England is noted for. When Herschel made the mirrors, he created two of each, one of which he kept polished and stored indoors, ready to be swapped out once the working mirror began to go bad. Then during the day, he would work on getting the swapped mirror re-polished while continuing his and Caroline's nightly observations with the fresh mirror. Most of Herschel's recorded observations were made using the '20-foot' telescope, as the larger '40-foot' was cumbersome to use and suffered from tube current distortions.

Herschel's telescopes didn't have clock drives to track the stars, so instead, he would point the telescope to the meridian and let the Earth's rotation carry objects across his field of view while he was up on a ladder observing. William would then call down to Caroline, at the bottom of the telescope, whenever he saw anything interesting, and she would write down his descriptions and time and where the telescope was pointing. Caroline would then quickly read this back to William and he would confirm the observation while the object was still in the eyepiece. This method allowed them to observe and record a nightly east-west strip of sky. The next day, the two of them would use their recorded observation to calculate the objects position on a star atlas. They would then move the telescope's elevation up or down, in preparation of the next nights survey run. Using this method, they were eventually able to observe all of the sky visible from England.

William Herschel published his deep-sky discoveries as three separate catalogues:

"Catalogue of One Thousand New Nebulae and Clusters of Stars", (1786)
"Catalogue of a Second Thousand New Nebulae and Clusters of Stars", (1789)
"Catalogue of 500 New Nebulae", (1802).

Herschel classified his list into eight categories:

Class I - Bright Nebulae:
This Herschel class tends to be objects of various sizes and shapes, such as galaxies, clusters, and nebula. But the one thing they all have in common is that they are very bright. These are the easiest Herschel Objects to observe.

Class II - Faint Nebulae:
This Herschel class tends to be objects that are generally faint, such as unresolved clusters and dim galaxies. You'll need fairly dark skies and a medium to large telescope.

Class III - Very Faint Nebulae:
This Herschel class tends to be made up of very, very faint objects, mostly galaxies. This class of objects will require a dark sky location, a large telescope, or video / CCD camera, and a bit of luck.

Class IV - Planetary Nebulae:
This Herschel class tends to be made up of objects that are actually planetary nebula, but you can find some emission nebula and galaxies mixed in.

Class V - Very Large Nebulae:
This Herschel class tends to consist of very large deep-sky objects. They may not necessarily be very bright. Depending on the object, you may need a dark-sky location, and a wide-field eyepiece.

Class VI - Very Compressed and Rich Clusters of Stars:
This Herschel class tends to be mostly bright resolvable globular clusters, and large open clusters with numerous members.

Class VII - Compressed Clusters of Small and Large Stars:
This Herschel class tends to be open clusters containing bright foreground stars, or cluster members with widely varying brightness.

Class VIII - Coarsely Scattered Clusters of Stars:
This Herschel class tends to be loose, somewhat dim open clusters. Best suited for wide-field eyepieces.

Within each of Herschel's categories, objects are numbered in the sequential date order by when they were discovered. So Herschel Object# **H VII-255** may have been discovered years before object# **H III-81**. In Herschel's time, the galaxies were considered to be all just nebula, so there is no separate class for them, and they are mixed among the first five classes.

William Herschel's discoveries of 2500 deep-sky objects were supplemented by those of Caroline Herschel (11 objects) and his son John Herschel's southern hemisphere South African observations (1754 objects), and published by John as the "*General Catalogue of Nebulae and Clusters"* in 1864. Eventually, this catalog of all the Herschel objects, along with discoveries from other 19th century astronomers were combined, revised, and renumbered by astronomer John Dreyer and published in 1888 as the "*New General Catalogue"* (abbreviated NGC) of 7840 deep sky objects.
So, for example, Herschel Object **'H IV-58'** a planetary nebula in the constellation of Cepheus, is known today as **NGC40**.

