Mike Inglis

Observer's Guide to Star Clusters

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Mike Inglis

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Dedication

For Arfur, Bynxie, and Charlie

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Martin Mobberly (UK)
Jim Mullaney (USA)

Thank you everyone!

Long Island, USA Mike Inglis

About the Author

Dr. Mike Inglis was born in Wales in the UK, but lives and works in the USA, where he is Professor of Astronomy and Astrophysics at the State University of New York. He is a Fellow of the Royal Astronomical Society, A NASA Solar System Ambassador, a Member of the American Astronomical Society, a Member of the Royal Institution, and a Member of the British Astronomical Association. He is the author of many books and research papers including Field Guide to Deep Sky Objects (Springer, 2012, 2nd Edition), An Observer's Guide to Stellar Evolution (Springer, 2003), Astronomy of the Milky Way, Vol. I and II (Springer, 2004), and Astrophysics is Easy (Springer, 2007). He is a Series Editor of several Springer book series for both amateur and professional astronomers. Although a professional astronomer, he is also a lifelong amateur astronomer, and observes the night sky, around the world whenever time, and the sky, permit.

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Introduction to Star Clusters

Rationale Behind the Guide

Star clusters are among the most intriguing, amazing, and beautiful objects in the night sky. They can be young or old, large or small, bright or faint, and so on. But what is important, as they relate to this guide, is that seen in a telescope (or binoculars, or even the naked eye), they can be glorious, with a dazzling array of colors, brightnesses, and even shapes with arcs and streams, wisps of nebulosity, and dark dust lanes, making them literally breathtaking.

This guide was written with a specific type of observer in mind. This person tends to live in an urban or semi-urban environment, that is to say, light pollution will be an ever-present evil, but the observer may be able to go, from time to time, to a dark location and observe the night sky in all its glory. The person will most probably work during the day for a living, and so all-night observing sessions will be rare, with most observing taking place on weekends.

Bearing in mind the constraints of the preceding paragraph, the clusters in this guide were chosen so that nearly all observers can observe them with a variety of telescopes. These can range from small apertures (3–6 in.), moderate apertures (6–8 in.) and larger apertures[1] (8–10 in.), while some of the brighter clusters are binocular objects, and a few are naked eye. Many of the clusters will be familiar, but I have attempted to include some that are often ignored or passed over, or even, in a few instances, largely unknown to the amateur astronomy community.

Before I discuss the layout of the guide, observing techniques, and cluster classification, it is worth spending a short time discussing just what star clusters really are.

[1]The number of clusters that can be seen in very large telescopes is astounding. Literally hundreds more will be available. And if you live in the southern hemisphere, then the number of clusters is vast, due to the Large and Small Magellanic Clouds.

M. Inglis, *Observer's Guide to Star Clusters*, The Patrick Moore Practical Astronomy Series,
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Open Clusters

Open clusters, or *galactic clusters* as they are sometimes called, are collections of young stars containing anywhere from a dozen members to hundreds. A few of them (for example, *Messier 11* in Scutum) contain an impressive number of stars, equaling that of globular clusters, while others seem little more than a faint grouping set against the background star field. Such is the variety of open clusters that they come in all shapes and sizes. Several are over a degree in size, and their full impact can only be appreciated by using binoculars, as a telescope has too narrow a field of view. An example of such a large cluster is *Messier 44* in Cancer. Then there are tiny clusters, seemingly nothing more than compact multiple stars, as is the case with *IC 4996* in Cygnus. In some cases, all the members of the cluster are equally bright, such as *Caldwell 71* in Puppis, but there are others that consist of only a few bright members accompanied by several fainter companions, as is the case with *Messier 29* in Cygnus. The stars that make up an open cluster are called Population I stars, which are metal-rich and usually to be found in or near the spiral arms of the Milky Way Galaxy.

Size

The size of a cluster can vary from a few dozen light years across, as in the case of *NGC 255* in Cassiopeia, to about 70 light years across, as in either component of *Caldwell 14,* the Perseus Double Cluster.

Distribution in the Sky

An interesting aspect of open clusters is their distribution in the night sky. You may be forgiven in thinking that they are randomly distributed across the sky, but surveys show that although well over a thousand clusters have been discovered, only a few are observed to be at distances greater than 25° above or below the galactic equator. Some parts of the sky seem to be very rich in clusters – i.e., Cassiopeia and Puppis – due to the absence of dust lying along these lines of sight, allowing us to see across the spiral plane of our galaxy. Many of the clusters mentioned here actually lie in different spiral arms, so as you observe them, you are actually looking at different parts of the spiral structure of our own Galaxy.

