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Sir Patrick Moore (Ed.)

(*continued after index*)

A User's Guide to the Meade LXD55 and LXD75 Telescopes

Martin Peston

With 119 Figures

Springer

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–David Kolb (Kansas, USA)

–George Tarsoudis (Alexandroupolis, Greece)

–Dieter Wolf (Munich, Germany)

Their images show what can be achieved with an LXD telescope and modest imaging equipment.

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It's been fun!

Martin Peston
London, UK
September, 2006

Author with AR-6 LXD55 Refractor mounted on an LXD75 mount.

Abbreviations

CCD	Charge Coupled Device
DEC	Declination
ECT	Estimated Completion Time
GPS	Global Positioning System
NCP	North Celestial Pole
OTA	Optical Tube Assembly
RA	Right Ascension
SCP	South Celestial Pole
SLR	Single Lens Reflex

Contents

CHAPTER ONE

Introduction

I have owned telescopes for over 25 years since I was a young lad. I purchased an LXD55 AR-6 Refractor in 2002, and was one of the first to own one in the UK. I am also a proud owner of an LXD75 SC-8. Armed with these two very different telescopes, I have spent many hours searching the skies for interesting objects using Meade's Autostar Goto facility.

My motivation to write a book about the LXD Goto telescope series, first came from comments about an LXD55 AR-6 Refractor review, that was published on the LXD55.com website. From then on, I have had regular emails from people asking technical questions about the telescope, and which model is best suited for them. Whilst attending Star parties in the UK, I found that many LXD owners would struggle to use them even at a basic level, especially if they have never owned or used an equatorially mounted Goto telescope before. Since the first LXD55 models came out in early 2002, owners have struggled to find useful information to help them use the telescopes to the best advantage. There have been mixed reactions about its quality and performance. Hence, this book is directed towards those who are new to Goto and the LXD telescope.

So why choose an LXD telescope? Many telescopes with Goto capabilities currently on the market, tend to be alt-azimuth mounted in design. They use either a single arm, or a fork mount to control the movement of the telescope tube. The LXD series however, uses a standard German Equatorial Mount (GEM) design, retro-fitted with Goto capability. Even though setting up a GEM with Goto is more involved than an Alt-azimuth mount, the GEM-Goto design of the LXD telescope is what has appealed to astronomers, both beginners and amateurs alike.

The Goto Revolution

Fifteen to twenty years ago if you wanted a telescope which could automatically find celestial objects in the night sky at a touch of a button, you would only be able to find them in custom-built observatories, or in professional telescopes on top of remote mountains.

The introduction of the Goto telescope to the astronomical community was heralded as a breakthrough in amateur astronomical observing.

Meade introduced their Autostar Goto handset back in 1999. They were supplied with the ultra portable popular ETX90EC. Since then, newer models of the Autostar handset have been released, and are supplied as standard with many Meade telescopes, including the ETX, LX90 and of course, the LXD telescope series. More information about Autostar in Chapter 3.

With today's skies seriously affected by light pollution, Goto has become *the* observing solution for astronomers to assist them in searching for those faint fuzzy objects.

To Goto or not to Goto?

Owning a Goto telescope has changed my personal attitude towards observing. I used to spend hours trying to search for elusive objects that were difficult to locate, and a whole night's observing would pass by with only a few distinctive objects seen. Of course, I used to enjoy those observing sessions but nowadays, I know that with my Goto telescope set up correctly, I can find many objects in a single observing session. I am not racing to see how many objects I can find in one night, it is the case of confidently knowing that an object I selected from the Autostar handset will be visible in the eyepiece.

I consider myself an experienced observer, and feel that using a Goto telescope has enhanced my observing skills rather than depreciate them, which is what many people are led to believe when they consider using these types of telescopes. If I was a beginner, new to astronomy and had the opportunity to purchase a telescope with Goto capabilities, I would expect the telescope to do all the complicated setting up procedures for me, and successfully point to an object selected from the Goto handset. Does this make me a lazy astronomer? Will I forget how to star hop? Or will I become completely dependent upon the electronics of the telescope to know my way around the sky?

