

Extract from Stargazing under Suburban Skies

A Star Hoppers Guide

Chapter 1 -Seeking Out the Dark

Example Bronze Object NGC 457

Example Silver Object

Example Gold Object

Example Lunar Object

Chapter 1 – Seeking Out the Dark

From Messier to the Modern Day

Lists of stars and objects are not a new idea in astronomy. Ancient observers noted the stars in the skies and as early as the 10th century AD, the Persian astronomer, Abd al-Rahman al-Sufi, compiled his “book of fixed stars”. Today, most astronomers eventually get to know the Messier Catalogue or to give it its proper title “Catalogue des Nébuleuses et des Amas d’Etoiles”. The first edition of the Messier Catalogue included 45 objects and grew to the 110 that are searched for, sketched, imaged, lost, found and talked about by experienced observers and beginners alike the world over.

Others, such as the New General Catalogue (NGC), and the Index Catalogue (IC), and specific lists including the Herschel 400 and the Caldwell objects generated by the much loved and missed Sir Patrick Moore, provide ample resources and targets to challenge and occupy the observing nights for astronomers everywhere.

Since 1758 when Messier first published his catalog, improvements in optical, radio and infrared technology have allowed us to see things that he could not have imagined.

Amateur telescope technology has moved on apace too. The price point of a seriously good telescope has dropped to affordable levels for almost everyone. Messier’s 3.5-inch (90-mm) refractor would be more than matched by the marvels available to amateurs today.

Sadly, however, the quality of skies in urban areas has declined markedly. What you can realistically find and really see in and around London, Manchester, New York, Los Angeles and other major towns and cities in the early 21st century does not compare to the descriptions written by observers fortunate enough to have regular and safe access to wonderful inky black skies.

It appears to be a battle that ground-based astronomers are not winning. As our society develops, the appetite to light up the night appears insatiable. Centers of cities and even small towns are awash not just with street lighting, but modern advertising screens and bill boards. Concerns over security encourage the use of lighting to deter crime. While the arguments for such concerns have serious validity, the power and scope of even domestic security lighting turns night into day at the flick of a switch or by the detection of movement. Drive along a smart street in suburbia and cars parked on drives are bathed in low lighting to highlight the parking area or even the vehicles themselves. Light gets reflected and much of it bounces back up into the skies. If the sky has haze or slight mist, the tiny particles can spread the light even more to build a general glow. Observers on the edge of cities and towns will be familiar with local domes of light that creep up part of the sky. Often orange in color due to the use of sodium lighting, the affected sky gradually dissolves into a peach shroud, through which only the brightest and most stubborn stellar objects can shine.

At open air gatherings or events, lasers and light shows tear across the ether to the “oohs and ahhs” of the crowds below, most of whom are oblivious to the far more impressive light show above the atmosphere, that provided by the heavens of our galaxy and the universe beyond. Much of this artificial light is wasted and presents an economic cost as well as the impacts upon wildlife. These are slowly becoming more understood as are the impacts lighting has upon health. Too much light, particularly at the blue end of the spectrum, can disrupt sleeping patterns and the circadian rhythms that our bodies have evolved with.

The overall effect is that the night sky is being hidden from us and more importantly, hidden from our children and from our souls. We are part of the Universe yet comparatively few of us take time to look up and take in the majesty of the night sky. Sometimes, for many non-astronomers, it can take a visit to a remote part of the country or abroad to jolt them into understanding what we are missing. How many people have never seen the Milky Way? No doubt this is many millions and shows no sign of decreasing.

So, if this all sounds somewhat depressing, what can be done about it and why bother observing anyway?! Valiant efforts to promote awareness of the problems of light pollution are led by organizations such as The Commission for Dark Skies in the United Kingdom. It leads initiatives and provides guidance and lectures to

highlight the impact of city and suburban lighting and to encourage more effective means of lighting up our world. One would think that the main argument would be so that we could all see the stars more easily. Of course, that is a primary aim, but the organization outlines the impact on the environment generally and how sensible lighting approaches can be of benefit to society. The International Dark-Sky Association, based in Tucson, Arizona, USA, shares similar aims. In parts of the United Kingdom, for example, some local authorities have recently started switching off street lighting from midnight to around 5am. This has met with mixed reactions for many of the reasons above such as security and in some cases the number of hours without street lights has been reduced. Nonetheless, a drive through the country will take you through “dark” villages where the principle of no street lighting is part of the local authority requirements. Loughton Astronomical Society used to be based in Loughton, Essex, when it was founded in 1968. It has since moved about five miles from Loughton to Theydon Bois, where the number of street lights and other forms of lighting for public buildings and social clubs is limited by planning laws.

