Introduction

This book is written for those who look at the stars with wonderment and would like to feel more at home with them, to go for a friendly walk with them.

In order to walk through the heavens and to know where you are, you must recognize what your eyes see. To call your neighbor by his or her name is the beginning of friendship. To know the names of stars and constellations is to form a friendship with our heavenly neighbors.

As we walk among the constellations, you will feel the immensity and quiet peace of the night sky. Do not ignore the legends about the constellations in Part 3 of the book. These legends will lend greater feeling to your vision of the world above. Friendship with the stars will deepen as we sense the thoughts and dreams of people who imagined people and animals living among the constellations.

Our walk will take us to the brightest stars in the sky. When we become familiar with them they will lead us to the dim stars.

It is not enough simply to find a constellation. Try to see relationships between constellations. This is best done if you know different pathways to the constellations.

Almost certainly the early cave dwelling people and probably the early forms of humans looked to the stars with a sense of awe. In their vivid imagination they joined certain bright stars together into patterns in which they imagined figures of animals or people with unusual attributes. These patterns, that we now call constellations, varied among different peoples across the world.

From the earliest of times people have looked to the stars to help them navigate across seas and deserts, know when to plant and harvest, establish their legends, mark the change of seasons and even to align their temples of worship.

Constellations were recorded over 5000 years ago and lists of such patterns were written 2400 years ago by the Greek astronomer Eudoxus who studied under Plato. Ptolemy, who lived 2100 years ago, compiled a list of 48 constellations which has remained relatively standard to this day. Later, Johann Bayer (1572–1625), Johannes Hevelius (1611–1687) and Nicolas de Lacaille (1713–1762) added more constellations to the list. Professional astronomers now officially recognize 88 constellations which they regard simply as areas of the sky, not as star 'pictures' or patterns. These patterns have never been made 'official', so you should feel free to make any constellation design you wish.

Before we begin our walk through the heavens, we should understand two concepts: how to measure distances in the sky, and the brightness of the stars.

After this is done, follow the instructions on how to use the atlas to best advantage.

In Part 2, 'A Walk through the Heavens', the design or picture of a group of stars to form a constellation image will usually, but not always, contain stars which are bright enough to be seen easily. Most of the constellation patterns are well recognized images, but some are new.

For convenience, each star in each constellation will be numbered and some will be named, so that we can more easily identify specific stars to help us walk around the sky. We will follow several paths to a constellation. By doing this you will have a better sense of star relationships.

Since I have been disturbed with the violence that is part of the commonly used legends associated with the constellations, I have taken the liberty of modifying and abridging them. Legends have been and will continue to be modified with each generation.

This book applies to people living in the northern hemisphere. Our other book, *A Walk through the Southern Sky* will benefit our friends in the southern hemisphere.

Relax and enjoy yourself as you travel across the sky.

Part 1

Measuring Distances in the Sky

Measuring Distances in the Sky

How do we measure the size of the Big Dipper or the distance between two stars? We cannot measure these distances in inches or millimeters, which are linear measurements (measurements along a line). Instead, we must use a measuring system using angles to determine how far apart one star or constellation may be from another.