The Herschel's observing technique of surveying, cataloguing, and classifying what they found, and then using that data to try and understand the structure of the universe, has become one of the most important tools of modern astronomy.
If you would like to learn more about the Herschel's, there's a number of good books out there. A few of my favorites are:
"*The Georgian Star*" by Michael Lemonick, "*The Comet Sweeper*" by Clare Brock, and "*The Age of Wonder*" by Richard Holmes

How I accomplished the project:
So back in 2016, as I began a multi-year effort to observe the entire Herschel 2500 Catalog, the first thing I needed to do was come up with a list of the Herschel Objects! While during the process of William and Caroline Herschel's original recording and publishing of their observations from 1786 thru 1802, along with subsequent reprints and revisions over the 19th century, there have been a number of discrepancies over misidentified or non-existent objects. Depending on the source, of the Herschel's 2500 objects cataloged, there are anywhere from the low 2400's to over 2500 actual objects. Mark Bratton, in his book "*The Complete Guide to the Herschel Objects*", gives a good review of the issues and historical attempts to rectify Herschel's list of objects. He eventually settles on there being only 2,435 identifiable Herschel Objects. (I utilize his book's visual descriptions and DSS images to help in comparing and confirming my personal observations). In addition to the above book, I also utilized George Kepple & Glen Sanner's "*Night Sky Observers Guide Handbook*" and internet resources '*WIKISKY*' and '*The NGC/IC Project'* to validate my observations.

To help tackle this project, I downloaded several lists from various websites, and after combining, distilling, and sorting, I generated a personal spreadsheet/logbook to help in my tracking & logging. The core data for my logbook comes from a list of **2,482** Herschel Objects by Steve Gottlieb.

All of my Herschel Object observations can be found in their individual constellations in my website under my 'Constellation Tour' page. To see the entire list together, I've created a specific page for the Herschel Project: "Herschel Tour"
http://www.stellar-journeys.org/herschel-tour.htm

Over the course of this project, I have spent a total of 239 nights working my way thru observing all of the Herschel Objects. Even though I really didn't get serious about completing the list until 2012, my observations stretch all the way back to 1984. All of the early observations are visual sketches, (78 objects), made at the telescope eyepiece, with everything after 2001 using videoastronomy (EAA) short-exposure lucky imaging technique. I eventually used a total of ten different telescopes for this project. Six visually - 80mm f3.2 refractor, 8" f4.5 dob, 10" f5.6 dob, 13.1" f4.5 dob, and a 8" & 12" SCT at f10. The dobs and small refractor were manual telescopes, with the two SCT's being motorized, but all required using star-charts and star-hopping techniques to locate the objects.

For the videoastronomy observations, I used four telescopes - 50mm f3 refractor, 80mm f6 refractor, 6" RC at f9, f6.3 & f5, and a 8" SCT at f10, f6.3 & f3.3. All these telescopes were on either SCT or CGEM mounts that could track and later utilize GOTO. The cameras used were a StellaCam-EX (2.5 seconds exposure), StellaCam-II (8 seconds exp), a Samsung SDC435 (8 seconds exp), a peltier cooled, wireless controlled StellaCam-3 (unlimited exp), and finally a ZWO ASI294MC Pro camera used in EAA mode (generally for around 120 second exposure).

While I prefer going to dark sky locations, such as Pennsylvania's Cherry Springs State Park, for my observing, utilizing near-realtime deep-sky videoastronomy cameras has allowed me to pull in faint 14th magnitude plus galaxies not visually possible from my backyard observatory located within 10 miles of downtown Pittsburgh, PA. This greatly expanded the number of clear evenings available for working on this project.

So what are the ingredients to successfully observe Herschel Objects. While most Herschel Objects are faint small galaxies and can be challenging, this is what makes them interesting to find and attempt to visually see or capture an image of. Observing them visually requires being at a dark-sky location, maintaining dark-adaptation, use of good starcharts, and slow sweeping with a wide-field low-power eyepiece and a fast low focal-length telescope. An 80mm f6 or shorter refractor piggybacked on a 10” or greater telescope would work very well. The 80mm acts as a low-power RFT giving you a wide-field in which to find the Herschel Object and the larger telescope it is attached to allows use of higher magnifications, depending on the object. You’ll need all your visual observing skills to find and bring out some of these subtle objects. Many Herschel Objects are very faint, and depending on what size telescope you are using, may not be visible. But like any deep-sky object, half the fun is just successfully finding it and knowing what it is that you are observing. For the Imagers, some Herschel Objects can also be challenging due to their faintest, in that even with an accurate GOTO mount, it may not position the telescope squarely on the object to where it’s framed the way you want it. Having a photographic atlas or picture of the galaxy will help you in both locating and identifying the object and in framing your image. I’ve found that using short-exposure videoastronomy cameras works great in positioning and identifying Herschel Objects.