People from all walks of life who take up astronomy as a hobby or as a vocation live in towns and cities. Despite all the problems described above, many are active observers and participants in local societies. We may complain and moan about the poor skies where we live, but when the clouds part, and darkness descends, lenses and mirrors are turned upward, and countless curious eyes peer into eyepieces to seek the starlight that has traveled for tens, hundreds, thousands and even millions of years.

That is the magic. That is the fascination that draws astronomers outside, away from the comforts and warmth of our homes and buildings, out into the night, seeking out the dark.

A companion for observers based in suburban skies

So how does this book help? “Making the Most of Suburban Skies – A Star Hopper’s Guide” is the essential companion to relative newcomers and more experienced observers who do nightly battle with orange gray skies, eye-piercing street lamps, stubbornly placed trees and inconveniently sited houses.

This book aims to help amateur astronomers find and enjoy popular and interesting objects visible in suburban skies. It is not intended to be a book for absolute beginners, so while some guidance is provided on the star charts and constellations, some basic knowledge of the sky is assumed, and readers are referred to well-known publications that can help them learn the constellations and major star names. These are listed in the Bibliography. Help is also readily available online these days and with world-conquering smart phones, star atlases and apps provide portable reference guides.

Our intended readers are those who own relatively modest equipment ranging from binoculars to refractors of 70-mm to 150-mm or reflectors of up to the 200-mm class. Many of the observations and images in this Guide were undertaken with such equipment which is described in Chapter 3. Those with larger instruments or those lucky enough to have access to darker skies will still find many of the target objects of interest and suitable to share with others. Though focused on northern hemisphere observers, visitors from more southerly climes should find it a helpful introductory companion. The hope is that users of the Guide will develop their knowledge such that when they are fortunate enough to have an opportunity to observe in darker and clearer skies, they can enjoy favorite objects even more and be able to share them with fellow observers.

The Guide is based on an original list of objects that experienced members of Loughton Astronomical Society drafted for its membership around 2011. The list had to include objects which could be found using star hopping methods rather than relying solely on a GOTO telescope.

The project originally started with 20 or so objects that less experienced members could locate in a typical year to help them learn their way around the sky and to be able to point out some famous objects to their family and friends. The criteria were that objects had to be seen reasonably well from our light-polluted, tree and house dominated skylines without the need to resort to sophisticated instruments, accurate polar alignment and GOTO telescopes, although these could still be useful.

This meant that the objects would generally be from middle to higher altitudes in the sky and typically binocular objects or smaller telescopic ones. This became known as the 'Loughton List'. It became clear that the initial draft list of 20 objects was insufficient, so it was later extended to over 60 to allow a choice of plenty of objects to be seen throughout the year. In fact, the first members' publication of the 'Loughton List' included 75 objects, many very well known, and found in most popular atlases and observing aids.

This book is a more comprehensive version of the original list and includes over 100 deep sky objects. Several dozen more objects are referred to in the text. Some well-known objects that are observable from mid-northern US and southern European latitudes are not included and lower positioned objects which are often hidden from view or lower down in the murk have not made the list, even though some observers would recommend their inclusion. Nonetheless, there are some that are a bit easier to see if you have a good southern horizon or are observing from those locations.

There is a range of object types including clusters, galaxies, variables and double/triple stars, plus some fun asterisms and unusual items such as deep red carbon stars which shine like a malevolent eye. If the Guide has omitted any of your own particular favorites or included items that may surprise you, please accept the authors' apologies! Many an hour over tea and biscuits (cookies) was spent debating the merits of each one. Was it truly a suburban object or one that was really for the darker skies? At the end of the day (and night), the observing team think they more or less got it right.

We extended the concept of the list to suburban observing in general. It may surprise some readers, but there is a wide range of astronomical phenomena that can be observed from here. Astronomy is a vast subject, and observers develop their own specific interests. This may be derived from where they live (city center dwellers may focus more on the Moon or planets and country-based observers on deep sky objects such as galaxies), or on particular interests such as photography. Some observers enter the hobby through other interests such as birdwatching, having turned their spotting scopes upwards one night and becoming hooked.

The simple pleasures of astronomy are free. You don't need an annual membership fee or a ticket to look up on a clear night. Learning the names of the major stars and constellations is rewarding in itself and newcomers to the hobby are always encouraged to take time first to do this before jumping feet first into buying telescopes, even though some of these have the ability to find things almost by themselves these days!

In fact, having a good sense of the way around the night sky and the major stellar signposts is a key skill for the suburban astronomer. Constellations have a habit of hiding behind trees or lurking behind your neighbor's rooftop. Knowing where a particular object you wish to observe is likely to be positioned at the time when you venture outside helps plan your session and avoid the frustration of setting up your equipment, only to find you can't see it!

The charts in this Guide are designed to help find objects in a local area but some knowledge of the wider sky is assumed. Help is at hand in some of the sources listed at the back of the book and there are many advantages in joining a local astronomical society. There are countless societies all over the world and a simple search on the internet should help identify groups nearby. They vary in size and activity and most these days have their own website for contact information and upcoming programs. Most will give talks on what is currently visible in the sky and hold observing sessions where experienced observers will be on hand to guide beginners.