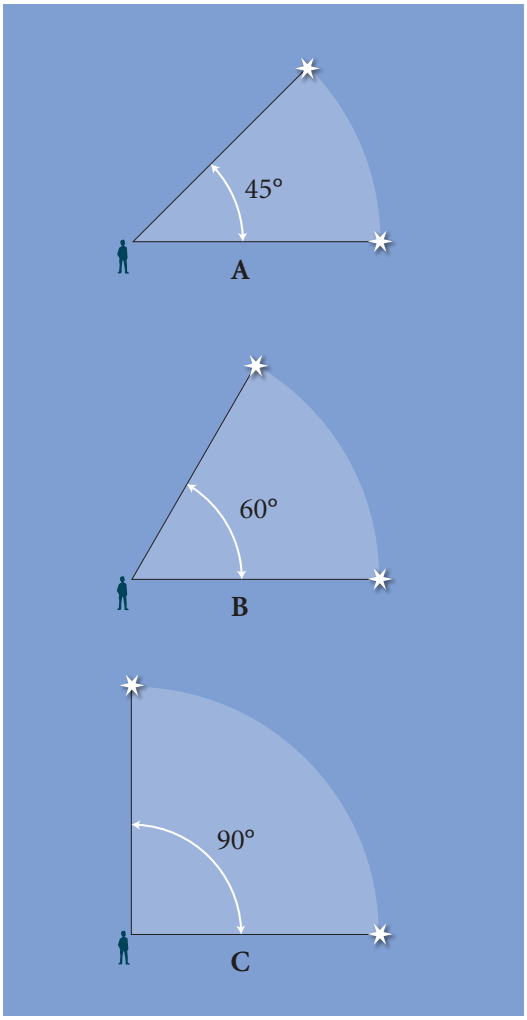

Fig. 1

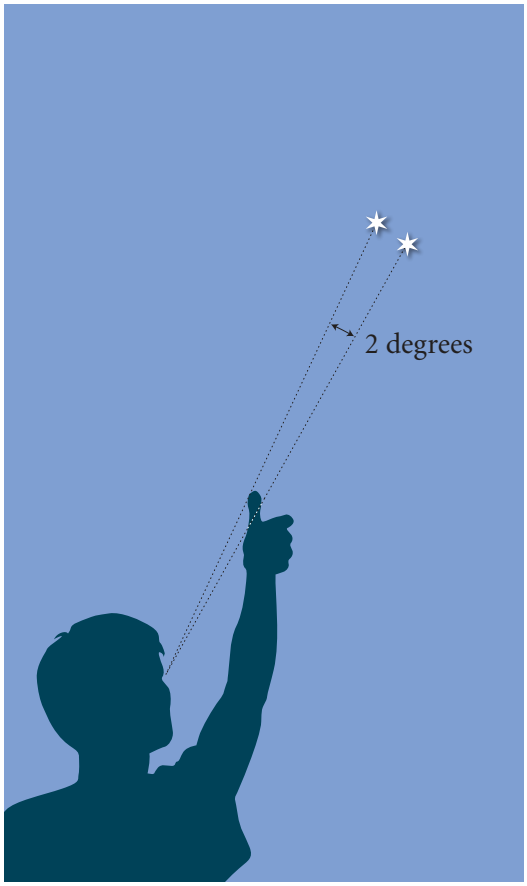

Fig. 2

An angle is formed by two lines that meet at one point. The space between the two lines forms an angle that is measured in **degrees**. There are 360 degrees in a circle. The angle in Fig. 1A is 45 degrees; 1B is 60 degrees; 1C is 90 degrees. The further apart two stars, the larger the number of degrees between them.

How do we measure angles in the sky in a practical way without fancy instruments?

We measure the distance between two far away objects such as stars using our eye as the corner of the angle and using a part of our hand to hide the sky between those stars. The further apart the stars are, the more of our hand we need to use to cover the space between them. Look at Fig. 2.

With your arm outstretched, your hand will help you determine angular distances. Extend your arm out in front of you and hold your thumb upright. It is now hiding part of what is in front of your vision. The amount of view that is hidden behind your thumb will depend upon how long your arm is and how thick your thumb may be. The shorter the arm, or the thicker the thumb, the more of your view will be hidden.

So our hand becomes an excellent device for measuring distances in degrees in the sky. Different parts of your hand can be used to measure different angles. Look at Fig. 3.

The tip of your small finger will cover approximately 1 degree of sky. In your room look at the door knob or light switch across the room. Your finger can cover it. Now look at a building across the street. The same finger will cover a large part of the building. Now look at the Moon. The same finger can cover the Moon. How can this be since one is so much larger than the other? Look at Fig. 4.