Whether a beginner should buy a Goto telescope for their first observing instrument is a subject of many discussions. My personal opinion on the questions asked above? Well, I firmly believe that for someone who has very little astronomical observational experience, should learn the night sky with nothing more than the naked eye, or a good pair of binoculars. However, for someone who has some experience of using a non-Goto telescope, but would like to upgrade their telescope to one with advance electronic features, then a Goto telescope is ideally suited for them.

If you happen to own an LXD telescope and you don't know the first thing about using it, then I hope this book will be of use to you. I hope to have provided you with

all the necessary information to help you get to grips with Goto. Unfortunately, the manuals supplied with these telescopes only go some way to describe the real practical aspects of using a Goto telescope. This is why some sections in this book notably, Chapter 4 (Telescope Setup) elaborates upon the instruction manual. I would still suggest however, that you browse through the manual, to fully appreciate the setup procedures described in this book.

About This Book

There is a deliberate chapter order to this book; assembling, setting up, and using the telescope.

- Chapter 2 provides you with a brief guide to the celestial sphere and jargon used elsewhere in the book.
- Chapter 3 explains the types of telescopes that are on offer and what LXD model is best suited for you.
- Chapter 4 describes how to set up the telescope prior to observing.
- Chapter 5 helps you to Polar align.
- Chapter 6 explains what happens during a typical night's observing with a Goto telescope.
- Chapter 7 provides a mixture of useful information, such as the operations and abilities of the telescope, Autostar features and general observing techniques.
- Chapter 8 is a complete breakdown of the Autostar Object menu including images taken by owners of the telescope.
- Chapter 9 describes how to connect to a personal computer to control the telescope remotely and upgrade the Autostar internal firmware.
- Chapter 10 explains the equipment required to take images through the LXD telescope.
- Chapter 11 shows how to look after your LXD telescope.
- Chapter 12 provides information about the accessories that are available for the LXD telescope series.
- Chapter 13 is the troubleshooting chapters and provides solutions to some of the most common problems encountered by LXD owners.

A quick mention about the term 'LXD' used throughout the book. When the term 'LXD' is used without the suffix '55' or '75', it represents both models in the telescope series. For descriptions that apply to specific models only, then the terms 'LXD55' and 'LXD75' will be used.

I have provided a detailed set of Constellation star charts, depicting the location of every 'Named Star' listed in the Autostar database (Appendix A). These charts will be essential during the Goto setup procedures outlined in Chapter 4.

Appendix B at the back of the book contains useful information, such as lists of deep sky objects and constellations.

There is an Autostar navigation table in Appendix C, which will help you find your way around Autostar's extensive menu systems. There were several Autostar firmware releases from Meade, and some menu options have been relocated or added during the drafting of the book, so the menu lists may change in subsequent firmware updates. The firmware I originally used for menu descriptions was 32Eh. I have now included changes up to version 42Ed. The Index also contains a full list of Autostar options and where they are described in the book.

I have decided not to delve too deeply into various topics such as mechanical modifications or detailed programming of the computer handset, as they are covered elsewhere in other books or Internet resources.

I hope to think that this book will inspire further research about the LXD telescope series, considering the amount of information that is now freely available on the Internet. Hence, lists of useful websites and further reading are provided in Appendix D. And finally, Appendix E provides details about the astronomical images that were used in the book.

CHAPTER TWO

Astronomy as a Hobby

Introduction

It is said that Astronomy is the oldest of the sciences. For thousands of years civilisations have looked up at the sky, the Sun, the Moon and the Planets and tried to link their destinies to them. Huge stone observatories were built to predict the movements of the Sun, Moon and the Stars.

Over the past few centuries the scientific pursuit of knowledge has driven mankind to explore the heavens, in an ever-increasing depth in order to understand the Universe around us. New theories and technical advances have expanded mankind's knowledge of the cosmos, to such an extent, that we can estimate the start of the Big Bang to within millionths of a second, or estimate what the Universe might look like billions of years into the future.