As you develop your interest, no doubt some investment in equipment will be necessary, but our advice is to take your time to research before buying and whenever possible look through equipment owned by others. It may seem to be an expensive hobby, but it does not have to be. Even those on a small budget should find equipment that will give them a lifetime of quality observing. Many of the objects in the Guide are well within the grasp of a pair of modestly priced, suitably mounted binoculars.

Making it easy: Bronze, Silver and Gold

The Bronze, Silver and Gold ranking of objects in this Guide leads observers through the team's favorite deep sky objects. Many of these are well-known, some perhaps less so, and using star hopping techniques, the

Guide teaches the way around the sky. Each object has a detailed description from an observer's point of view and a 'Why we like it' section. As a result, readers will gain a sense of the 'view from Earth' from their backyards and gardens, pavements and sidewalks and a host of popular objects to share with friends and family.

Bronze objects are the easiest and for the least experienced. Many of these are visible to the naked eye or at least visible in fair skies with binoculars. Silver-ranked objects present a bit more of a challenge and may be seen more easily in small telescopes with a little more power than typical binoculars. Gold objects include some of the lesser-known but interesting targets that are still visible from towns and cities. These are admittedly the most challenging, but they are well within the reach of experienced observers with a good chart and patience.

Each object in the Star Hopper's Guide has a designation of SG(n) and its own page explaining its official designation, some basic technical data, why we like it and how to find it using star hopping techniques. On its adjacent page the relevant finder chart and image are shown. Figure 1.1 below illustrates the basic layout.

Fig 1.1. The layout of text, charts and images in Chapters 4 and 5.

The Right Ascension¹ (RA) and Declination (Dec) of each object are provided so readers who are familiar with electronic GOTO or Push To instruments can search for them that way if they wish. Appendix B provides detailed positions although most GOTO systems will have the named objects in their databases.

All objects are included in the eight general sky reference charts provided in Appendix D. Collectively, these show all relevant regions of the sky and can be useful for planning an observing session.

Tools, techniques and other astronomical phenomena

Chapter 2 explains methods and techniques for observing in suburban skies, including star hopping. It considers the wide range of locations in which town dwellers find themselves and how to make the best of the sky by minimizing the effects of lights and buildings and includes an introduction to useful equipment. It also covers areas such as understanding the size and measurement of the sky and technical terms such as apparent field of view. These are key in learning and moving around the night sky.

Chapter 3 covers the telescopes and equipment used by the observing team to make the images and drawings and to test the star hopping directions. There is a considerable range of instruments, including handheld binoculars, small modern refractors, larger apochromats, Newtonian and Cassegrain reflectors and even a classic telescope with a lens dating back to the 1940s. It continues with a review of types of mounts, eyepieces and related equipment including using filters for visual and photographic use. A section on sketching aims to encourage observers to record observations using more traditional methods. The message from this chapter is that there is no one best form of equipment for observing, however light or dark the sky may be. Whatever you have at your disposal can provide years of enjoyment and learning.

Chapter 4 is the largest chapter in the book and contains the main list of deep sky objects. It starts with those best found in the early autumn of the northern hemisphere and progresses eastwards around the sky. There are 100 separate Star Hopper's Guide (SG) objects. Others which may be nearby or on the way to the target are highlighted in the text or on the charts. All in all, the Guide mentions nearly 200 objects. A list of the 100 is provided in Appendices B and C. These and other features are listed in the index.

¹ Right Ascension and Declination are the celestial equivalent of longitude and latitude. RA is measured in hours from a position known as the Vernal Equinox, a kind of 'Greenwich Meridian' on a star chart. There are 24 hours of RA around the sky. Declination is measured in degrees from the celestial equator.

Chapter 5 contains 30 of our favorite features on the Moon. This is the easiest and most detailed object visible from suburban areas and is an obvious candidate to include! Indeed, for some observers located well into town and city centers, the Moon is the best target as it is largely unaffected by light pollution, although tall trees and buildings still manage to get in the way! Other features in and around the 30 targets are highlighted, so the reader will build up an initial inventory of over 50 interesting objects to track along the lunar surface. It uses the same grading, charting and imaging styles as the deep sky list and it is intended to provide a launch pad for readers to observe the Moon in more detail.

Chapter 6 on planetary positions and good observing times over the next 30 years up to 2050 completes the main observational sections. There are many excellent publications and sources of information on the internet about the planets and so this chapter highlights where to find them and some basic observational data.

