Open Star Clusters

A Guide for the Open Star Cluster Observing Club

Astronomical League

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NGC 6520 (left) and B 86 (right)
Cover: M45
Courtesy of Russell Croman

A Selection of 125 Open Star Clusters

By
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Astronomical League

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References:
http://www.geocities.com/ariane1au/Page030.htm
Star Clusters by Brent A. Archinal and Steven J. Hynes, published by Willmann-Bell Publishing, 2003.

Pictures under the Trumpler Classification examples referenced to the Digital Sky Survey. The Digitized Sky Surveys were produced at the Space Telescope Science Institute under U.S. Government grant NAG W-2166. The images of these surveys are based on photographic data obtained using the Oschin Schmidt Telescope on Palomar Mountain and the UK Schmidt Telescope. The plates were processed into the present compressed digital form with the permission of these institutions.

Acknowledgements

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Sue French, Dr. Brent Archinal, John Wagoner, Mikkel Stein, Becky Ramotowski, and Michael Hotka.

I want to thank Russell Croman for providing permission to use his astrophotography in this program. Russell's pictures of M 45 (cover), NGC 6520, M11, and M46 add color to this manual. To see more of Russell's pictures, please visit his website at www.rc-astro.com

I want to personally thank Charlie Warren for his picture of the Double Cluster in Perseus and his picture of the M 35/NGC 2158 region which is the background for the logo and lapel pin.

I would also like to express my appreciation to Brent Archinal, Steven Hynes and Willmann-Bell for providing permission to use the right ascension, declination, magnitude, and cluster size data from the book *Star Clusters* for all of the objects in *Open Cluster Observing Program.*

Star Clusters is an excellent resource to build upon and expand your experience with the *Open Cluster Observing Program*. It is both a descriptive text of the historical study and astrophysics of some of the youngest (open clusters) and oldest (globular clusters) objects that populate the Universe along with the most up-to-date catalog of these objects in existence — an effort that took more than a decade to complete. It is the only book that definitively catalogs open star clusters, globular clusters, and asterisms. Star clusters have a history of multiple identifications. Overall 5,045 objects were matched against 13,949 different names using detailed observing logs and other historic sources. This information has been skillfully incorporated into the text making Star Clusters an observing handbook suitable for any body interested in these fascinating objects.
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For more information on this book or to purchase one for yourself, please go to Willmann-Bell's website at http://www.willbell.com

Lastly, I want to thank my grandmother Barbara Wilson for giving me the tools to see the universe and for her guidance when I needed it most. Without her help and support, this program couldn't have been made.

—Benjamin Jones

Preface

The Astronomical League has had observing programs or "clubs" for observing various types and classes of objects, starting with their venerable Messier Club in the mid 1960's. After an initial interest in astronomy, many an amateur became hooked while accepting the challenge of observing the objects in the Messier or other club lists. The League has thereby provided an invaluable service, generating and maintaining through these clubs and other programs an interest in astronomy, both in North America and for that matter worldwide. I myself recall with great fondness doing a Messier Marathon in March of 1980, which (along with some earlier observations of a few objects missed in the Marathon) qualified me for an honorary Messier Club certificate (no. 449 of 1980 May 2), and how that spurred me to continue observing.

What you hold here is the core material for a new club, the Open Clusters Observing Club of the Astronomical League. This club, organized by Benjamin Jones under the auspices of the League, once again highlights a significant class of astronomical objects.

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.

However, there is far more to the study of star clusters than that. Anyone who has looked at a cluster through a telescope or binoculars has realized that these are objects of immense beauty and symmetry. They have been revered not just in astronomy, but also in literature and poetry through the ages. Alfred, Lord Tennyson (1809-1892) wrote in *Locksley Hall* (1842) some of the most beautiful words regarding any star cluster:

Many a night I saw the Pleiads, rising thro' the mellow shade,
Glitter like a swarm of fire-flies tangled in a silver braid.

Whether a cluster like the Pleiades seen with delicate beauty with the unaided eye or in a small telescope or binoculars, or a cluster like NGC 7789 whose thousands of stars are seen with overpowering wonder in a large telescope, open clusters can only bring awe and amazement to the viewer.