Having spent time over the past several years following in the Herschel’s tracks, you could begin to pick-up on how they were doing their observing run for that particular night back in the 1780’s, slowly letting the Earth’s rotation bring each object into their sweep. Using today’s modern equipment, there’s no need to wait; all you had to do was hop down the sweep path to the next observable object. When you think about that, it’s sort of inspiring to think that in your own way you are following in their footsteps!

In retrospect, I have learned a lot about the lives of William and Caroline Herschel, along with the objects that they discovered. While there are a number of nice large, bright objects including galaxies, star clusters, and nebula, the majority of Herschel's objects are small, faint, dim smudges of galaxies. It gives you an appreciation for the brighter Messier Objects. Still, there is a wide variety of shapes and sizes of interesting deep sky objects for any type of telescope. I now have a much greater respect for all those faint fuzzies and the work of the Herschel's! So I encourage everyone to get out tonight and try your hand at finding and observing the deep-sky objects of William and Caroline Herschel!!

Larry McHenry
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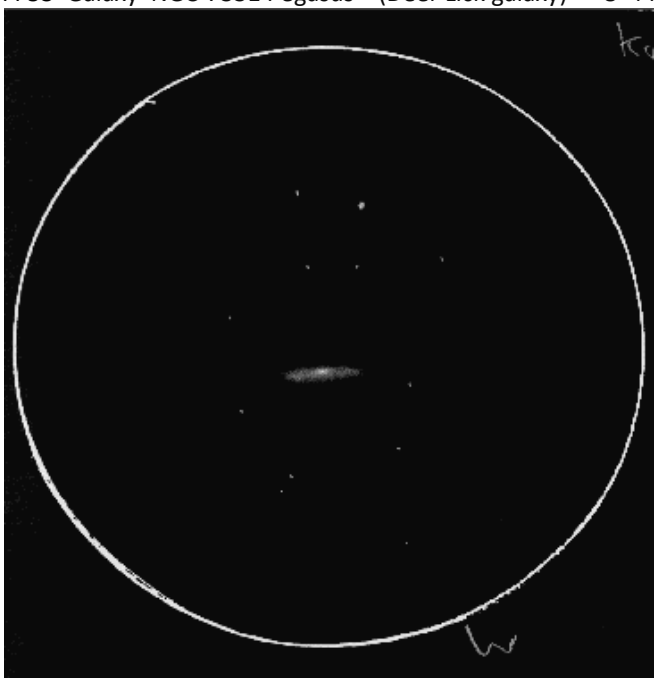
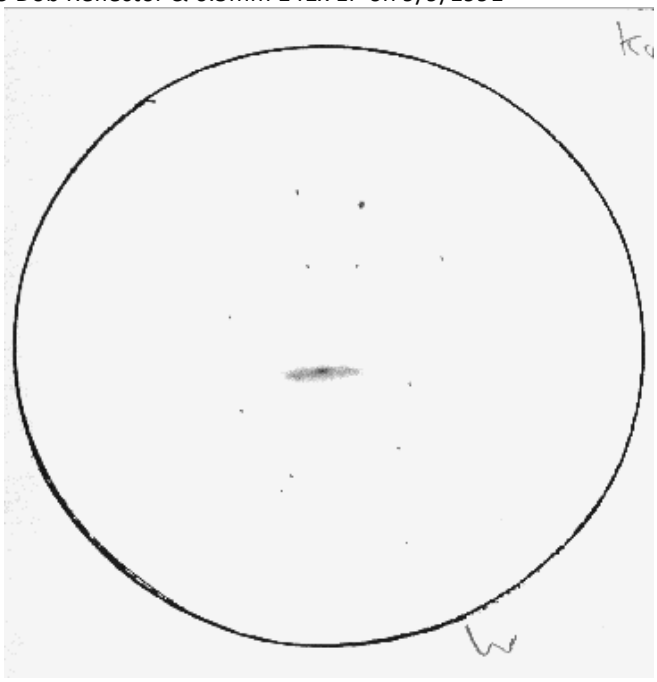
The Herschel Objects Project: Class Examples! - sketches and video-capture images