Chapter 7 covers reviews on some of the astronomy apps that are widely available and other astronomy software. There are some outstanding books and guides on astro-imaging, so it is not the intention to cover this rewarding part of the hobby in this Guide. However, all with the exception of two of the images were taken by members of the Society from their homes and locations in suburbia, on the edge of London or the nearby counties of Essex and Hertfordshire. Imaging is certainly possible from suburban skies with patience so a section on software and techniques used by Andy Gannon is included. Appendix A outlines the technical methods used for the images used in the Guide and summarizes equipment and methods used by other imaging contributors.

Chapter 8 brings together other objects and events that can be observed from almost anywhere in towns and cities such as lunar eclipses, meteor showers, occultations, planetary conjunctions, bright asteroids and solar observing. So, although the main focus of the Guide is the deep sky star hopping objects in Chapter 4, this chapter, along with Chapters 5 and 6, bring together other areas of observational and photographic astronomy that are possible from suburban areas.

An astronomy guide often relies on the expertise of others and so during our research, various well-known books and online sources were utilized. Readers will find these publications and sources enjoyable additional reading, leading on to more objects to seek and find. A full list is provided in the Acknowledgments and Bibliography sections.

A Society Project

The Guide is a Loughton Astronomical Society project involving over a dozen members. It has certainly improved everyone's knowledge of the night sky, and at the same time, provided a lot of fun.

Thanks are extended to everyone who contributed to the Guide in a variety of ways. Without them, we would still be in the dark.

NGC 457

<i>Object type:</i>	Open cluster
<i>Also known as:</i>	The ET Cluster, the Owl Cluster, Caldwell 13
<i>Apparent magnitude:</i>	6.4
<i>Angular size:</i>	20'
<i>Distance:</i>	7,900 light years
<i>Constellation:</i>	Cassiopeia
<i>Coordinates:</i>	RA 01h 19m Dec 58° 20'

Why We Like It

A favorite and a great binocular and telescopic object, it fully deserves its listing in Patrick Moore’s Caldwell List. One of the very best clusters in the Cassiopeia region, NGC 457 may not be as well-known as the Messier Objects but it outshines many of them. It is visible all year from higher northern latitudes.

A 70-mm (2.75-inch) refractor at x25 with a wide field is enough to pick out the shape of this cluster. Binoculars may struggle to show the shape at lower powers but x20 will do it. The Owl has two bright watchful eyes, bearing down out of the night. The brighter one is ϕ Cas and is the one to star hop to. At powers of x25 to x40 you can see the wings and central body. There is a suggestion of more stars in the center of the cluster in small instruments. The insert in the chart opposite illustrates the brighter stars although it shows the Owl as upside down. In a 120-mm (4.7-inch) refractor at medium powers it is truly a marvel. The central stars begin to flesh out the body and averted vision will reveal more of the brighter members. Powers up to x75 or so will bring the body in close-up and improve the contrast. This is a fun object to share with family and friends.

In the United States, it is better known as the ET cluster and with a little imagination, and looking at it upside down, it is easy to see why. Others have described it as a dragonfly or even as a fighter jet on afterburners with ϕ Cas being the engines. Look at the chart and the image and see if you agree! The Owl, however, has that feel of the night about it, so be sure to catch the bird as you swoop around the constellation.

When Best To See It

January – March	April – June	July – September	October – December
Evening to end of night	Dusk or just before dawn	Rising in early hours, to well seen from midnight	All night

How Best To See It

Naked Eye	Binoculars	<150-mm aperture	>150-mm aperture
Not visible	★★	★★★★	★★★★

How To Find It

Select the second star from the left in the “W” of Cassiopeia. This is δ Cas, which is also known as Ruchbah. Then move slowly down and right towards ϕ Cas which marks the brighter eye. Once it is centered in your finder, move to your telescope and increase the power.

Fig. 4.5a. Chart showing the directions to NGC 457.