Appearance

The reason for the varied and disparate appearances of open clusters is the circumstances of their births. It is the interstellar cloud that determines both the number and type of stars that are born within it. Factors such as the size, density, turbulence, temperature, and magnetic field all play a role as the deciding parameters in star birth. In the case of giant molecular clouds, or GMCs, the conditions can give rise to both O- and B-type giant stars[2] along with solar-type dwarf stars, whereas in small

[2] For a detailed explanation of the classification of stars, and even more information about their life cycles, see the references listed at the end of this book.

molecular clouds (SMCs) only solar-type stars will be formed, with none of the luminous B-type stars. An example of an SMC is the Taurus Dark Cloud, which lies just beyond the *Pleiades* cluster.

Stars are not born in isolation. Nor are they born simultaneously. Some clusters have bright young O and B main-sequence stars, while at the same time contain low-mass members, which may still be in the process of gravitational contraction (for example, the star cluster at the center of the Lagoon Nebula). In a few cases, the star production in a cluster is at a very early stage, with only a few stars visible, the majority still in the process of contraction and hidden within the interstellar cloud.

A perfect example of such a process is the open cluster within *Messier 42,* the Orion Nebula. The stars within the cluster, the *Trapezium*, are the brightest, youngest, and most massive stars in what will eventually become a large cluster containing many A-, F-, and G-type stars. However, the majority of those are blanketed by the dust and gas clouds and are only detectable by their infrared radiation.

Age

As time passes, the dust and gas surrounding a new cluster will be blown away by the radiation from the O-type stars, resulting in the cluster's becoming visible in its entirety, such as in the case of the young cluster *Caldwell 76* in Scorpius.

Once a cluster has formed, it will remain more or less unchanged for at least a few million years, but then changes within the cluster may occur. Two processes are responsible for changes within any given cluster. The evolution of open clusters depends on both the initial stellar content of the group and the ever-pervasive pull of gravity. If a cluster contains O-, B-, and A-type stars, these stars will eventually become supernovae, leaving the cluster with slower evolving, less massive, and less luminous members of type A and M stars. A famous example of such a cluster is *Caldwell 94, the Jewel Box* in Crux*,* which is a highlight of the southern sky, and, alas, unobservable to northern hemisphere observers. However, these too will become supernovae, with the result that the most luminous members of a cluster will, one by one, disappear over time. This doesn't necessarily mean the demise of a cluster, especially those clusters that have many tens or hundreds of members. But some, which consist of only a few bright stars, will seem to meld into the background star field. However, even those clusters that have survived the demise of their brighter members will eventually begin to feel the effect of a force that pervades everywhere – the Galaxy's gravitational field.

As time passes, the cluster will be affected by the influence of nearby globular clusters and the interstellar matter itself, as well as the tidal force of the Galaxy. The cumulative effect of all of these encounters will result in some of the less massive members of the cluster acquiring enough velocity to escape from the cluster. Thus, given enough time, a cluster will fade and disperse. (Take heart, as this isn't likely to happen in the near future so that you would notice. The *Hyades* star cluster, even after having lost most of its K- and M-type dwarf stars, is still with us after 600 million years!).

Color

Many experienced observers know that color in observed stars is best seen when contrasted with a companion(s). Thus, an open cluster presents a perfect opportunity for observing star colors. Many clusters, such as the ever and rightly popular *Pleiades,* are all a lovely steely blue color. On the other hand, *Caldwell 10* in Cassiopeia has contrasting bluish stars along with a nice orange star. Other clusters have a solitary yellowish or ruddy orange star along with fainter white ones, such as *Messier 6* in Scorpius. An often-striking characteristic of open clusters is the apparent chains of stars that are seen. Many clusters have stars that arc across apparently empty voids, as in *Messier 41* in Canis Major.

Globular Clusters

In the night sky are many compact and spherical collections of stars. These stars clusters are called *globular clusters*. These are metal-poor stars, often called Population II stars, and are usually to be found in a spherical distribution around the galactic center at a radius of about 200 light years. Furthermore, the number of globular clusters increases significantly the closer one gets to the galactic center. This means that particular constellations that are located in a direction towards the galactic bulge have a high concentration of globular clusters within them, such as Sagittarius and Scorpius.

The origin and evolution of a globular cluster is very different from that of an open or galactic cluster. All the stars in a globular cluster are very old, with the result that any star earlier than a G- or F-type star will have already left the main sequence and be moving toward the red giant stage of its life. In fact, new star formation no longer takes place within any globular clusters in our Galaxy, and they are believed to be our Galaxy's oldest structures. This means the youngest of the globular clusters is still far older than the oldest open cluster.