Below are original sketches and images that I have created as part of this project.
(included both negative and positive versions of each sketch)

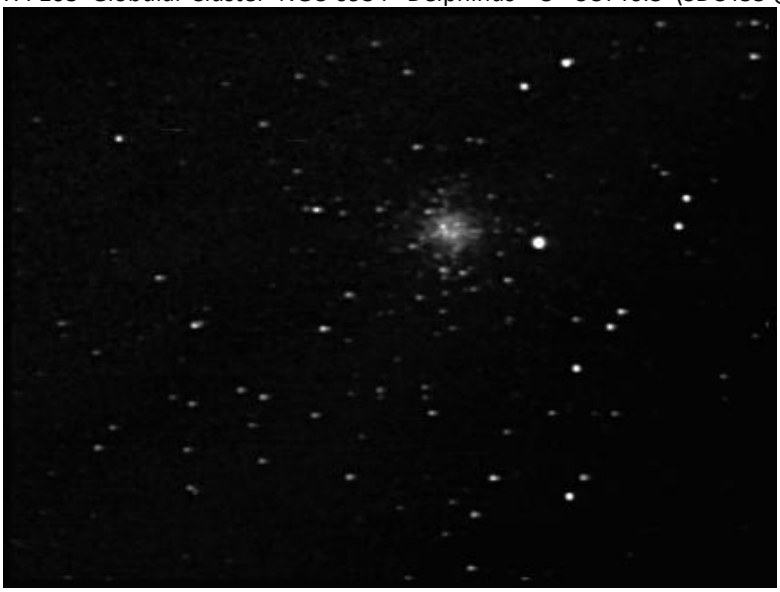
Class I Objects:

H I 53 Galaxy NGC-7331 Pegasus (Deer Lick galaxy) 8” f4.5 Dob Reflector & 6.5mm 141x EP on 9/9/1991





H I 103 Globular Cluster NGC-6934 Delphinus 8" SCT f6.3 (SDC435 @ 8 seconds) on 7/7/2010



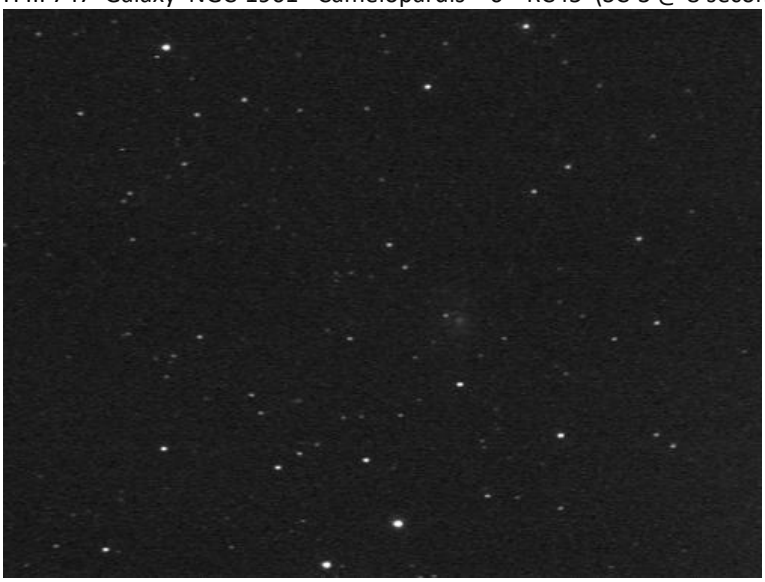
Class II Objects:

H II 707 Galaxy NGC-185 Cassiopeia 6" RC f5 (SC-3 @ 25 seconds) on 11/01/2013

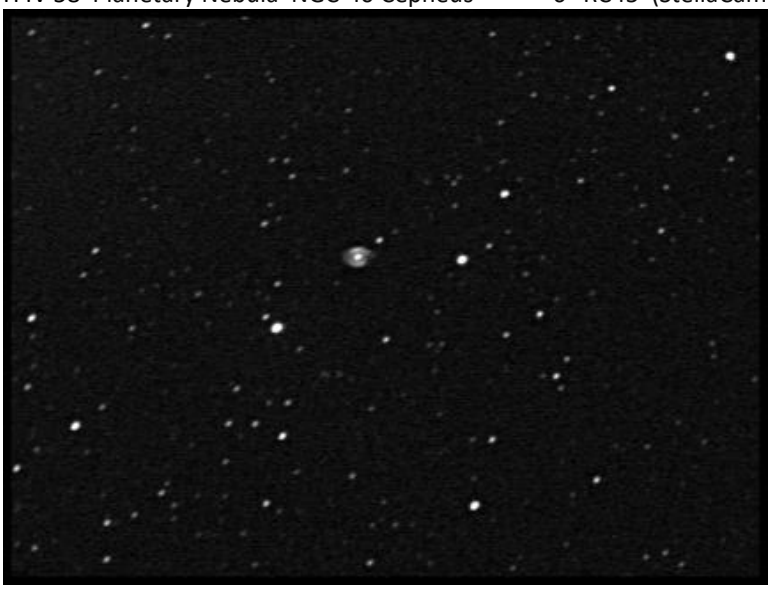
H II 195 Globular Cluster NGC-6287 Ophiuchus 8" SCT f6.3 (SC-3 @ 15 seconds) on 7/12/2012

Class III Objects:

H III 747 Galaxy NGC-1961 Camelopardis 6“ RC f5 (SC-3 @ 8 seconds) on 9/11/2012

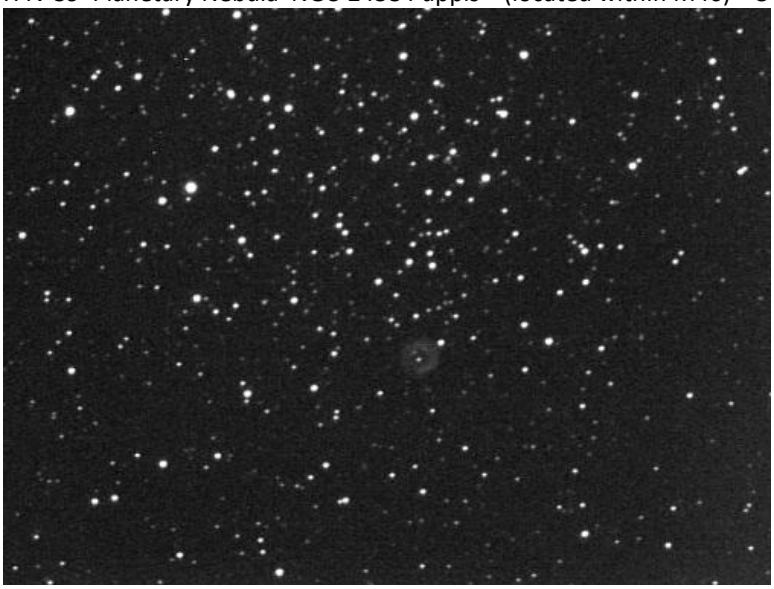


H IV 58 Planetary Nebula NGC-40 Cepheus 6“ RC f5 (StellaCam-3 @ 15 seconds) on 8/23/2011