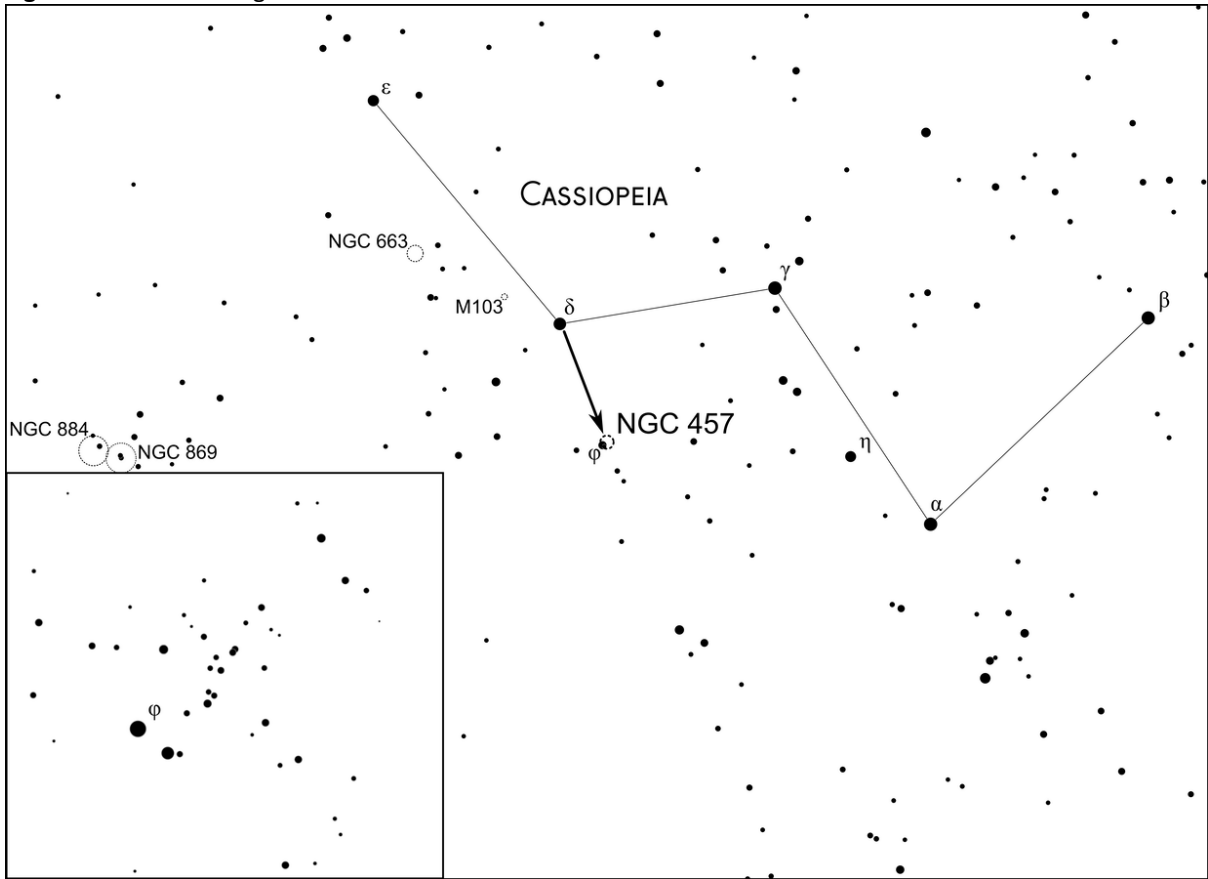


Fig. 4.5b. NGC 457, the Owl Cluster. (Image by Andy Gannon)



κ and ι Boötis

<i>Object type:</i>	Double star
<i>Also known as:</i>	N/A
<i>Apparent magnitude:</i>	4.5, 6.6 4.8, 7.4
<i>Separation:</i>	13.4", 38.6"
<i>Distance:</i>	155 light years
<i>Constellation:</i>	Boötes
<i>Coordinates:</i>	RA 14h 13m Dec 51° 47' (Kappa)

Why We Like It

These objects can be observed in one go as you traverse the northern sky. Practically circumpolar, they can be seen most of the time except mid-winter when they are skirting the northern horizon at evening observing times. Mid spring and late summer present comfortable observing positions. κ needs a small telescope; a 70-mm telescope at about x30 should cope well. If you are not sure, just ramp up the power. ι is further spaced and so a lower power should be sufficient, but it may be a struggle in x20 binoculars.

Look for some color. Some observers suggest κ has a white primary and a yellow companion and ι a yellow primary with an orange companion. This is a good 'double double'!

In H A Rey's pictorial of Boötes, he is a herdsman smoking a pipe. κ and ι mark the top of the pipe and γ and λ the stem. Both are very near Alkaid in the Great Bear, Ursa Major, and it is from Alkaid that these two can be located. Note that they are a similar distance from Alkaid as M51 (SG53) is on the other side. By placing Alkaid in the center all three can be covered in a short observing period. Nearby is another galaxy, M101, which is another face-on spiral galaxy. Given its low surface brightness, it is best to observe when it is higher up away from light domes. It will be overhead in late spring and early summer and you may detect a hazy patch.

When Best To See It

March – May	June – August	September – November	December – February
Rising in east following Ursa Major	Visible high in the south and west	Low in north-west until October	Not really visible until February early hours, low in north

How Best To See It

Naked Eye	Binoculars	<150-mm aperture	>150-mm aperture
N/A	**	***	*****

How To Find It

Start with Alkaid in Ursa Major, the bright star at the end of the handle of the Plough or Big Dipper. Place it to the right of your field of view and κ Boo should just about squeeze in on the left in x7 or x10. If not, just nudge a bit to the left and both doubles should appear. ι is visually below a line drawn east from κ to θ.

A good finder scope which is well aligned to your main scope will locate all three in the field. Use your lowest power first in the scope before zooming in.

Fig. 4.54a. Chart showing the directions to κ and ι Boötis.