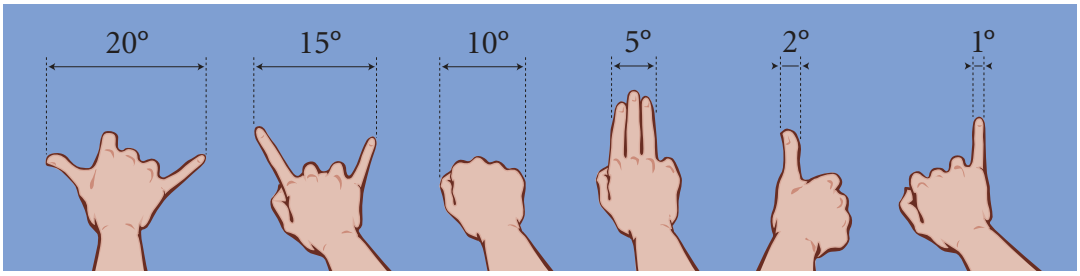

Fig. 3

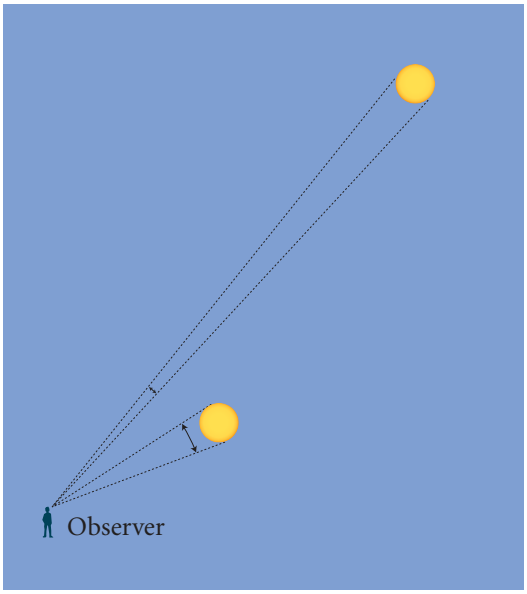

Fig. 4

Although the Moon is so much larger than the building across the street, it can actually be hidden by a narrow object like a finger. The diameter of the Moon, when measured this way, is seen to be only half a degree wide. The farther away an object is, the smaller the angle needed to hide it from sight. The Moon looks much bigger than a star because it is so much closer to us.

Distances to the stars

We measure the distance between a star and the Earth, not in miles or kilometers, but in **light years** by using the speed of light. It is important to remember that a light year is a distance; it is not a measure of time. The distance light travels in one year is a light year. Light travels 186 000 miles per second (299 000 kilometers per second), which is 680 760 000 miles per hour (1 096 000 000 kilometers per hour). Therefore, a light year is a distance of almost 6 000 000 000 000 (6 trillion) miles, or 9.6 trillion kilometers.

It takes slightly more than one second for light from the Moon to reach the Earth and more than 8 minutes for light from the Sun to reach Earth. Compare this with the 4.4 years that it takes for the light from the nearest star, Alpha Centauri, to reach the Earth. Deneb in the Northern Cross is over 2500 light years away. That means the light we now see left the star over 2500 years ago. It is therefore possible that the star may not even be there any more.

Three-dimensional awareness

The stars within each constellation appear as if painted on a flat surface. This is an illusion. As you study the diagram of the constellation Cassiopeia (Fig. 5) try to imagine the tremendous degree of separation of each star from what would appear to be its close neighbor. This three-dimensional phenomenon holds true for the relationships between all stars in the heavens.