The origin of globular clusters is still hotly debated, with some researchers suggesting that they may have been formed within the proto-galaxy clouds that went to make up our Galaxy. However, in recent years two other origins for the globular clusters have come to light. Firstly, several seem to have been literally ripped from other nearby smaller galaxies, by the gravitational attraction of the Milky Way, and now orbit the core of our Galaxy, for example, *Palomer 12*. Secondly, it is known that our Galaxy has destroyed several smaller galaxies by a process called galactic cannibalism. The remnants of these devoured galaxies are, in some instances, believed to be some of the globular clusters we see, for example, *Omega Centauri*.

As previously mentioned, globular clusters are old; this means that all of the high-mass stars in a globular cluster evolved into red giants a long time ago. What remain are the low-mass main-sequence stars that are very slowly turning into red giants.

From an observational point of view, globular clusters can be a challenge. Many are only visible in optical instruments, from binoculars to telescopes, but a few are visible to the naked eye. There are about 200 globular clusters,[3] ranging in size from 60 to 150 light years in diameter. They all lie at vast distances from the Sun and are about 60,000 light years from the galactic plane. The nearest globular clusters (for example, *Caldwell 86* in Ara) lie at a distance of over 6,000 light years, and thus the clusters are difficult objects for small telescopes. That is not to say they can't be seen; rather, it means that any structure within the cluster will be difficult to observe. Even the brightest and biggest globular will, in most cases, require apertures of at least 15 cm for individual stars to be resolved. However, if large-aperture telescopes are used, these objects will be magnificent. Some globular clusters have dense concentrations towards their center, while others may appear as rather compact open clusters. In some cases, it is difficult to say where the globular cluster peters out and the background stars begin.

Stellar Associations and Streams

There exists another type of star grouping, which is much more ephemeral and spread over a very large region of the sky, and although not strictly associated with star clusters, they are very, very large groups of stars.[4] They are included in the guide because they are impressive objects, and what's more can be seen with the naked eye.

[3] Not all of these are visible in the range of amateur telescopes as mentioned in this book.

[4] These are large groups of stars, so, can be thought of as clusters – with only a small distortion of the truth.

A stellar association is a loosely bound group of very young stars. It may still be swathed in the dust and gas cloud within which the stars formed, and star formation may still be occurring within the cloud. Where they differ from open clusters is in their enormity, covering both a sizable angular area of the night sky and at the same time encompassing a comparably large volume in space. As an illustration of this huge size, the *Scorpius-Centaurus Association* is about 700 by 760 light years in extent, and it covers about 80°.

There are three types of stellar associations:

OB Associations. These contain very luminous O- and B-type main-sequence, giant, and super-giant stars.

B Associations. These contain only B-type main-sequence and giant stars but with an absence of O-type stars. These associations are just older versions of the OB association, and thus the faster-evolving O-type stars have been lost to the group as supernovae.

T Associations. These are groupings of T Tauri-type stars. They are irregular variable stars that are still contracting and evolving toward being A-, F-, and G-type main-sequence stars. More often than not they will be shrouded in dark dust clouds, and those that are visible will be embedded in small reflection and emission nebulae.

The lifetime of an association is comparatively short. The very luminous O-type stars are soon lost to the group as supernovae, and, as usual, the ever-pervasive gravitational effects of the Galaxy soon disrupt the association. As time passes, the B-type stars will disappear through stellar evolution, and the remaining A-type and later stars will now be spread over an enormous volume of space, the only common factor among them their motion through space. At that point, the association is called a stellar stream.

An example of such a stream and one that often surprises the amateur is the *Ursa Major Stream.* This is an enormous group of stars, with the five central stars of Ursa Major (the Plough) being its most concentrated and brightest members. The stream is also known as the *Sirius Supercluster* after its brightest member. The Sun actually lies within this.

Observing Star Clusters

I are now going to make a somewhat odd statement: “All clusters are not created equal.” What I mean by this is that some clusters are spectacular, with a glittering display of colored doubles and triples, in curving loops, chains, and arcs, interspersed with dark starless voids and lanes. These clusters will literally make your jaw drop, and you will revisit them time and time again. Others, it has to be said, even with the largest apertures and with the highest magnifications, will be nothing more than a tiny, hazy spot. And once found and observed, you may well ask yourself why you bothered to observe it in the first place.

I regard all clusters worthy of observation, but honestly, in some cases, a few clusters will be very unimpressive. Nevertheless I have included both types, as the former are great to look at, while the latter can be used as an exercise in your observing techniques and a test of your telescope optics. Maybe it is best put this way: “All clusters are equal, but some clusters are more equal than others.”