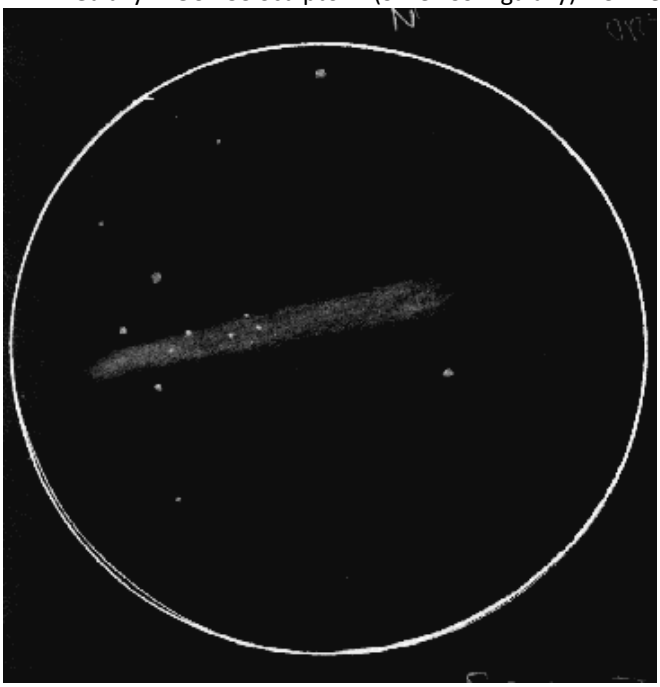
Class IV Objects:

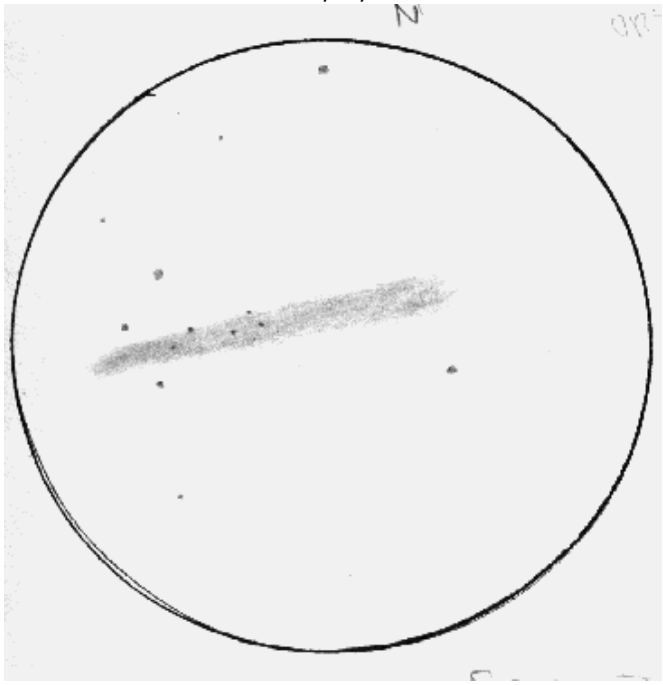
H IV 39 Planetary Nebula NGC-2438 Puppis (located within M46) 8" SCT f6.3 (SC-3 @ 20 seconds) on 2/26/2012



Class V Objects:

H V 1 Galaxy NGC-253 Sculptor (Silver Coin galaxy) 13" Reflector & 28 mm 41x EP on 11/30/1986