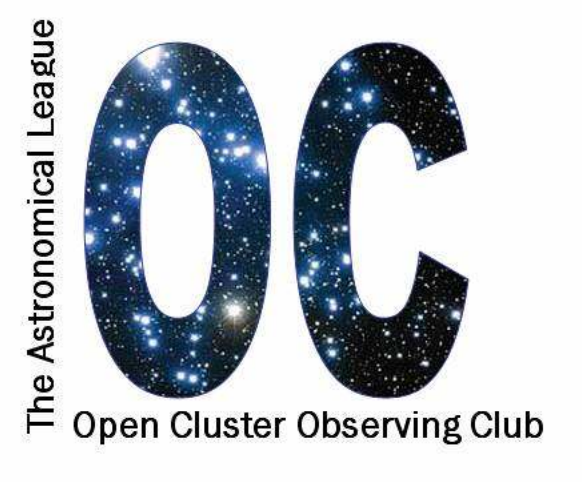
These sights are available to all. Whether a large or small telescope is used, whether one observes with only binoculars or the unaided eye, or whether one observes from a dark sky location or a light-polluted city, these clusters are there waiting on any clear night for us to take a look.

It is an honor to have been asked by Benjamin Jones to write this forward. Ben tells me that much of his reason for doing so is his reliance for data and other information on open clusters on the book *Star Clusters* (Willmann-Bell, Inc., Richmond, VA) by my co-author Steven Hynes and me. That book evolved from Steve's and my long interest as amateur astronomers in observing and understanding star clusters, and not incidentally from my interest in improving astronomical catalogs, particularly of clusters. We provided general information and history on the subject of star clusters and as best we could a summary of the current state of the field of study. We also provided what we believe to be the most extensive and accurate catalog of star clusters ever created. Not only did we check the identifications and positions – and in a large number of cases other data – for all the included objects, but an integral part of that catalog is a substantial set of notes on various objects of interest. We covered the details of a wide sample of objects of astrophysical interest. We also corrected and covered the identification of hundreds of clusters. Many of the object notes are perhaps best described as detective stories as each ambiguous or incorrect identity was tracked down.

There is always more to do of course. Although we believe our work summarized the state of current research on star clusters and fundamentally improved the identification and positional information for clusters, further minor improvements can always be made. New theories remain to be written and fundamental physical data can always be improved on – or even collected for the first time in the case of some clusters. Perhaps you, the reader, may someday use the information we have provided in order to extend our knowledge of these objects even further. Perhaps you will provide new information with your own images or other measurements, or make some fundamental discovery like an interesting previously unknown asterism or a new physical cluster. However, the real objective, the ultimate goal of our book – and I now believe this League observing club – is to lead you and others to have an interest in and to observe these marvels, these spectacular wonders of the night sky.

Brent A. Archinal
Flagstaff, Arizona
2005 May 31

Observing Club Guidelines



The Open Cluster Observing Program is open to any Astronomical League member in good standing, either through an affiliated club or through a Member-at-Large membership.

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 types of programs within the Open Cluster Observing Club:

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.

Those completing the Basic Program who want to move up to the Advanced Program must observe an additional 25 open clusters that were not observed under the Basic Program. Furthermore, the observer must sketch an additional 25 open clusters that had not been previously sketched to qualify for the Basic Program.

The Trumpler Classification System: The observer will be required to classify all of the open clusters observed in this program under the Trumpler classification system. Examples of some of the official Trumpler classifications are given on page 6. By classifying all of the open clusters, the observer will be developing a better understanding of their differences and appearances.

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.

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; a sample is on page 11. 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 like they are on page 11.

Awards: Once you have met the above requirements, send in your observing logs, program completed (basic or advanced), name, address, email, affiliation (club association or member-at-large), and phone number to the administrator of this club. Your Astronomical League Awards representative may send in your logs to the administrator as well. Make sure you send copies of your logs and not originals because the administrator of this club ***will not*** mail back your logs.

The administrator of this club will mail the observer a certificate, letter, and lapel pin when the basic or advanced program has been completed, unless the observer requests that the award be mailed to the Awards Coordinator of their club for presentation at a club meeting.

The individuals completing the advanced program will receive special recognition on their certificate.

Furthermore, only the Advanced Program awards will count toward the Master Observer Award. Keep this in mind when picking what to observe.

Observers completing either the Basic Program or Advanced Program using only star-hopping techniques should indicate so in their letter to the program coordinator. These individuals will receive special recognition on their certificate and cover letter.