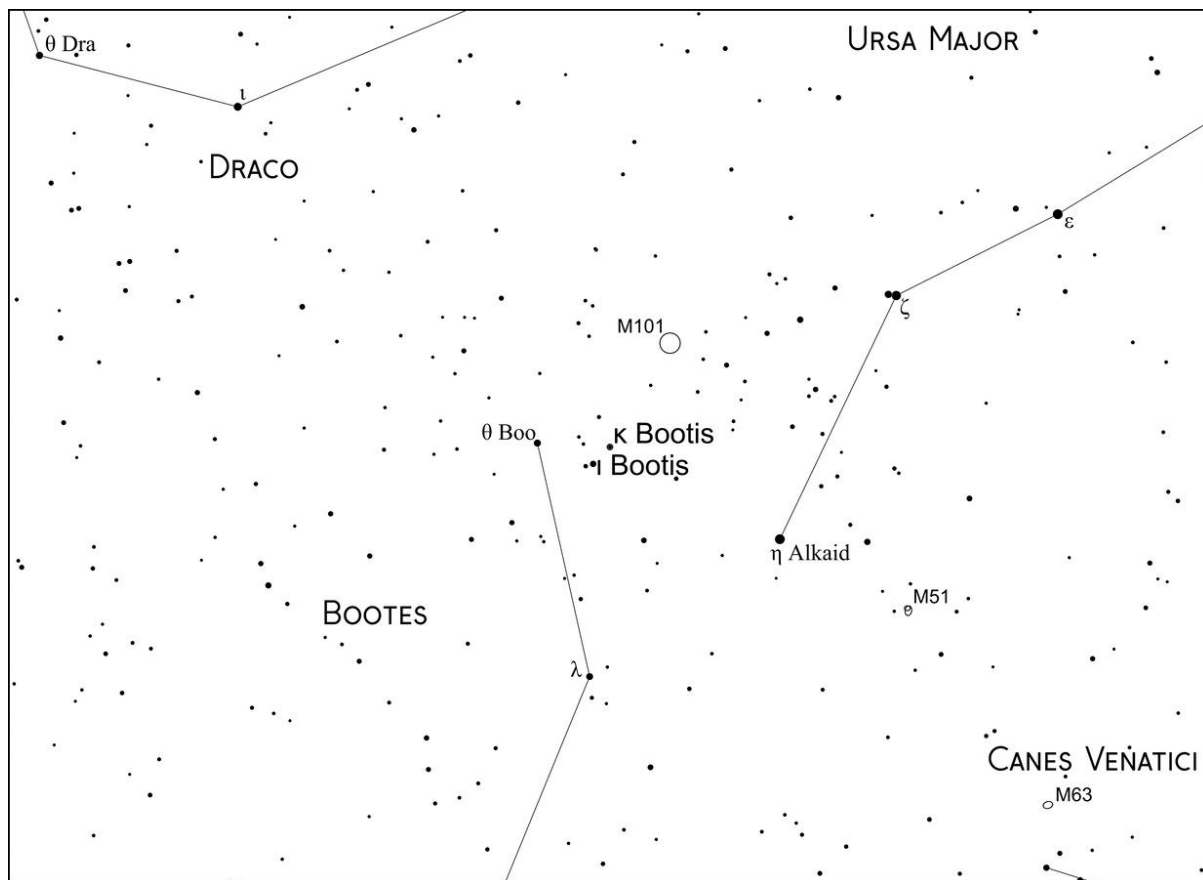


Fig. 4.54b. κ and ι Boötis. (Image by Andy Gannon)



M65 and M66

<i>Object type:</i>	Galaxies
<i>Also known as:</i>	Part of the Leo Triplet (with NGC 3628)
<i>Apparent magnitude:</i>	9.3 and 8.9
<i>Angular size:</i>	8.7' x 2.5' and 9.1' x 4.2'
<i>Distance:</i>	35 million light years
<i>Constellation:</i>	Leo
<i>Coordinates:</i>	RA 11h 19m Dec 13° 5'

Why We Like It

The coordinates given are for M65. This is an attractive pair of spiral galaxies which are best seen shielded as far as possible from light in a low power view with telescopes above 80-100-mm in aperture. These galaxies, along with NGC 3628, form the famous Leo Triplet which is a popular target for astro-imagers and deep sky observers. After M81/M82 in Ursa Major (see SG43 next), they are probably the most popular galaxy “doubles” sought after by amateur astronomers. The galaxies are estimated to be about 35 million light years away. Both of them were discovered by Charles Messier in 1780.

