Computer Lab #4

Chapter 4

Naming Objects in *TheSky*

Astronomers need to be able to assimilate and exchange information about specific objects in the sky. Many systems have been devised over the last few thousand years to identify and name the most conspicuous ones. As our technology has advanced, studies of astronomical objects have become more precise. Today it is common for astronomers to assign numerous designations to a single celestial body.

Humans have observed the stars for millennia. Our ancestors named the bright stars as well as larger groups of stars called constellations. As we said in Chapter 1, the ancients named many of the constellations after mythological beasts, gods, demigods, and ordinary household objects. Astronomers continue to use the names of the constellations first recorded by ancient astronomers thousands of years ago. It is here that we may begin to learn about where things are located in the sky and how they are named.

Astronomers officially recognize 88 distinct constellations today. *TheSky* displays all of them quite accurately. From the mid-northern latitudes, you can see over half of them. Most are visible every night from your location at some time during the night. *TheSky* helps you to find them but you must go outside on any clear night throughout the year and look for them yourself.

About a half dozen or so constellations are visible every night from 40°north latitude all year round. These are the circumpolar constellations. They are all located in the northern sky near the North Star, Polaris. Using *TheSky* will definitely help you locate all these constellations easily during any season of the year. Exercise A is designed to help you locate some of the constellations visible from mid-northern latitudes.

Exercise A: View Some Constellations

1. Run *TheSky*.

2. Click Data on the toolbar at the top of the sky window, then Site Information and then click the Location tab.

3. Set your location to 40° north latitude. The city or longitude is not important here! Figure 4-1 displays the appropriate information that should be entered into the Site Information window.

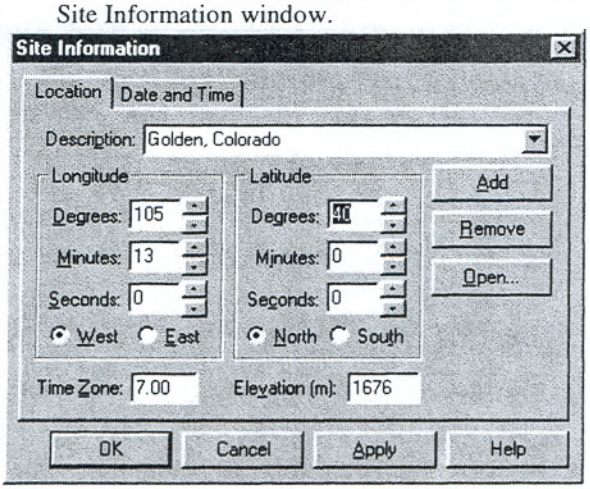

Figure 4-1 Entering 40° north latitude for any observer

4. Click Apply.

5. On the Orientation toolbar, click "North" ().

6. Go to View toolbar and click on the constellation lines (), if they are not already displayed.

7. Click the common names button () on the View Toolbar, if they are not already displayed.

8. Go to the Time Skip toolbar and click the Go Forward () button and watch the motion.

9. List the names of the constellations that do not go below the northern horizon.

_____

_____

_____

_____

_____

_____

_____

These constellations are visible every night throughout the year and are known as *circumpolar constellations*. Exercise B is designed to find a particular constellation in *TheSky*.

Exercise B: Find the Constellation of Orion

1. Click Edit on the toolbar at the top of the sky window, and then Find, or right click the mouse anywhere in the sky window.

2. Click on the "Constellation Labels" in the Common Names window.

3. Use the scroll bar and find the constellation Orion. Figure 4-2 displays the "Find" window.

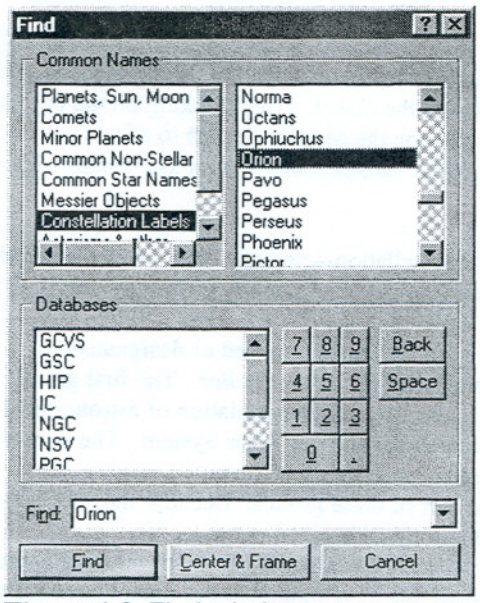

Figure 4-2 Find window

4. Double-click on "Orion."

5. After clicking on "Orion," an Object Information window appears, like the one displayed in Figure 4-3. This box indicates where the constellation is located in the sky and other pertinent information about the constellation, such as the pronunciation of its name.