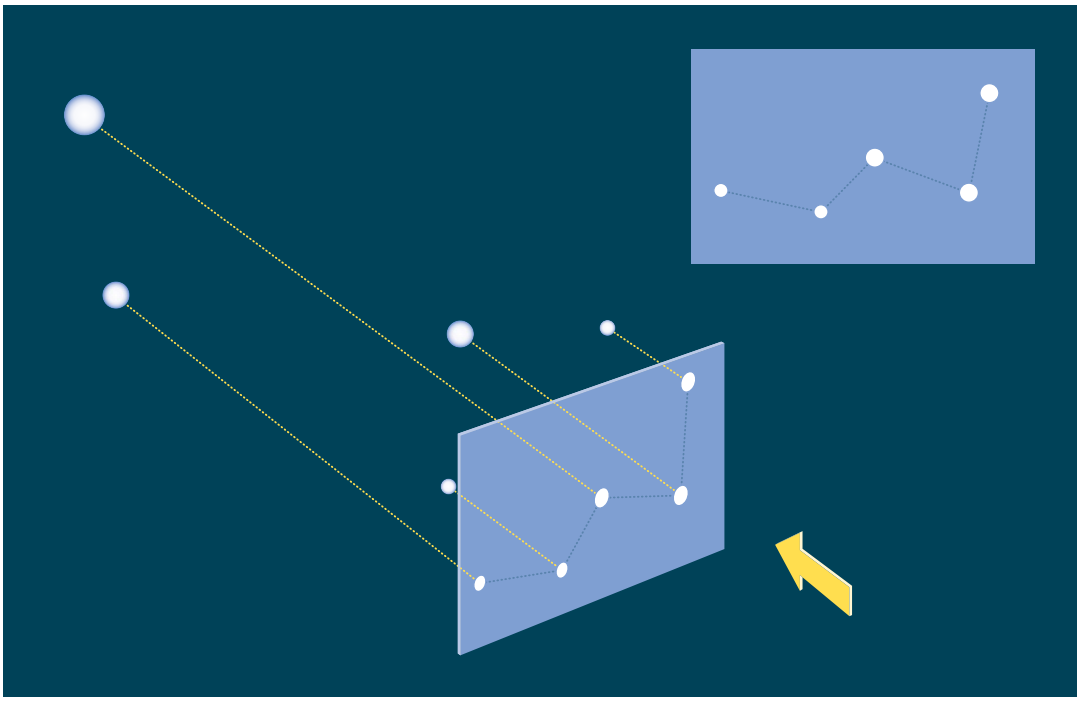

Fig. 5 – Cassiopeia

The brightness of stars

Some stars appear much brighter than others. This does not necessarily mean that the bright star is bigger or giving off more light than the dimmer star. The **apparent brightness** (how bright it seems to us) depends upon three things: (1) how big it is; (2) how far away it is from Earth; and (3) how much light it actually emanates per diameter of the star. The brightest star to us is our Sun, but it is only an average size star – it seems the brightest because it is the nearest star to us on Earth.

The star Sirius in the constellation of Canis Major appears considerably brighter than Rigel in Orion. However, Rigel is actually thousands of times brighter than Sirius. It appears fainter because it is almost 900 light years away, while Sirius is only 8.5 light years from us.

We measure the brightness of the stars as seen with the naked eye on a scale called the **magnitude** scale. Hipparchus, a Greek astronomer, rated the importance of stars by their brightness and used the word magnitude to describe their relative brightness. Magnitude means bigness. In ancient times they may have assumed that the brighter star is a bigger star. A very bright star would have a magnitude of 1 or less and a very faint star a magnitude of 6. The smaller the number, the brighter the star. A very powerful telescope can see very faint stars beyond magnitude 20. You may be able to see stars with a magnitude of 6 to 7 with your naked eye under very clear, moonless skies. The very brightest planets have magnitudes of –1 to –4. Unfortunately, light pollution from home and street lamps may prevent you from seeing as many stars as you could if your surroundings were in total darkness.

Remember, magnitude measures how bright the star is to our naked eye, not how much light the star actually produces, nor how big it is.

Although there are billions of stars, we can only see approximately 2500 stars with our naked eye at one time under the best of conditions. Later look on page 79 and read how to test your vision.