Astronomy is no longer confined to the Royal Court of Kings and Queens or forms part of a wealthy gentleman's leisurely pursuit. Nowadays, to be an astronomer you don't have to build telescopes or grind mirrors, draw your own star maps or manually calculate the next phase of the moon or position of a planet. A lot of astronomers still like to do these tasks, including myself, and they are worthwhile pursuits for the more dedicated. But for the beginner it could sound daunting that to become an amateur astronomer you have to be an engineer, mathematician, physicist or all three rolled into one. This is not the case and you don't have to be experienced in a scientific discipline to enjoy astronomy as a hobby. The hobby of astronomy is not a 'black art' as most people make it out to be.

Everyone has their own reasons for pursuing astronomy as a hobby. Some like the thrill of one day discovering something such as an Asteroid, Comet or exploding Star.

Others find it a sociable hobby in order to meet with like-minded people to talk about life, the Universe and everything!!

The hobby is becoming more popular amongst the general public. One of the reasons for it being more popular nowadays is the use of equipment that makes it easier to find objects in the sky. Thanks to innovative technology introduced into the telescope market over the past decade, thousands of astronomical objects are now within reach of the amateur astronomer.

'Instant astronomy' is here. You can now buy telescopes at all levels, from the simple point-and-observe to all-seeing all-dancing Goto systems with GPS Satellite tracking that even tells you what to see when you are out observing. The only thing they cannot do is keep you warm during those cold dark winter nights! Even today's professional astronomers never physically look through large telescopes they are using. It's all done remotely through computer control. A typical amateur astronomer's setup nowadays is almost at par with the professionals' of ten or more years ago.

The popular misconception that most people have when buying a telescope with Goto features in particular, is that they do not need any prior knowledge of the night sky. The telescope will do everything for them and they will learn the sky through the use of the telescope features. Unfortunately this is not always the case and it always invariably leaves the user frustrated and disappointed after a failed night's attempted observing

While it is true that once you get to grips with using the telescope correctly, you can find all manner of astronomical objects in the night sky, learning to use the telescope from scratch; switch on and off you go, is more difficult than originally realised. The use of a Goto telescope still requires a basic knowledge of the night sky.

The rest of this chapter is dedicated to explaining some of the very basic concepts in astronomy. It is primarily directed to those who have very little experience, or no knowledge of the night sky. Those who have a grasp of the basic concepts can skip the next few sections if they so wish.

The Sky Above Us

Most people take the sky above them for granted. This may sound an odd thing to say, but it's often true. Only during something exceptional, which is normally publicised through the national media, do people then take notice that the sky is displaying something worth looking at, such as a Solar or Lunar Eclipse, Meteor Shower or usual lighting conditions.

Unfortunately the skies in the United Kingdom from the major cities are heavily light polluted, drowning out all but the Moon, some Planets and the brightest stars. The United States and other countries around the world no doubt also have their own light pollution problems in densely populated areas. There have been mixed responses by Governments to try and reduce the light pollution in the most populated urban areas with improved lighting. For now though, the only real way to fully appreciate the night sky in all its glory is to observe from a location a distance away from the cities and towns. However, most people make do with the light pollution situation and enjoy astronomy no less.

So, if you look up into the sky over a particular period of time what do you see?

If you happen to be fortunate to live in a place where there are dark skies and little light pollution, you will be able to see the Milky Way seen as a band of stars, arching the sky from horizon to horizon. I will discuss more about the Milky Way later in this chapter.

Over the period of a year you will see different constellations in the night sky on display throughout the seasons. Intermixed with these constellations you will see what appear to be slowly moving bright stars. These are in fact the Planets in our Solar System which course independently along the ecliptic, as they orbit the Sun through the Zodiacal constellations. Over the period of a month, you will see the phases of the Moon, and over the period of a day you will see the daily motion of the Sun.