History & Description of Open Clusters

For centuries our ancestors looked at the heavens with a great familiarity of the night sky. The Milky Way streaming across the sky, with little patches of loosely connected stars dotting the scene. As ancient societies observed more, and integrated their knowledge of the heavens into their culture and mythology, the patches of light where given names; the Pleiades in Taurus, Praesepe in Cancer, the Hyades in Taurus, and the glorious Double Cluster in Perseus. These names became stories, folklore, to be passed down from generation to generation.

The Double Cluster in Perseus
Courtesy of Charlie Warren

With the advent of the telescope around 1608, the shroud of mystery around these patches of light began to unravel. Galileo Galilei (1564-1642) may have been the first to observe open star clusters through a telescope, believing that every nebula in the sky could be resolved into individual stars. In his opinion, the galaxy can be resolved into stars grouped together in many clusters. For about 200 years this theory of the galaxy stood, until William Herschel proved it wrong when he was unable to resolve the apparent central star of NGC 1514.

Charles Messier (1730-1817) in his revolutionary catalog, recorded many of the open star clusters that had been unknown for so long. Out of the 30 open clusters that Messier recorded in his catalog, 8 or more were discovered by Messier himself. When William Herschel (1738-1822) received a copy of Messier's published catalog, he began a search of his own. Herschel, who discovered some 2300 new objects, hypothesized on the astrophysics of open star clusters. His rationale was that open clusters were made of similarly massive stars that attracted each other when in close proximity. Even if his theory was not correct, he was the first person to base his idea on observation of the objects.

Today, the most complete catalog of open clusters is the 5th Edition of the *Lund Catalogue of Open Cluster Data*, which contains information on over 1100 objects. It is estimated that the Milky Way galaxy contains 40,000 open clusters.

As information on open clusters increased, classifying them became a priority. One of the earliest classification systems was developed by Harlow Shapley in 1930; it had seven components:

a. **Field Irregularities:** This class deals with irregular star counts and associations. They differed than the normal distribution of stars, being more closely concentrated yet not enough to be studied.
b. **Star Associations:** This category contains clusters that have distantly spaced stars sharing the same motion. The Ursa Major group is a member of this class.
c. **Very Loose and Irregular Clusters:** These are very large and scattered clusters. Examples of this class include the Pleiades and Hyades clusters, and the alpha Persei group.
d. **Loose Clusters:** These clusters have very small amounts of stars and appear loose. Shapley gave M21 and M34 as examples of this type.
e. **Intermediate Rich and Concentrated:** These clusters are more compact and concentrated; M38 is in this class.
f. **Fairly Rich and Concentrated:** This group is a compact as the *e* group, yet with more stars; M37 falls in this group.
g. **Considerably Rich and Concentrated:** This group is similarly compact as group *f*, yet contains more stars; the Jewel Box (NGC 4755) is in this class.

Shapley immediately found that his classification system was not complete because it was dependent on stellar density and distance of the group. With this knowledge he further divided the group into the color of the stars in the cluster. The Pleiades type, where the stars where mainly Main Sequence, and the Hyades type, where the stars were older yellow and red spectra. Even with the later addition, the Shapley classification system has fallen out of favor because of the astrophysical limitations; it is dependent on density and concentration.

Robert J. Trumpler devised a classification system that has stood the test of time. It is superior to many of the prior classification systems because it incorporates specific features of an open cluster. Trumpler classified the clusters based on criteria that were independent of distance. By taking into account the independent features of the cluster, he was able to more accurately asses the nature of the cluster. This advantage of the Trumpler system over the others makes it the most widely used classification system; in this program, the Trumpler system of classification will be used.

Today, astronomers have an excellent grasp on the origins and astrophysics of open clusters. The main commonality shared by all open clusters is their gravitational attraction; stars in open clusters gravitationally attract each other thus holding the stars within close proximity. In order to explain the mutual attraction, it has been concluded that open clusters are born in nebulae and are thus not formed independently, but in vast numbers where they concentrate into open clusters. The mystery that still surrounds open clusters involves their demise. Astronomers are eager to learn if external forces, from a nearby galaxy or star, influence the dynamics of the clusters and if so, what happens.

Trumpler Classification System

In order to complete this program, the observer must classify the selected open clusters based on the Trumpler classification system. This system is the most widely used and accepted classification of open clusters because it independently assesses the nature of the cluster. Trumpler identified three features in an open 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.