Clothing

This may seem a odd topic, but, as experienced observers know only too well, if you are not kept reasonably warm while you observe, then in only a very short time you will be far too cold to even make any pretence of observation.[5] Basically, common sense should prevail, and even if you don't actually wear any thick clothing to begin with, it should be available as the temperature drops. Nothing spoils a clear night's observing more than having cold hands and feet.

A last piece of advice is to know when it's time to stop observing! This is usually when your teeth are chattering, and your body is shaking from the cold.[6] This is the time to go indoors and have a hot drink, looking back in your mind over the incredible sights you have seen earlier that evening.

Recording Your Observations

This is a subject that, for some unknown reason, is often ignored by many amateur astronomers but is quite important. If you are just casually observing, sweeping the sky at leisure, then recording your observations may indeed be superfluous. But once you start to search out and observe specific objects, then note-taking should become second nature, if only to make a checklist of the items you have seen.

Basically, you should record the object viewed, the time of the observation, the telescope used (with eyepiece and magnification), the seeing and transparency, and maybe a brief description of the object and a sketch. If you wish these notes can then be copied up into more formal notes later, preferably the next day. (Your initial notes should always be made at the telescope, so as to keep as accurate a record as possible.)

You'll notice this book has left some room at the end of each constellation section for you to make brief notes on what you have observed. Some observers use a separate book or notepad for each type of object observed. A pocket dictation machine can be a quick and easy substitute for the notebook (apart from the sketch!). Whatever method you use, keeping a record will help you keep track of your observations and will help you to become a better observer.

Classification

Because open clusters display such a wealth of characteristics, different parameters are assigned to a cluster that describe its shape and content. For instance, a designation called the Trumpler type is often used. It is a three-part designation that describes the cluster's degree of concentration – that is, from a packed cluster to one that is evenly distributed, the range in brightness of the stars within the cluster, and finally the richness of the cluster, from poor (fewer than 50 stars) to rich (more than 100). The full classification is:

Trumpler Classification for Open Star Clusters

Concentration

I. Detached – strong concentration of stars towards the center.
II. Detached – weak concentration of stars towards the center.

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[5]Those of us familiar with the climate of northern Europe and the UK know that even in early and late summer, when the days may be warm, and sometimes hot, the nights can still be quite chilly.

[6]Believe it or not, many observers myself included, have reached this stage on several occasions, not wanting to waste a minute of a clear night!

II. Detached – no concentration of stars towards the center.
IV. Poor detachment from background star field.

Range of Brightness

1. Small range
2. Moderate range
3. Large range

Richness of Cluster

p-Poor (fewer than 50 stars)
m-Moderate (50 to 100 stars)
r-Rich (more than 100 stars)
n-Cluster within nebulosity

Shapley-Sawyer Classification for Globular Star Clusters

As in the case of open clusters, there exists a classification system for globular clusters, the Shapley-Sawyer Concentration Class, where Class I globular clusters are the densest and Class XII the least dense. The ability of an observer to resolve the stars in a globular actually depends on how condensed the cluster is, and so the scheme will be used in the descriptions, but it is really only useful for those amateurs who have large-aperture instruments. Nevertheless, the observation of these clusters, which are among the oldest objects visible to amateurs, can provide you with breathtaking, almost three-dimensional, aspects.

Constellation Data and Cluster Lists

The constellations are presented alphabetically,[7,8] and so are at their best for observing at different times of the year. The following table will help you locate the clusters and constellation throughout the year.[9,10]

January
Cancer, Canis Minor, Carina, Gemini, Lynx, Monoceros, Puppis, Volans

February
Cancer, Carina, Pyxis, Vela

[7] You may notice that some constellations are absent from the list. That is because they do not have any clusters in them.

[8] The material was presented this way after much consultation with many astronomers.

[9] If a constellation appears in 2 months, it is because it culminates on either the last, or first, day of a month.

[10] Any cluster or constellation can of course be observed earlier or later than this date as it rises about 4 min earlier each night, nearly ½ h each week, and thus about 2 h a month. To observe any cluster or constellation earlier than its culmination date, you will have to get up in (or stay up to) the early hours of the morning. To observe later than the culmination date will mean observing earlier in the evening, and vice versa.