Fig. 6 – Side view of a galaxy

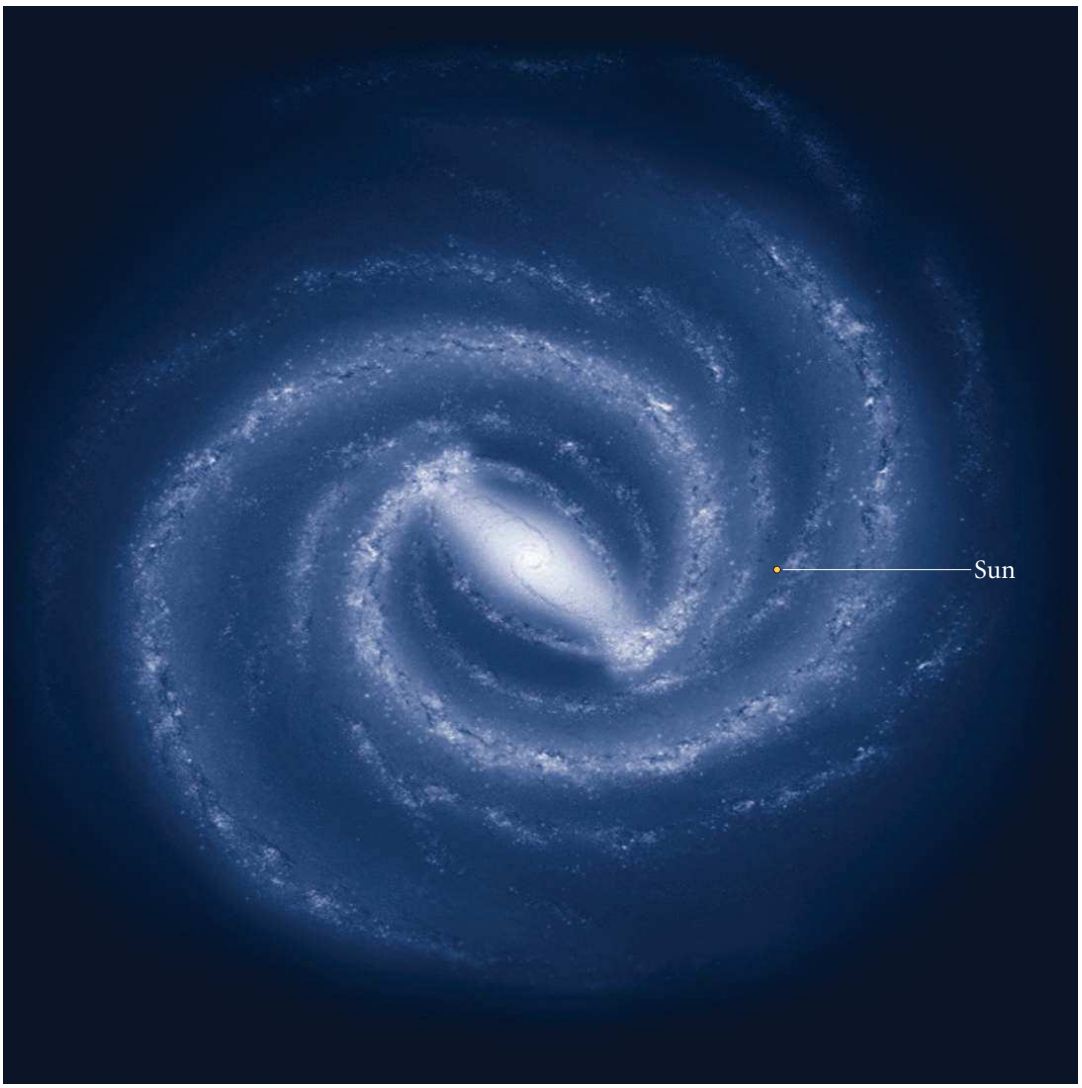

Fig. 7 – Top view of our galaxy, showing the position of the Sun

The Milky Way

The space around us seems to be endless. It is a space occupied by billions upon billions of galaxies, each of which is composed of billions and billions of stars, of which our Sun is an average-sized example. The faint band of stars that arches across the sky was called the Milky Way by the early Greeks. It is our view of the galaxy in which we live from within one of our galaxy's spiral arms. The location of our Sun and Earth in that spiral arm is approximately 30 000 light years from the center of our galaxy.