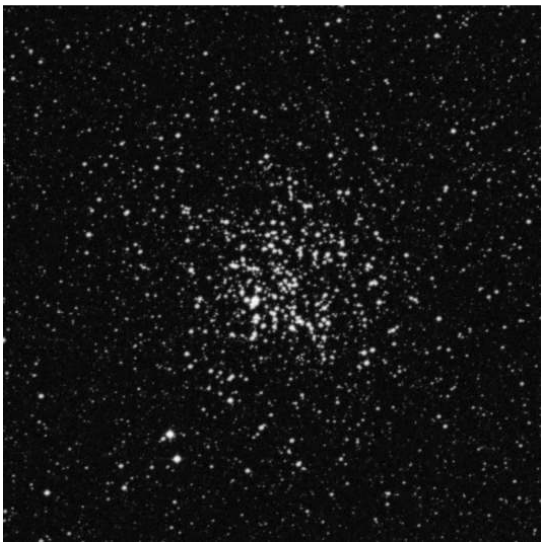
Number of Stars in Cluster

- **p.** Poor clusters with less than 50 (fifty) stars.
- **m.** Medium rich cluster with 50-100 stars.
- **r.** Rich clusters with over 100 stars.

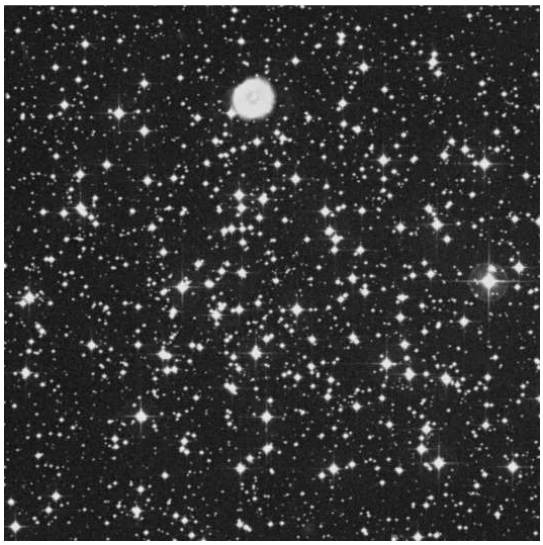
Some open clusters may be in, or are surrounded by nebulosity. Trumpler denoted open clusters with any type of nebulosity (including light and dark nebula) with an "n" at the end of the classification. For example, the official classification for NGC 3293 is I 3 r n because it is imbedded in a nebula. If you find that any of the selected clusters in this program are in or around nebula, denote that in your classification of the cluster.

Since this requirement is needed to complete the program, previous observations of open clusters in this program will not be accepted, unless you classified the cluster under the Trumpler system with you first observed it. If you have already observed all of the open clusters in this program, than you just need to go back and classify the cluster and make a sketch of any 25 of the 125 selected objects.

Examples of Trumpler Classifications



M11
Class: I 2 r



M46
Class: II 2 r

NGC 6664
Class: III 2 m

NGC 6568
Class: IV 1 m

Open Cluster Catalogs

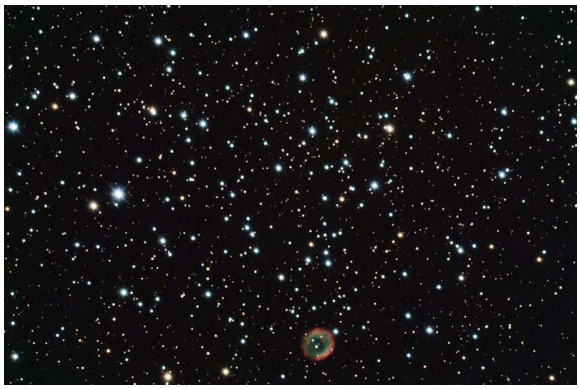
Most of the catalogs used in this program are more obscure than the NGC and IC catalogs. However obscure these catalogs are, they contain many wonderful objects that are visible in the smallest of telescopes. One of the goals of this program is to make the observer aware of the many different catalogs that contain open clusters; not the familiar Messier, Herschel, IC, and even NGC. By observing out of unfamiliar catalogs, the observer will see clusters that are generally overlooked because of their unfamiliar catalog names.