The Earth in Motion

The changing displays of the constellations in the sky over a period of time are governed by the Earth's rotation (daily changes) and Earth's motion around the Sun (monthly and yearly changes).

We base our lives on the 24 hours day–night cycle. This is known as the Solar day, and is the length of time it takes for the Earth to spin on its axis once with respect to the Sun.

However, in relation to the Stars, the Earth spins on its axis once every 23 hours 56 minutes and 4 seconds. It is shorter than a solar day by about 4 minutes. This is the Earth's true period and is called the Sidereal day.

The reason for the difference in solar and sidereal days is that the Earth moves a specific distance along its orbit around the Sun in a single day. The position of the constellations which, for all intense purposes, are fixed in their positions in the sky will be seen by an observer on the Earth to have moved a small distance in the sky (about 1°), with respect to the Earth's position in its orbit around the Sun.

The difference of about four minutes between the solar day and sidereal day means that the constellation you see at a particular time on any given day will be in the same position in the sky, but 4 minutes earlier each night.

For example, a constellation that is due south at 10 p.m. at the beginning of a month, will be due south at 8 p.m. by the end of the month, almost 2 hours earlier. Hence over a period of 6 months, it will be due south some 12 hours earlier, i.e. during the day. In a single standard year, that constellation will be due south once again but 24 hours, one Solar day earlier. This doesn't mean however, that over longer time periods, such as decades or centuries, the winter constellations would be seen during the summer months and the summer constellations during the winter months, because of this one-day-per-year time drift; it's just that you can 'fit' 366¼ Sidereal days into one Solar year.

In other words, by the time the Earth has travelled round to the same point in the orbit again with respect to the Sun (one Solar Year), 365¼ Solar days or 366¼ Sidereal days will have transpired. The 'odd' quarter day is accounted for by having a 'Leap' day every 4 years.

The Celestial Sphere

The sky can be thought of a sphere with the stars projected onto it. Its coordinates are set horizontally and vertically, much like the longitude and latitude that we adopt for fixed positions on the Earth. In addition, the Earth's poles and equator are projected onto the sphere.

The Earth has its polar axis inclined at an angle of 23½° to the plane of its orbit around the Sun. This inclination gives rise to the seasons.

At different times of the year there are different constellations on display. This depends upon the Earth's position around its orbit of the Sun. As you can see from Figure 2.1, at different times of the year, the Earth is placed such that the night-time hemisphere is facing a particular group of stars. During the day the Sun is visible and because of its sheer brightness drowns out the other constellations that are in the sky