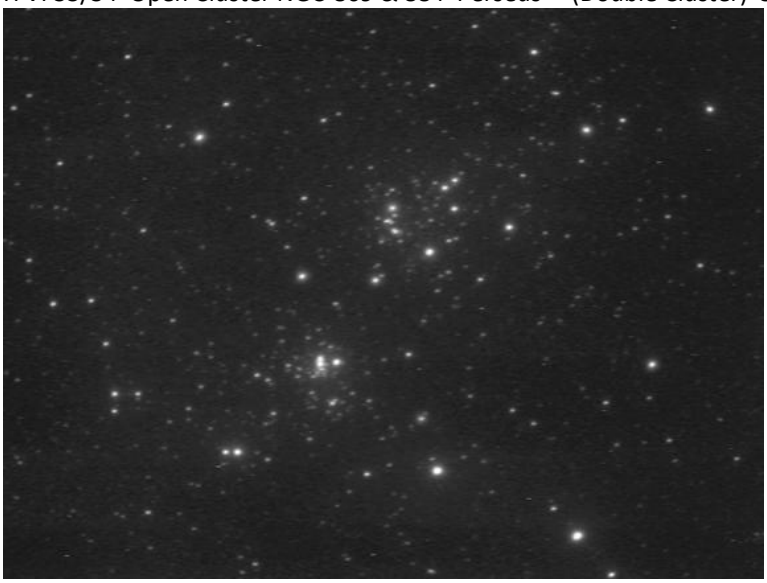


H V 19 Galaxy NGC-891 Andromeda 8” SCT f6.3 (SC-3 @ 45 seconds) on 10/08/2010

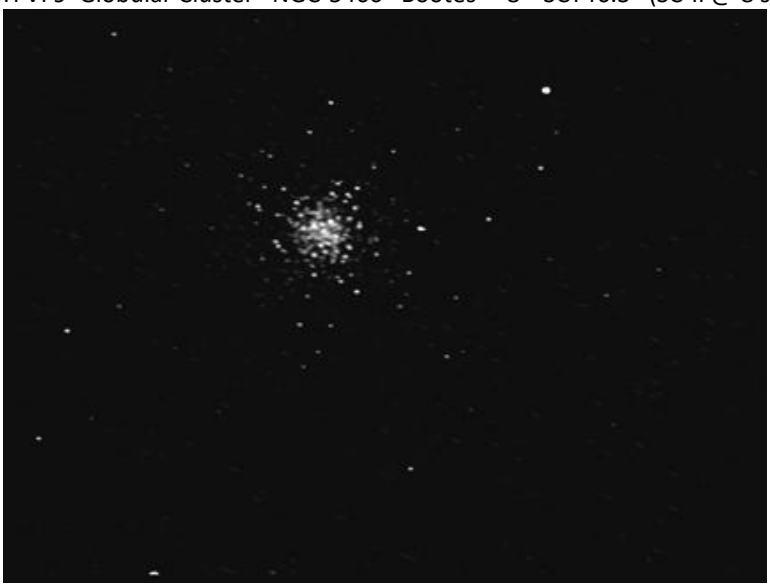
H V 28 Nebula NGC-2024 Orion (Flame Nebula) 6“ RC f5 (SC-3 @ 35 seconds) on 9/15/2012

Class VI Objects:

H VI 33/34 Open Cluster NGC-869 & 884 Perseus (Double Cluster) 50mm Refractor f3 (SC-II @ 8 seconds) on 11/10/2012

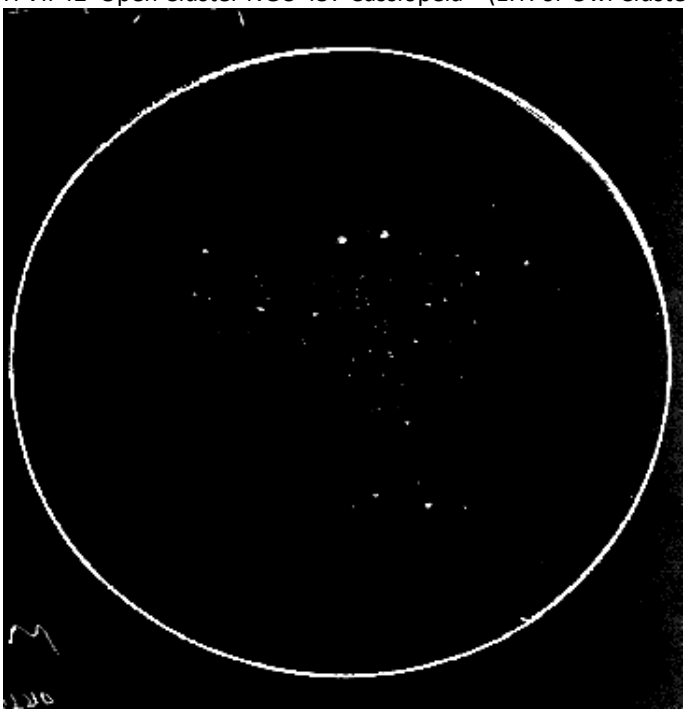


H VI 9 Globular Cluster NGC-5466 Bootes 8" SCT f6.3 (SC-II @ 8 seconds) on 7/06/2010