Catalogs Used in This Program

Abbreviation	Catalog Name
None	King
None	Dolidze
None	Stock
None	Biurakan
None	Harvard
None	French
None	Tombaugh
Berk	Berkeley
Tr	Trumpler
Cr	Collinder
NGC	New General Catalogue
IC	Index Catalogue
Ru	Ruprecht
Mel	Melotte
Steph	Stephenson
DoDz	Dolidze Dzimselejsvili
M	Messier

Messier 11

Courtesy of R. Croman



Messier 46

Courtesy of R. Croman

125 Selected Objects

Catalogue Name	Other Name	RA (2000)	Dec (2000)	Con	V-mag	Size (′)[1]	U1[2]	U2[3]
Berk 58		00 00 12	+60 56.5	Cas	9.7	5.0	35	18
Berk 59		00 02 10	+67 25.2	Cep	?	10.0	15	8
King 13		00 10 10	+61 11.0	Cas	?	5.0	15	18
Berk 2		00 25 15	+60 23.3	Cas	?	2.0	35	18
King 14		00 31.9	+63 10	Cas	8.5	7.0	15	8
NGC 225	Caroline's Cluster	00 43 36	+61 46.0	Cas	7.0	15.0	16	18
King 16		00 43.7	+64 11	Cas	10.3	5.0	16	8
NGC 188		00 47 30	+85 14.5	Cep	8.1	15.0	1	1
NGC 581	M103	01 33 22	+60 39.5	Cas	7.4	6.0	37	29
Tr 1	Cr 15	01 35 40	+61 17.2	Cas	8.1	3.0	16	29
Cr 463		01 45 45	+71 48.6	Cas	5.7	57.0	16	17
Stock 4		01 52.7	+57 04	Per	?	12.0	37	29
Cr 26	IC 1805	02 32 42	+61 27.4	Cas	6.5	20.0	17	29
Tr 2	Cr 29	02 36 53	+55 54.9	Per	5.9	17.0	38	29
NGC 1027		02 42 36	+61 35.7	Cas	6.7	15.0	17	29
DODZ 1	Do-Dzim 1	02 47 27	+17 15.3	Ari	7.1	7.5	130	99
IC 1848		02 51 11	+60 24.1	Cas	6.5	18.0	38	29
Cr 34		02 59 23.2	+60 34 00	Cas	6.8	24.0	38	29
Tr 3	Cr 36	03 12 00	+63 11	Cas	7.0	15.0	18	17
Stock 23	Pazmino's Cluster	03 16 10.8	+60 06 56	Cam?	?	29.0	38	28
NGC 1342		03 31 40	+37 22.5	Per	6.7	17.0	94	60
IC 348		03 44 34	+32 09.8	Per	7.3	8.0	95	60
Tombaugh 5		03 47 44	+59 05.4	Cam	8.4	15.0	39	28
NGC 1444		03 49 27	+52 39.3	Per	6.6	4.0	39	28
King 7		03 59 10	+51 46.8	Per	?	8.0	39	28
NGC 1496		04 04 32	+52 39.7	Per	9.6	3.0	39	28
NGC 1502		04 07 50	+62 19.9	Cam	6.9	20.0	18	28
NGC 1662		04 48 29	+10 55.8	Ori	6.4	12.0	179	97
NGC 1746		05 03.6	+23 49	Tau	6.1	40.0	134	77
NGC 1807		05 10 46	+16 30.8	Tau	7.0	12.0	180	97
NGC 1798		05 11 40	+47 41.7	Aur	10	5.0	65	42
NGC 1893		05 22 46	+33 25.2	Aur	7.5	25.0	97	59
NGC 1912	M38	05 28 43	+35 51.3	Aur	6.4	15.0	97	59
DODZ 3	Do-Dzim 3	05 33.5	+26 31	Tau	?	10.0	135	77
Cr 69	Lambda Ori Cluster	05 35.0	+09 56	Ori	2.8	70.0	180	96
NGC 1981		05 35.2	-04 26	Ori	4.2	28.0	225	116
DODZ 4	Do-Dzim 4	05 35.9	+25 57	Tau	?	25.0	135	77
NGC 2141		06 02 56	+10 26.8	Ori	9.4	10.0	181	96
NGC 2158		06 07 26	+24 05.8	Gem	8.6	5.0	136	76
NGC 2169		06 08 25	+13 57.9	Ori	5.9	6.0	182	96
NGC 2232		06 27 15	-04 45.5	Mon	4.2	53.0	227	99
NGC 2244		06 32 19	+04 51.4	Mon	4.8	30.0	227	116
Ru 1		06 36.4	-14 09	CMa	?	6.0	272	135