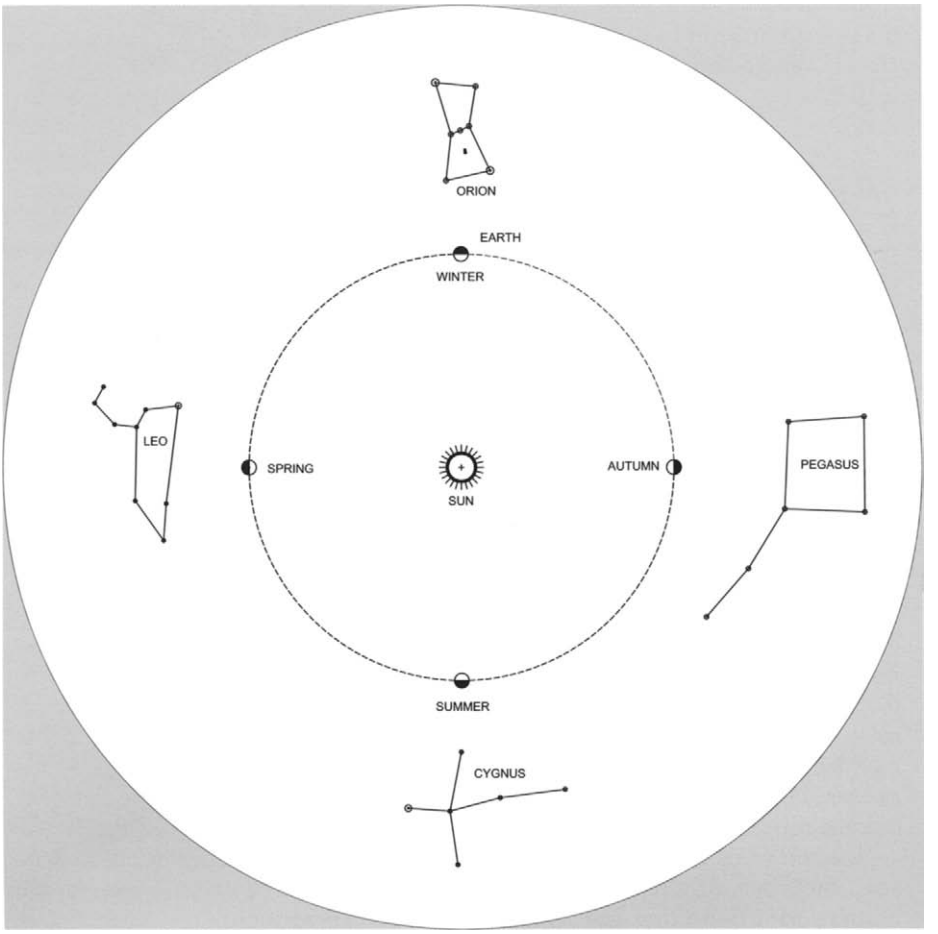

Figure 2.1. Earth's motion around the sun. Image courtesy of Alan Marriott.

at the time. If the Sun wasn't there, you would see a different set of stars during the daytime. As the Earth travels round the Sun in its orbit, the view of the stars from the Earth gradually changes from season to season.

The Earth's inclination to the plane of its orbit produces some interesting effects depending upon where you are standing on the surface of the Earth. If you happen to be at the North or South poles, the stars will move around the poles in a circular motion directly overhead to your position. The stars near the horizon will never rise or set and will appear to follow it all the way around in parallel paths during the course of the night. These are known as circumpolar stars.

If you are standing on the equator however, you will notice that all the stars will rise and set in huge semi-circles from East to West. None will stay above the horizon all night.

Most of us however, do not live on the equator or at the poles and so what we see is a star that rises, reaches its highest point (culminates) and then eventually sets, describing a great arch in the sky. Directly above an observer's head at the highest point of the sky is called the Zenith. Stars near the local Zenith do not stay above the horizon all night in most locations on the Earth, except for locations that are very close to the North and South poles (Figure 2.2).

Sky Coordinates

Astronomers use Sidereal time to work out which astronomical objects are visible in the sky at any given time. A Sidereal day is split into twenty-four 1 hour segments just like the normal clock time that we use. Using the Sidereal day makes it rather more convenient for astronomers than trying to split up 23 hours 56 minutes of the solar day with respect to the stars motion.

Stars rise, culminate and set at the same sidereal time every sidereal day. Hence, the stars are more or less fixed to the sidereal positions. This is useful if astronomers want to map the position of the stars in the sky. Stars have *proper* motions in which they slowly change positions in the sky over long periods of time as they orbit the galaxy. This motion, however takes hundreds, if not thousands of years and therefore their sidereal positions are not adversely affected in the immediate short term. Star Maps however are periodically updated every 50 or so years so that they can provide up to date positions of the stars.

Astronomers call the sidereal time of any given astronomical object, its Right Ascension (RA). The initial starting point is 0 hour 0 minute 0 second, which is known as the 'First point of Aries' and is incremented in hourly points eastwards from the initial start point. It is similar in concept to Greenwich Mean Time, which starts from the meridian at Greenwich, London where all other references to the Earth's Longitude are based upon. The right ascension is projected onto the celestial sphere along the celestial equator.

Note: the term 'First point of Aries' was first coined by the Greeks over 2000 years ago. Since then, this 'point' has moved into the constellation of Pisces, due to the Earth's polar axis drifting over a long period of time (precession).