March
Centaurus, Crux, Hydra, Musca, Ursa Major

April
Canes Venatici, Circinus, Coma Berenices, Virgo

May
Apus, Boötes, Libra, Lupus, Norma, Serpens, Triangulum Australe, Ursa Minor

June
Ara, Corona Austrina, Hercules, Ophiuchus, Scorpius, Scutum

July
Corona Austrina, Cygnus, Lyra, Pavo, Sagitta, Sagittarius, Scutum, Telescopium, Vulpecula

August
Aquarius, Capricornus, Delphinus, Lacerta, Octans, Pegasus

September
Aquila, Cepheus, Pegasus, Sculptor, Tucana

October
Andromeda, Cassiopeia, Hydrus, Triangulum

November
Fornax, Horologium, Perseus, Taurus

December
Auriga, Camelopardalis, Columba, Dorado, Lepus, Mensa, Orion, Pictor, Taurus

In the constellation descriptions, I have used the following nomenclature:

- The name of the constellation
- The abbreviated name of the constellation
- The genitive name of the constellation (Every constellation name has two forms: the *nominative*, for use when one is talking about the constellation itself, and the *genitive*, or possessive, which is used in star names). For an example, Capella, the brightest star in the constellation Auriga (nominative form), is also called Alpha Aurigae (genitive form), meaning literally "the Alpha of Auriga."
- The common translation for the constellation
- The (approximate) latitude range within which the constellation can be seen
- The month during which the constellation will be at its highest point in the sky at midnight, known as its culmination,[11] or transit

Regarding specific clusters, the following information is given:

First line:

- Official reference name, i.e., NGC 5272, IC 4321
- Popular name, or another reference name, i.e., Collinder 42, Messier 3, Caldwell 10, Herschel 61

[11] It can of course be seen earlier or later in the month given, but of course it may not be at its highest point in the sky at midnight.

- Position, in right ascension, and declination. RA, Dec
- Type of object
  - OC (open cluster)
  - GC (globular cluster)
  - Ast (asterism)
  - Neb (nebula)
  - ?-unknown

  Second line:

- Visual magnitude,[12] v, the combined magnitude of all stars in cluster, or photographic magnitude, p.
- Object size[13] in arc minutes (⊕)
- Approximate number of stars in the cluster, but bear in mind that the number of stars seen will depend on magnification and aperture, and will increase when large apertures are used. Thus the number quoted is an estimate using modest aperture.
- Trumpler designation, or Shapley-Sawyer concentration class
- Level of difficulty on observing the cluster based on the magnitude, size, and observing conditions, plus ease of finding the cluster.

Constellation Maps

Each constellation has its own star map to help you to locate the clusters within them. But note here and now that these maps are *very simple* and are only meant to be signposts to their approximate location of the objects in the sky. They are not meant to be detailed charts, and should not be treated as such, but rather as pointers to the approximate locations of the objects under discussion.

There exist a plethora of planetarium software programs and apps for use on smart phones, iPads or the equivalent and desktop computers. Several of them are free, and nearly all are excellent. These can be used for making detailed star maps for use at the telescope, if needed.

Also, in recent years there has been in revolution in observational astronomy, specifically with the introduction of go-to telescopes. These have truly revolutionized astronomy and can, in some instances, make star atlases obsolete and the locating of very faint objects a trivial exercise.

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[12] The quoted magnitude of a cluster is the integrated magnitude. This is the combined visual magnitude of all its components, as if the cluster's light was combined into a star like point. It may be the result of only a few bright stars, or, on the other hand, may be the result of a large number of faint stars. But beware! The cluster is not a point of light but spread across a discernible diameter, so, as the light spreads out, its intensity will drop off rapidly, causing the cluster to become fainter. Thus, the quoted magnitude may appear considerably dimmer than a star of the same absolute magnitude. Different observers will see differing magnitudes. Treat the given value with a certain amount of caution.

[13] Also, the diameter of a cluster is often misleading, as in most cases it has been calculated from photographic plates, which, as experienced amateurs will know, can bear little resemblance to what is seen at the eyepiece.

However, even with a computerized telescope, it is still vitally important to obtain a good star atlas. There are many now in print, and so choose the one that best suits your needs.

Here, now, is a list of constellations found in this guide:

Constellation List

Andromeda	**Delphinus**	**Perseus**
Apus	**Dorado**	**Pictor**
Aquarius	**Fornax**	**Puppis**
Aquila	**Gemini**	**Pyxis**
Ara	**Hercules**	**Sagitta**
Auriga	**Horologium**	**Sagittarius**
Boötes	**Hydra**	**Scorpius**
Camelopardalis	**Hydrus**	**Sculptor**
Cancer	**Lacerta**	**Scutum**
Canes Venatici	**Lepus**	**Serpens**
Canis Major	**Libra**	**Taurus**
Canis Minor	**Lupus**	**Telescopium**
Capricornus	**Lynx**	**Triangulum**
Carina	**Lyra**	**Triangulum Australe**
Cassiopeia	**Mensa**	**Tucana**
Centaurus	**Monoceros**	**Ursa Major**
Cepheus	**Musca**	**Ursa Minor**
Circinus	**Norma**	**Vela**
Columba	**Octans**	**Virgo**
Coma Berenices	**Ophiuchus**	**Volans**
Corona Austrina	**Orion**	**Vulpecula**
Crux	**Pavo**	
Cygnus	**Pegasus**	

How to Use This Guide

You may think this penultimate section has an odd title, but bear with it.