Catalogue Name	Other Name	RA (2000)	Dec (2000)	Con	V-mag	Size (′)	U1	U2
Ru 3		06 42 06	-29 27.2	CMa	?	3.0	360	154
Biurakan 9	Berk 30	06 57 46	+03 13.7	Mon	?	3.0	228	115
Ru 7		06 57 50	-13 13.2	CMa	?	3.0	273	135
NGC 2353		07 14 31	-10 16.0	Mon	7.1	18.0	274	135
Tr 6	Cr 145	07 26 23	-24 12.7	CMa	10.0	6.0	319	153
Tr 7	Cr 146	07 27 21	-23 58.0	Pup?	7.9	5.0	319	153
NGC 2422	M47	07 36 36	-14 29.0	Pup	4.4	25.0	274	135
Mel 71	Cr 155	07 37 30	-12 03.1	Pup	7.1	8.0	274	135
NGC 2439		07 40 46	-31 41.5	Pup	6.9	9.0	362	171
NGC 2453		07 47 35	-27 11.7	Pup	8.3	4.0	320	153
Tr 9	Cr 168	07 55 40	-25 53.2	Pup	8.7	6.0	320	153
NGC 2548	M48	08 13 44	-05 45.0	Hya	5.8	30.0	275	134
NGC 2632	M44	08 40 22	+19 40.2	Cnc	3.1	70.0	141	74
NGC 2682	M67	08 51 24	+11 49	Cnc	6.9	25.0	187	94
Dolidze 27		16 36.5	-08 56	Oph	?	25.0	291	127
Tr 26	Cr 331	17 28 29.9	-29 29 50	Oph	9.5	7.0	376	146
Cr 333		17 31 31.3	-34 00 37	Sco	9.8	8.0	376	164
NGC 6383		17 34 42.2	-32 34 54	Sco	5.5	20.0	376	164
Tr 27	Cr 336	17 36 12.7	-33 29 19	Sco	6.7	7.0	376	164
Tr 28	Cr 337	17 36 59	-32 28.4	Sco	7.7	6.0	376	164
NGC 6416		17 44.3	-32 21	Sco	5.7	15.0	377	164
Cr 347		17 46 18.9	-29 20 09	Sgr	8.8	10.0	377	146
IC 4665		17 46.2	+05 43	Oph	4.2	70.0	203	86
NGC 6475	M7	17 53 46	-34 47.1	Sco	3.3	75.0	377	164
NGC 6520		18 03 25	-27 53.5	Sgr	7.6	5.0	339	145
NGC 6530	NGC 6523	18 04 25	-24 23.2	Sgr	4.6	15.0	339	145
DODZ 9	Do-Dzim 9	18 08.8	+31 32	Her	?	28.0	116	49
Tr 32		18 17 10.4	-13 20 39	Ser	12.2	12.0	294	126
NGC 6604		18 18.1	-12 13	Ser	6.5	6.0	294	126
Tr 33	Cr 378	18 24 38.8	-19 43 57	Sgr	7.8	6.0	340	145
NGC 6649		18 33 28.3	-10 24 08	Sct	8.9	6.0	295	126
Tr 35	Cr 388	18 43 00.5	-04 13 31	Sct	9.2	6.0	250	105
NGC 6694	M26	18 45 15	-09 23.1	Sct	8.0	10.0	295	125
NGC 6705	M11	18 51 04	-06 16.2	Sct	5.8	11.0	295	125
NGC 6709		18 51.5	+10 20	Aql	6.7	15.0	205	85
Ru 146		18 52 30	-21 04.9	Sgr	?	4.0	340	145
Berk 80		18 54 20.6	-01 13 12	Aql	?	3.0	250	105
Steph 1		18 54 30.6	+36 53 59	Lyr	3.8	40.0	117	49
NGC 6716		18 54 34	-19 54.5	Sgr	7.5	10.0	340	145
Berk 82		19 11 20.3	+13 06 42	Aql	?	2.5	206	85
NGC 6774		19 16.3	-16 19.5	Sgr	?	45.0	296	125
NGC 6791		19 20 52.7	+37 46 27	Lyr	9.5	10.0	118	48
NGC 6793		19 23 12.6	+22 09 27	Vul	?	7.0	161	66
King 25		19 24.5	+13 42	Aql	?	5.0	206	85
NGC 6800		19 27 00	+25 05.6	Vul	?	5.0	161	66
Berk 47		19 28 27.3	+17 21 57	Sge	?	3.0	162	85
NGC 6811		19 37 09.6	+46 22 32	Cyg	6.8	15.0	84	33