Each 1 hour of RA projects 1/24th of a complete circle. Since a circle is 360° each 1 hour part represents 15°. So a star at 6 hours RA is 90° from the first point of Aries,

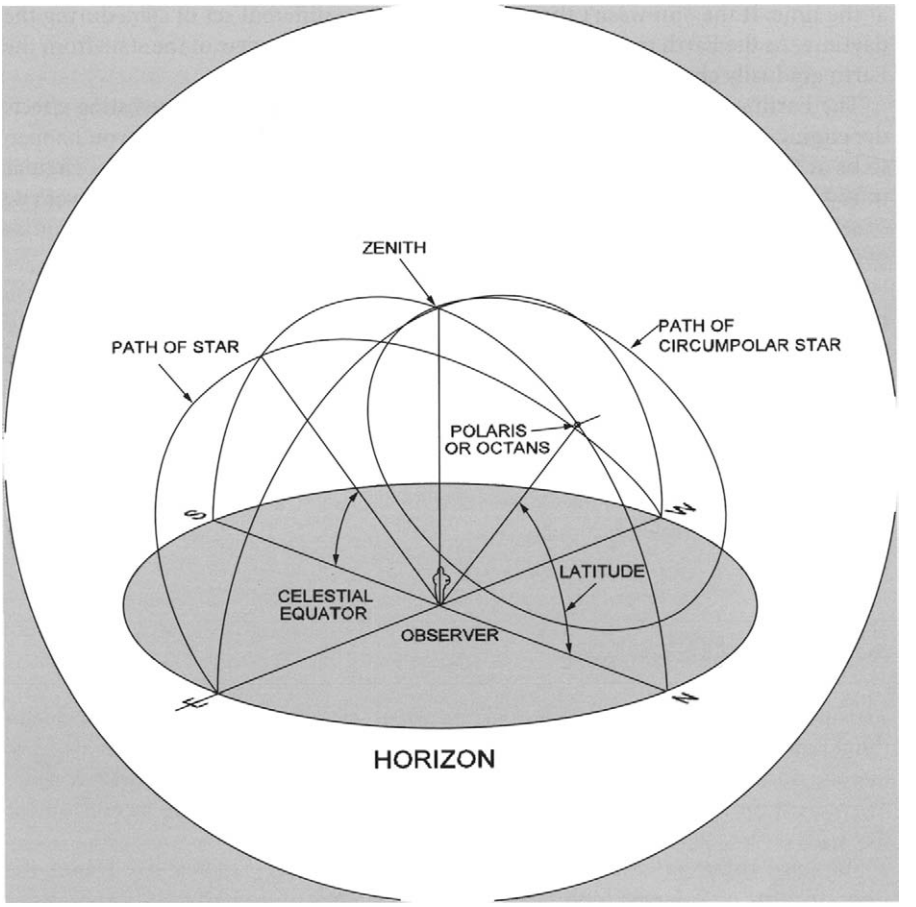

Figure 2.2. Observer's perspective of the celestial sphere. Image courtesy of Alan Marriott.

a star at 12 hours is 180° from the first point of Libra on the opposite side of the sky and so on.

Vertical coordinates of the celestial sphere are known as the declination (Dec) which are measured in angular intervals, degrees denoted by the degree symbol °, minutes denoted by the single quote symbol ′ and seconds denoted by the double quote symbol ″. These pairs of RA and Dec coordinates are often referred to as Equatorial or Celestial coordinates.

The declination of a star is also fixed, just as the right ascension so astronomers can pinpoint astronomical objects in the sky by using both their RA and Dec coordinates. The declination of an astronomical object is the angular distance from the celestial equator. It has positive coordinates up to 90° above the equator and negative coordinates below the equator down to minus 90°. Hence, if you see a star with a

negative declination you will automatically correctly conclude that the star is located below the celestial equator.

For example, the brightest star in the northern hemisphere is Sirius whose coordinates are RA. 06 hours 45 minutes and Dec. −16° 45′. So the star is situated about 16° below the celestial equator.