There exist today many wonderful books that describe in great detail star clusters, with photographs of each object along with detailed star maps, drawings of each object under discussion, and a history of the object, etc. Such books are truly wonderful, printed on the best quality paper, and a must purchase for any observer's library.[14] However, you would never dream of writing in them, or taking them out to the telescope in the evening. They are more for reference in planning an observing session.

This book is different. This guide of star clusters is to be used! Take it out at night when you observe, write in it, comment on what you see, draw in it. Use it as you will, as it is not meant to be left on your bookshelf but rather used at the telescope as you seek out these amazing objects.

And Finally…

Having read this chapter, you should now have some idea of what's in store for you, but before you rush outside, keep these thoughts in mind. Astronomy, like any other hobby or pastime (or lifelong devotion!), gets easier with time. The longer you spend observing, the better you will become at it. But remember that success in seeing all the objects that you observe – or try to observe – will depend on many things: the seeing, the time of year, the instruments used, and even your state of health! Don't be despondent if you can't find an object on your first attempt.[15] It may be beyond your capabilities, at that particular time, to see it. Just record the fact of your non-observation, and move onto something new. You'll be able to go back to the elusive object another day or month. It will still be there. You may see differing star colors to those mentioned here, or different asterisms. This doesn't matter, as nobody's eyes are identical, and neither are their observing locations or sky conditions. Also, take your time; you don't need to rush through the observations. Try spending a long time on each object you observe. In the case of several clusters, it can be very instructive, fascinating, and often breathtaking to let the cluster drift into the telescope's field of view. You'll be surprised at how much more detail you will seem to notice.

Although I have tried to include all the famous objects, if any of your favorites have been omitted, then I apologize! To include everybody's favorites would be a nice idea, but an impossible task.[16]

Now get started! The universe awaits you!

[14] They also quite heavy, and so could probably be used as an emergency counterweight.

[15] It is often useful to be able to determine the night sky's observing conditions (light pollution, haze, cloud cover, transparency) before starting an observing session, so as to determine what types of objects will be visible and even allow you to decide whether observing is viable at all. A good way to do this is to use a familiar constellation, which should be observable every night of the year, and estimate what stars in the constellation are visible. If only the brighter stars are visible, then this would limit you to only bright stellar objects, while if the fainter stars in the constellation can be seen, then conditions may be ideal to seek out the more elusive, and fainter objects. A favorite constellation used by many amateurs for just such a technique is Ursa Minor, the Little Bear. If, once outside, you can see υ UMi (magnitude 5.2) from an urban site, then the night is ideal for deep-sky observing. However, if υ UMi is not visible, then the sky conditions are not favorable for any serious deep-sky observing, but casual constellation observing may be possible. If the stars δ, ε, and ζ UMi, located in the "handle" of the Little Bear, are not visible (magnitudes 4.3, 4.2 and 4.3, respectively) then do not bother observing at all, but go back indoors and peruse this book.

[16] Compiling such an guide that includes a terrific amount of data was a difficult, but tremendously rewarding task. However, there may be times when I have inadvertently made a typographic error, such as in the size of a cluster, or its magnitude, etc. If this occurs then I apologise, as any such errors are mine and mine alone.

The Constellations and Their Star Clusters

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Andromeda

Fast Facts

Abbreviation: And	**Genitive: Andromedae**	**Translation: Princess of Ethiopia**
Visible between latitudes 90° and −40°		**Culmination: October**