Catalogue Name	Other Name	RA (2000)	Dec (2000)	Con	V-mag	Size (′)	U1	U2
Cr 401		19 38 21.7	+00 20 43	Aql	7.0	1.0	252	105
NGC 6819		19 41.3	+40 11	Cyg	7.3	5.0	84	48
NGC 6823		19 43 10	+23 18.0	Vul	7.1	7.0	162	66
Harvard 20		19 53 10.3	+18 21 24	Sge	7.7	8.0	162	66
NGC 6871		20 06 27	+35 47.4	Cyg	5.2	30.0	119	48
Biurakan 2		20 09 14.3	+35 29 03	Cyg	6.3	20.0	119	48
NGC 6885	NGC 6882	20 12 01	+26 28.7	Vul	?	20.0	163	66
IC 4996		20 16 31.7	+37 38 35	Cyg	7.3	7.0	119	48
Berk 85		20 18 47	+37 45.3	Cyg	?	6.0	119	48
Berk 86		20 20 21.2	+38 42 01	Cyg	7.9	7.0	120	48
Berk 87		20 21 35	+37 23.5	Cyg	?	10.0	120	48
NGC 6910		20 23 12	+40 46.7	Cyg	7.4	10.0	84	32
Cr 421		20 23.3	+41 42	Cyg	10.1	8.0	84	32
Dolidze 9		20 25 33.4	+41 54 25	Cyg	?	3.0	85	32
Berk 90		20 35 16	+46 50.7	Cyg	?	3.0	85	32
French 1		21 07 22	+16 17.9	Del	?	13.0	210	83
IC 1369		21 12 07	+47 46.0	Cyg	8.8	5.0	86	32
Berk 55		21 16 57	+51 45.5	Cyg	?	5.0	56	19
NGC 7063		21 24.5	+36 30	Cyg	7.0	9.0	121	47
IC 1396		21 39.0	+57 30	Cep	3.5	90.0	57	19
NGC 7142		21 45 09	+65 46.5	Cep	9.3	12.0	33	9
NGC 7209		22 05 08	+46 29.0	Lac	7.7	15.0	87	31
IC 1434		22 10.5	+52 50	Lac	9.0	7.0	57	19
NGC 7235		22 12 24	+57 16.4	Cep	7.7	6.0	57	19
King 9		22 15 31	+54 24.6	Lac	?	3.0	57	19
Berk 94		22 22 53	+55 52.5	Cep	8.7	3.0	57	19
Berk 96		22 29 51.2	+55 24 22	Lac	?	2.0	57	19
King 18		22 52 08	+58 18.7	Cep	?	5.0	58	19
NGC 7423		22 55 06.5	+57 05 41	Cep	?	5.0	58	19
King 10		22 55.0	+59 10	Cep	?	4.0	58	19
King 19		23 08.3	+60 31	Cep	9.2	5.0	58	18
NGC 7510		23 11 04.2	+60 34 08	Cep	7.9	7.0	58	18
NGC 7686		23 30 07	+49 08.0	And	5.6	15.0	88	30
King 21		23 49.9	+62 42	Cas	9.6	4.0	15	8
King 12		23 53.0	+61 57	Cas	9.0	3.0	15	18

[1] Diameter is in arcminutes minutes
[2] Number refers to page number in Uranometria 2000.0 1st Edition
[3] Number refers to page number in Uranometria 2000.0 2nd Edition

Observation Log

Location:_____

Catalog and Number:_____

Date:_____

Time:_____

Seeing Conditions:_____

Transparency:_____

Aperture size of Telescope:_____

Power Used:_____

Estimated Trumpler Class:_____

Description:_____

_____

_____

Drawing