Like most galaxies, M65/M66 are affected by light pollution and you will need a telescope to see them properly in suburban skies. If you happen to have a good night and can get further away from light, binoculars will show them as faint oval smudges. M66 is slightly brighter and may be a bit easier to see. The third member of the group is best left for observing in rural or semi-rural skies. Nonetheless, this is a pleasing object and one of the few galaxies we have picked out for this Guide. You can sense the billions of stars in this view, all there but tantalizingly beyond our reach. One wonders what any inhabitant of a planet looking back towards us thinks of our Milky Way and its neighbor, the Andromeda Galaxy (SG1)!

When Best To See It

March – May	June – August	September – November	December – February
All night. Looking south	Visible in June but gradually lost in summer twilight	Pick up before dawn in November	Early hours onwards, getting earlier in night as winter progresses

How Best To See It

Naked Eye	Binoculars	<150-mm aperture	>150-mm aperture
Not visible	★	★★★★	★★★★★

How To Find It

Locate β , which is also known as Denebola, and move right towards θ . From there drop down about 3 degrees to a line of stars, the top one of which is 73 Leonis. 73 is slightly orange in color and a short move left should bring the two galaxies into view. A third galaxy, NGC 3628, is shown nearby making up the Leo triplet.

Fig. 4.42a. Chart showing the directions to M65 and M66.

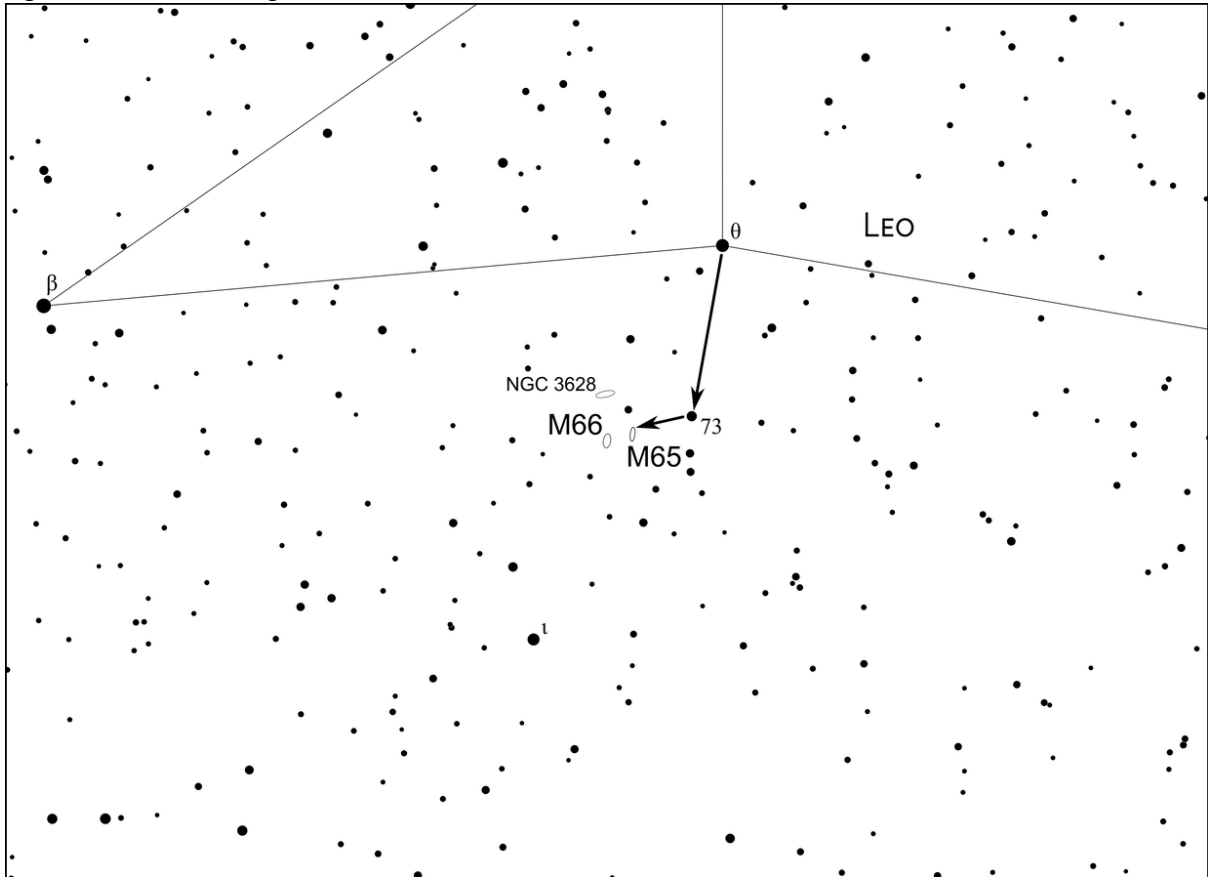


Fig. 4.42b. M65, M66 and NGC 3628, the Leo Triplet. (Image by Andy Gannon)



Langrenus

Object type: Impact crater
Diameter: 132 km
Depth: 4,500 m
Coordinates: 8.9° S | 61.0° E