Star Clusters

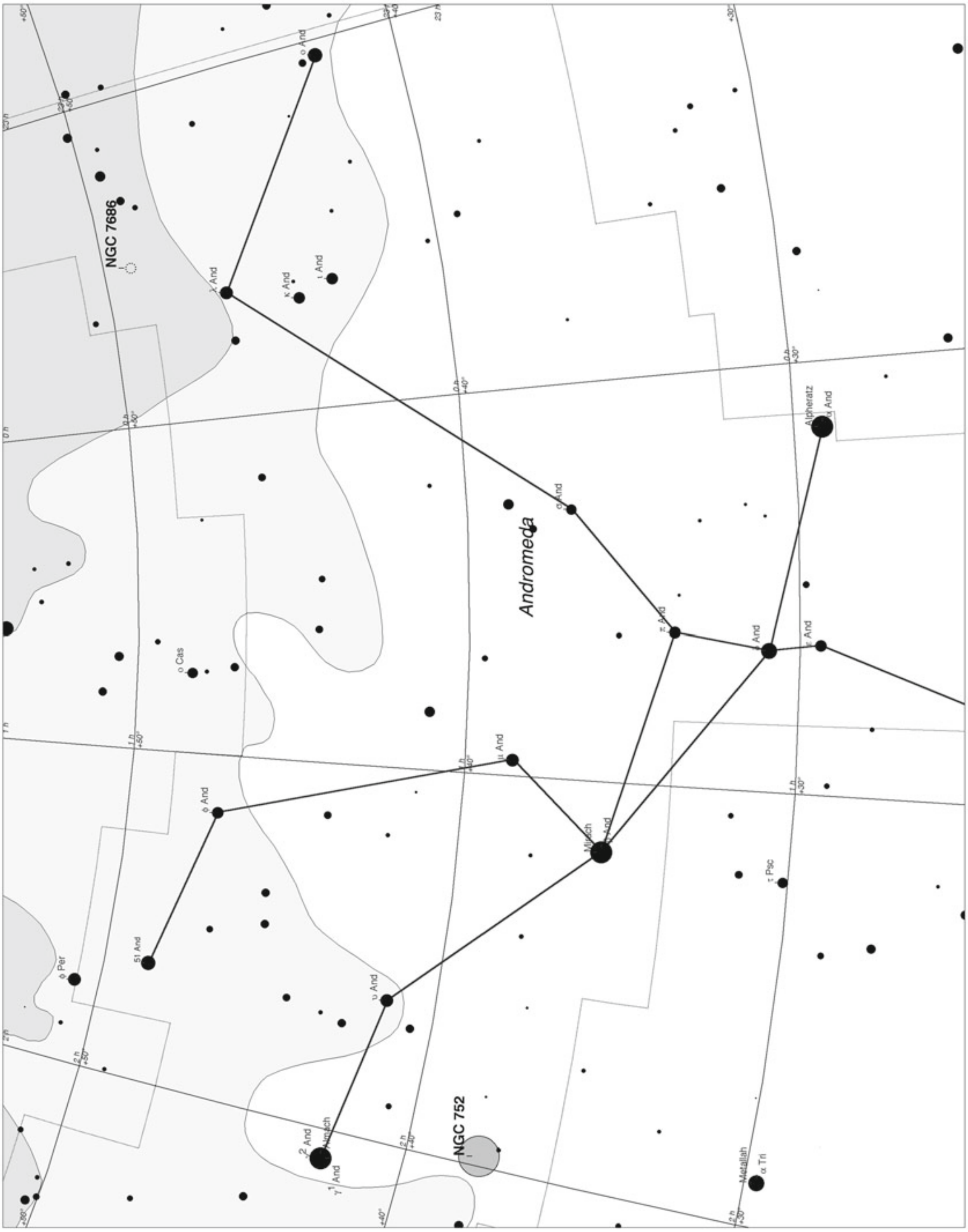
Herschel 69	**NGC 7686**	**23^h 30.1^m**	**+49° 08′**	**OC**
5.6 m	**⊕15′**	**80**	**IV 1 p**	**Moderate**

A sparse and widely dispersed cluster with many 10th and 11th magnitude stars, the cluster can be glimpsed in binoculars as a diffuse glow centered on a yellowish 6.5 magnitude star (it has also been called reddish-orange!). As larger apertures are used, fainter members appear and stream off in several chains. It lies at a distance of 3,000 light years and is around 13 light years in diameter. It was discovered in 1787.

Collinder 33	**NGC 752**	**01^h 57.8^m**	**+37° 41′**	**OC**
5.7 m	**⊕45′**	**77**	**III 1 m**	**Easy**

Best seen in binoculars, or even at low powers in a telescope, this is a large, loosely structured group of stars containing many chains and double stars. It l lies about 5° south-southwest of γ Andromedae. Often underrated by observing guides, it is worth seeking out. It is a cluster of intermediate age.

Notes


NGC 7686
Andromeda
NGC 752
Alpheratz
Mirach
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51 And
o Cas
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Apus

Fast Facts

Abbreviation: Aps	**Genitive: Apodis**	**Translation: The Bird of Paradise**
Visible between latitudes 5° and −90°		**Culmination: May**