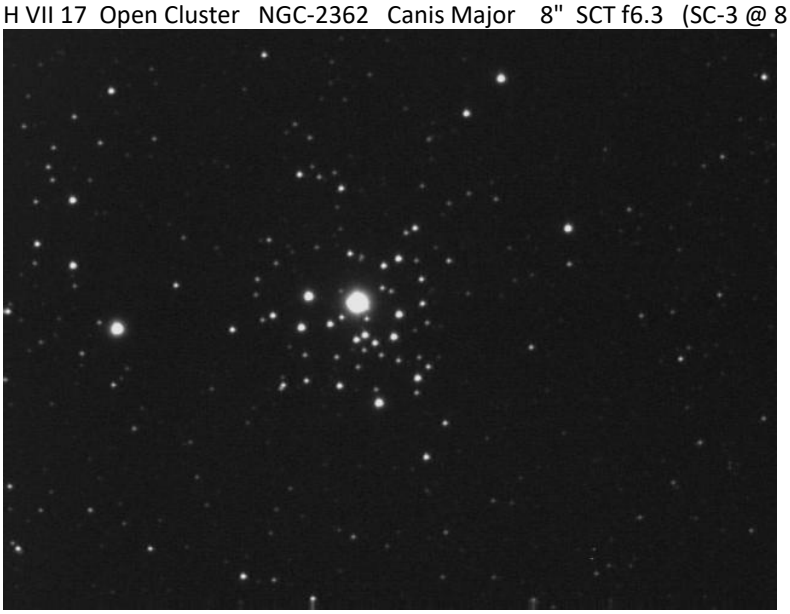


Class VII Objects:

H VII 42 Open Cluster NGC-457 Cassiopeia (E.T. or Owl Cluster) 13” Reflector & 28 mm 41x EP on 12/10/1987

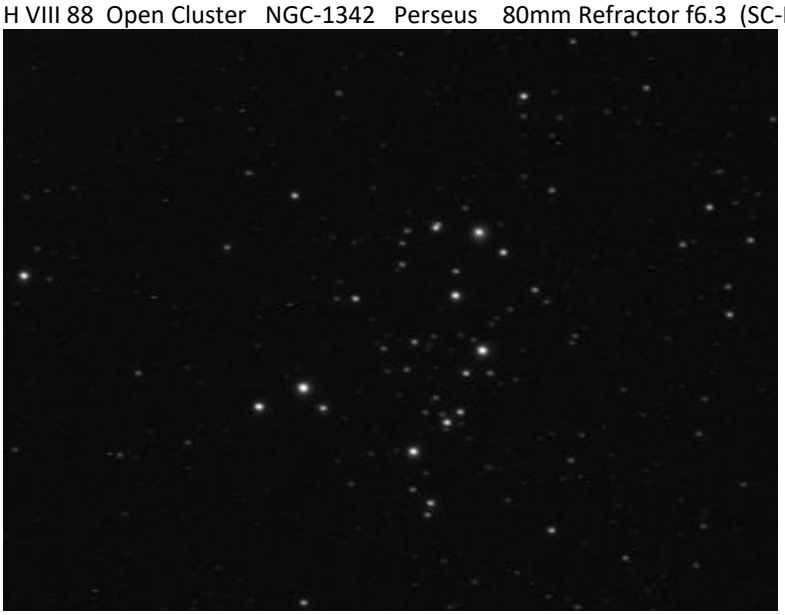


H VII 17 Open Cluster NGC-2362 Canis Major 8" SCT f6.3 (SC-3 @ 8 seconds) on 3/01/2011



Class VIII Objects:

H VIII 88 Open Cluster NGC-1342 Perseus 80mm Refractor f6.3 (SC-II @ 8 sec) on 10/08/2010



H VIII 56 Open Cluster NGC-6910 Cygnus 8" SCT f6.3 (SC-3 @ 8 seconds) on