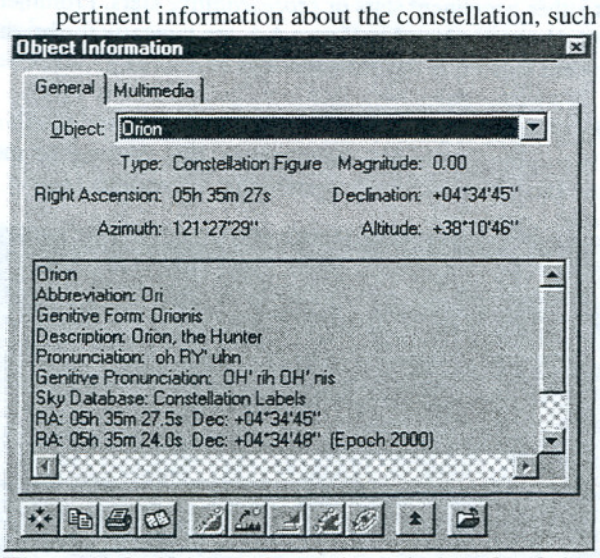

Figure 4-3 Object Information window for Orion

6. Click the Rise, Transit, and Set button () at the bottom of the Object Information window. This displays the time of day that Orion appears to rise, cross your local celestial meridian, and set at your location. The time of meridian transit is the best time to view the object.

At what time does Orion appear to rise? ____:____
At what time does Orion appear to set? ____:____
When is the best time to view Orion? ____:____

7. Next click the Center Object button () at the lower left-hand corner of the Object Information window. This will center Orion in your sky window.

8. Click on some of the objects in the constellation. Did you find M42?

9. If a camera icon is displayed in the sky window, you can view an image of the object by simply clicking on the camera. If the camera icon is *not* displayed in the sky window, then to view an image of the object you must click on the object. After clicking on the object, an Object Information window appears. Now click on the Multimedia tab to access any images of the object. You can display or hide the camera icons in your sky window by choosing either option in the Filters menu.

That's all there is to it. Try finding another constellation—perhaps one you like better than Orion. You can use this exercise to find any astronomical object in *TheSky's* database. Appendix B contains a list of the 88 recognized constellations.

Now let's turn our attention to how astronomical objects are named or designated. Basically, astronomical objects fall into two groups, *stellar* and *nonstellar*. The first group includes *only* the stars. The second group has a more diversified population of astronomical objects. The later group contains objects that lie well beyond our Solar System. The nonstellar group contains objects such as nebulae, star clusters, and other galaxies.

The planets in contrast are not included in either of these groups. Because they are Solar System objects, astronomers usually designate them by their given name.

Let's first discuss how stars are designated. Over the millennia people have used several systems to denote the stars. The numerous cultures that have inhabited our planet have assigned many names to the stars over the years.

Proper Names

Astronomers usually refer to stars as either *prominent* stars or *representative* stars. Prominent stars are the bright stars. Stars, such as those displayed in Figure 4-4, are typically the bright stars seen in the winter months. They are located in the constellations of Taurus, Orion, Canis Major, and Canis Minor.

The dot sizes displayed in the sky window, representing stars, indicate the stars' relative brightnesses, not their true physical sizes. In other words, the bigger the dot, the brighter the star; the smaller the dot, the fainter the star. The magnitude system that astronomers use in observational astronomy is discussed in Appendix F.