Why We Like It

Langrenus is a large and impressive structure forming the northern end of a chain of huge walled plains together with Vendelinus, Petavius (SGM2) and Furnerius. The walls exhibit fine terracing and there is a compound central mountain system, the highest peak reaching 1,000 meters. Langrenus has a faint ray system best viewed under a high Sun. However, the most favorable time to observe Langrenus is just before lunar sunset (around 16 days) when shadows are lengthening. The sight of the last rays of sunlight striking the eastern wall as the shadow from the central peak approaches is quite spectacular. Sunrise on Langrenus occurs when the Moon is a slender waxing crescent, a phase difficult to observe due to the Moon's low altitude at sunset. However, the best opportunity occurs in early spring when the ecliptic forms its steepest angle to the horizon, lifting the Moon higher.

Langrenus can just be seen with the naked eye as a bright patch near the eastern limb. Binoculars will show its location well and small telescopes will show the rays, terracing and central mountain complex. A larger aperture will resolve a wealth of craterlets and fine detail around the ramparts of Langrenus when seeing is steady.

When Best To See It

	Lunar Sunrise	High Solar Illumination	Lunar Sunset
When:	December – April	September – March	August – December
Moon's age:	2-4 days	5-14 days	15-17 days
Best time to observe:	At dusk	All night	Around midnight

How Best To See It

Naked Eye	Binoculars	<150-mm aperture	>150-mm aperture
★	★★	★★★★	★★★★★

How To Find It

Locate Mare Fecunditatis.

Langrenus is the large prominent crater situated on the eastern margin of Mare Fecunditatis.

Fig. 5.3a. The location of Langrenus.

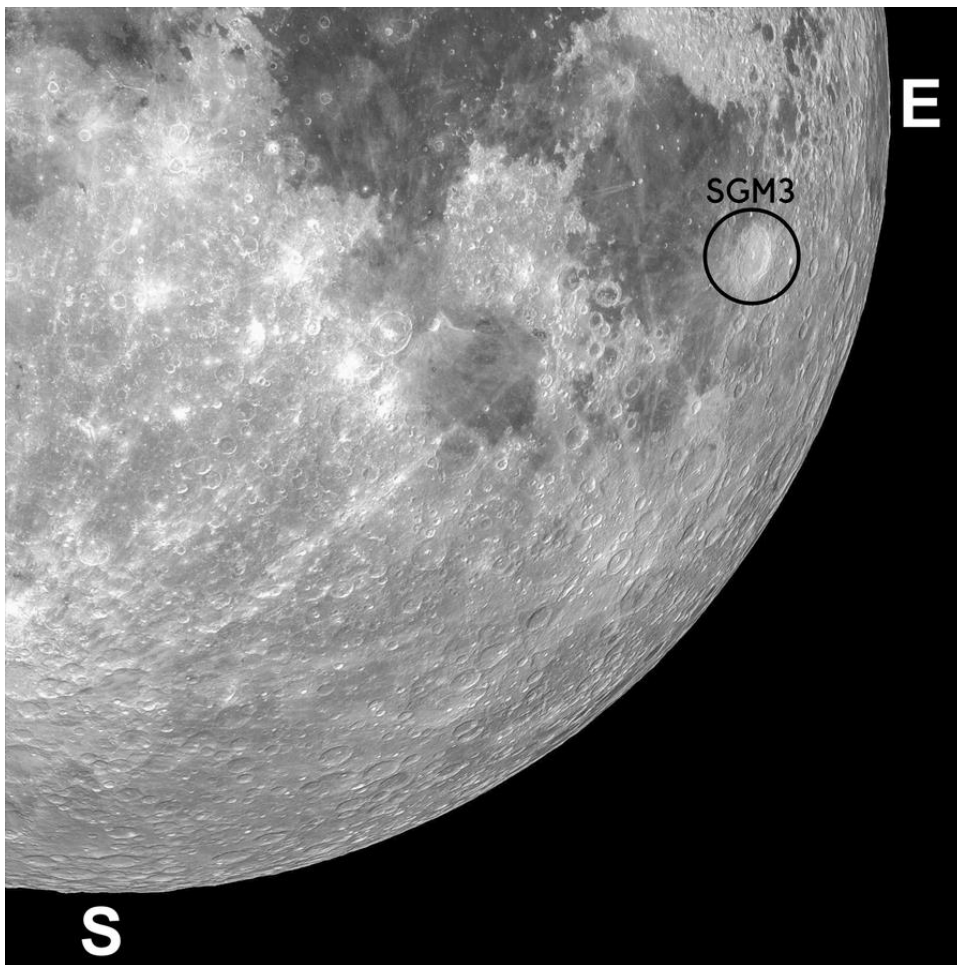


Fig. 5.3b. Langrenus about a day before lunar sunset. (Image by Andy Gannon)



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