Polaris however, is RA. 02 hours 31 minutes and Dec +89° 16′, which places it very close to the celestial pole. We shall be talking more about Polaris in Chapter 5.

In addition to the celestial equator, we have the Ecliptic. This is the apparent path that the Sun takes over the period of a year and represents the plane of the Earth's orbit. It makes an angle of 23½° to the celestial equator (Figure 2.1). Our Moon, the rest of the Planets and other bodies of the Solar System are located on or around the area of the ecliptic plane. The constellations that the ecliptic passes through are known as the Zodiacal constellations. Astrology attempts to draw upon some significance of the positions of the Planets and the Zodiacal constellations at specific times of the year, and how they are supposed to govern our daily lives.

The ecliptic and the celestial equator crosses at two points on the sphere. The first one is at the 'First point of Aries', which happens to be where RA measurement is started from. The second position is directly at 180° on the opposite side of the sky, at the position known as the 'First point of Libra'. When the Sun crosses these points we have the Equinoxes. On or around March 21st each year, the Vernal equinox occurs when the Sun moves northwards to above celestial equator from below. The Autumnal equinox occurs on or around September 23rd each year, when the Sun moves southwards to below the celestial equator.

I have discussed just a few of the main concepts of the celestial sphere in this section. The more advanced concepts are not required here as you only need to understand the basic concepts in order for you to use a Goto telescope.

Absolute Beginners

If you are just starting out in astronomy and have very little or no experience of the night sky, then I would not recommend that you jump straight into the deep end and start using a telescope immediately. It is best to start observing with nothing more than your eyeballs and a good set of sky maps. With a little dedication and patience, you will find observing a rewarding and enjoyable experience.

Back to Basics

The first steps in familiarising yourself with the sky is to go out at night, armed with nothing more than a red-light torch and a sky map. There are many excellent sky maps available. A sky map will assist you to recognise well known bright stars and constellations, and when they are visible at specific times of the year.

Even this simple task of finding well known stars and constellations to an absolute beginner is easier said than done. Simply going straight out and trying to match constellations with what you see on the sky map, can still be a difficult task, especially if you happen to live in an area where the skies are light polluted. The stars on the sky map might not depict what you can actually see in the sky. It is the locations of the brightest stars along with their proper names that you should familiarise yourself with. Once you know the positions of the well-known stars in the night sky, you will be able to set up telescopes that have Goto features.

Before you can begin use a sky map at night, what you need to do first is to get your bearings. You need to work out which way the Cardinal points; North, South, East and West are facing, as this will help you find your way around the sky. The steps below will help you determine the cardinal points at your location.

1. During daylight hours, take with you to the observing area, a compass or anything other means that will allow you to determine which way you are facing. For example, by electronic means such as a GPS.
2. Survey the observing area and find North using the compass. Make a mental note which way you are facing. For example, North could be facing towards your residence or towards a recognizable terrestrial landmark, such as a tree or distant hills.
3. Do the same for the other South, East and West cardinal points.
4. You may want to make a mark on a nearby object that represents a cardinal point so at night you will be able to determine the direction you are facing.

This basic procedure will help you not only find astronomical objects in the night sky, but will also help you towards setting up a telescope when the time comes. Now you are ready to find your way around the sky.

Naked Eye Observing

The Mark I eyeball is the best tool for you to use to help you find your way around the night sky. The eye is a remarkable astronomical instrument and has been used for millennia to observe the heavens long before optical aid was conceived.

Finding Your Way Around the Sky

Preparation

When you go out to look at the night sky, make sure you are prepared.

- Take a Torch with you – preferably one with a red light. This is essential in finding your way around the observing site, also for security and safety. This will allow you to dark adapt much easier, as bright white light tends to dazzle your eyes, making it more difficult for you to see faint astronomical objects. It takes approximately 30 minutes or so for the eye to dark adapt. More on dark adaption techniques later in Chapter 7.