What we see with our naked eye is confined to our own galaxy. However, with good eyesight, and if the night is dark enough, you may see a neighboring galaxy as a faint blur in the constellation Andromeda, or the Small and Large Magellanic Clouds in the region of the constellation Hydrus. Although our galaxy is whirling in space at tremendous speed it still takes 225 million years to complete one revolution. That time period is called the Galactic Year.

Imagine yourself sitting near the end of a spiral arm of our galaxy. If you look straight up or down you will see neighboring stars in our spiral arm of our galaxy but when you look toward Sagittarius you are looking along the flat side of the spiral arm toward the wider and more dense center bulge of our galaxy. We cannot see the spiral arm opposite us because it is hidden by the billions of stars in the center of the galaxy.

As you look along the Milky Way you will notice that some areas appear to have dark holes or slots in them. These are not empty spaces, but rather dark masses of dust, star debris and gases that hide the stars behind them. There is a very definite dark slit in the area of Cygnus, sometimes called the Great Rift, or the Northern Coalsack, and a similar dark patch in area of the Southern Cross, called the Southern Coalsack.

Life in the heavens

There are eight known planets orbiting around our Sun. (Pluto, formerly the ninth planet, was officially demoted in 2006.) There are over 200 000 000 000 (200 billion) suns (stars) in our galaxy. There are billions of galaxies. Just imagine how many planets there must be in our galaxy alone. It is therefore almost impossible to assume that we are the only planet with life on it. Since 1995, several thousand planets have been identified around distant stars. Some of them appear to be as far from their sun as Earth is from our Sun. This suggests that at least as far as distance to the life-giving source of a sun is concerned they are not unlike Earth. It is also important to realize that the basic elements necessary for life as we know it, carbon, hydrogen, oxygen and nitrogen, exist throughout the heavens. The question is not whether there are any living organisms among the stars, but rather what kind of life is there and are they trying to contact us? We should realize that amino acids have been found in meteorites. Given the proper environmental conditions these molecules may join to form the proteins and RNA of living cells, which can then replicate themselves. Such action signifies life.

Instructions for the use of the atlas

Begin your walk through the sky by first determining which constellations are visible overhead during the month of your walk. Therefore, look at the following four star charts, which give an overview of the constellations visible during each of the four seasons. Look at the chart for the appropriate season. Hold the chart in front of you like reading a book. Do not place it overhead. You will notice north at the bottom. Face north and compare the lower half of the chart with the stars in the sky. Then face south, east, or west and turn the star chart around so that the direction you are facing is at the bottom of the chart.

When you have determined which constellation you wish to see, turn to the index (pages 95–97) to find out which are the diagrams for that constellation. There is a date in the caption below each diagram. If you are looking at the sky on a different date, the positions of the constellations will not change in relationship to each other. Those relationships are constant, but since the stars appear to move due to the Earth's rotation, you may have to turn the diagram in order for the constellations to appear as they do at your time and date.

If you are not familiar with the constellations then start your walk with the Big Dipper on page 18. Concentrate upon the four main constellations, Ursa Major, Ursa Minor, Cepheus and Cassiopeia (see Fig. 12 on page 22). If you are familiar with some of the star groups, then, depending upon the season, look for a specific constellation by using the index to find the diagram dealing with that constellation's relationship to other constellations. If you are only slightly familiar with some constellations the four charts here can help you find others.