Clusters

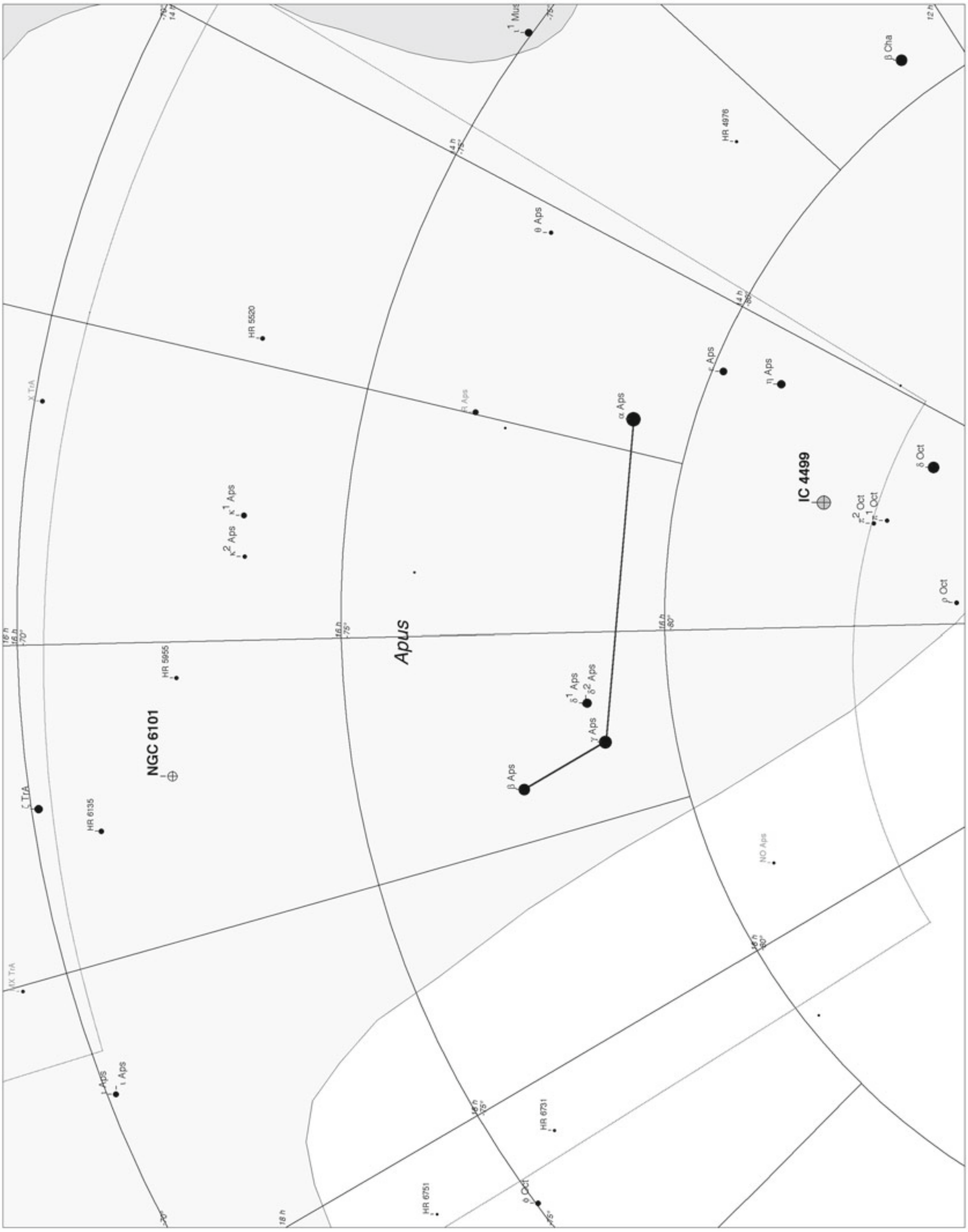
IC 4499	**–**	**15^h 00.3^m**	**−82° 13′**	**GC**
10.1 m	**⊕ 8′**	**–**	**XI**	**Difficult**

This is a globular cluster that needs a large aperture in order for it to be resolved. Lying between π^1 and π^2 Apodis it appears as an unresolved soft glow in telescopes of 30 cm, but with larger apertures of, say, 35 cm and up, it will begin to show a granular appearance.

NGC 6101	**–**	**16^h 25.8^m**	**−72° 12′**	**GC**
9.2 m	**⊕ 5′**	**–**	**X**	**Difficult**

As with the previous entry, IC 4499, this is another globular cluster that presents a challenge. Larger apertures are needed to see and resolve the cluster, but it is worth it as it presents quite a spectacle and takes high magnification well. With an aperture of 40 cm and larger, and still and transparent skies, the core shines out!

Notes


Apus
NGC 6101
IC 4499
α Aps
β Aps
γ Aps
δ¹ Aps
δ² Aps
ε Aps
η Aps
θ Aps
κ¹ Aps
κ² Aps
ι Aps
R Aps
NO Aps
HR 5520
HR 5955
HR 6135
HR 4976
HR 6731
HR 6751
ζ TrA
X TrA
MX TrA
β Cha
δ Oct
ρ Oct
π¹ Oct
π² Oct
φ Oct