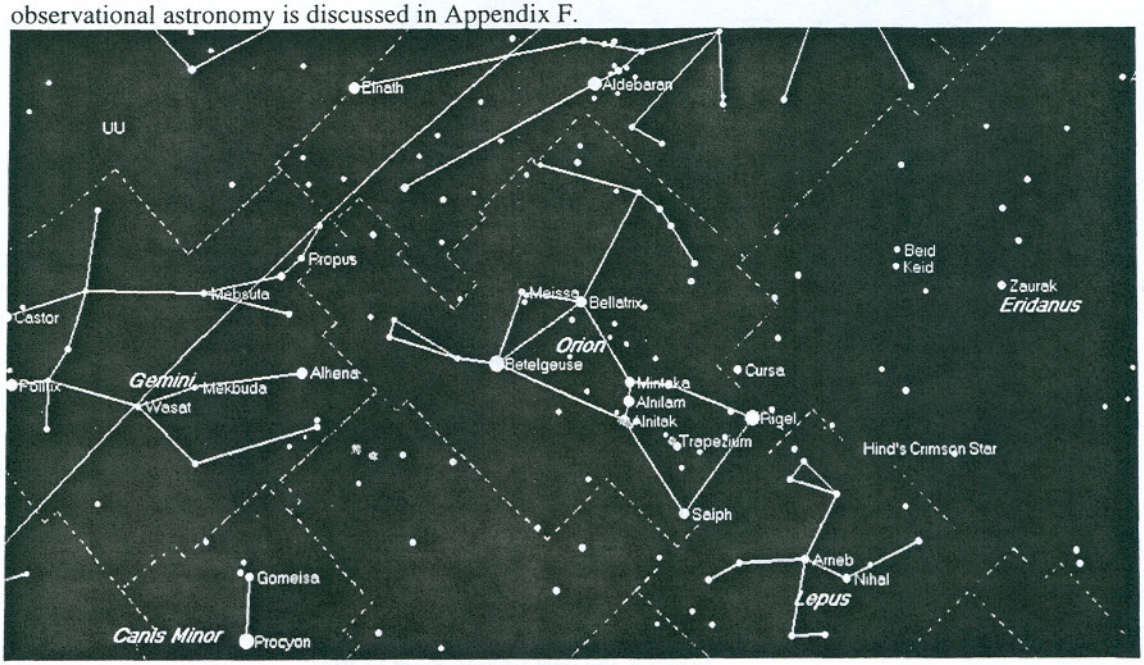

Figure 4-4 Prominent or bright stars of winter

The bright stars of summer are typically those that are displayed in Figure 4-5. These stars are located in the constellations of Lyra, Cygnus, and Aquila.

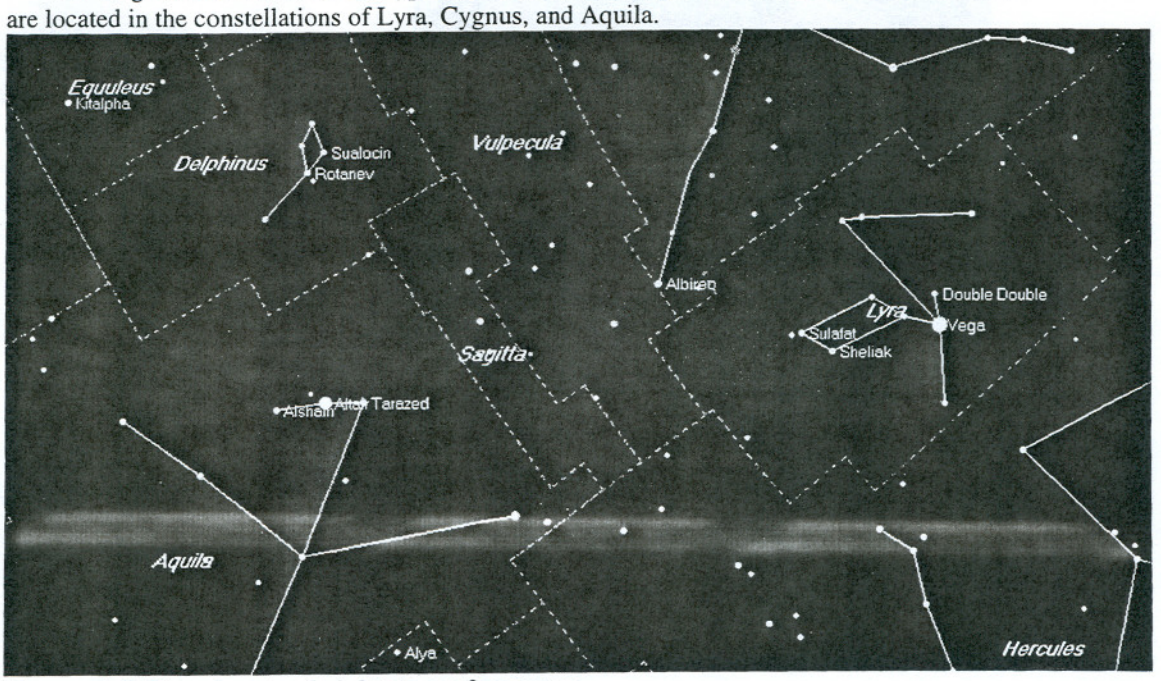

Figure 4-5 Prominent or bright stars of summer

The brightest stars are usually designated with proper names. Only a few dozen stars are frequently referred to by their proper names. Several hundred stars have been named this way, but only a few are easily recognized by name. The bright stars are easily seen after the Sun goes down and twilight falls.

The representative stars, in contrast, are those that are for the most part in the solar neighborhood. They are close by, so to speak. Their distances are within 4 to 8 parsecs of Earth. This is about 13 - 26 light years. Not many of the representative stars have proper names. The representative stars in the Milky Way Galaxy are usually fainter than the Sun's intrinsic brightness. These stars are usually small, cool, and very faint.

On any clear night in spring, you can find the bright star Arcturus in the evening sky. In summer, it might be Antares (heart of the scorpion), or perhaps Vega, the brightest star in the constellation Lyra. In autumn, you might find the star Capella in Auriga, the charioteer. In the winter, it might be Betelgeuse or Rigel in the constellation of Orion. A list of some of the brightest stars is provided in Appendix A. This list includes the stars' designations, proper names, coordinates, apparent brightnesses, spectral types, intrinsic brightnesses, and their approximate distances. Exercises C and D are designed for you to locate some bright stars.

Exercise C: Find the Bright Star Aldebaran

Set your location for Cleveland, Ohio.
Set the date for October 19, 2005.
Set the time to 9:00 P.M.
Set Daylight Savings adjustment option to "North America."
The Site Information window looks like that in Figure 4-6.

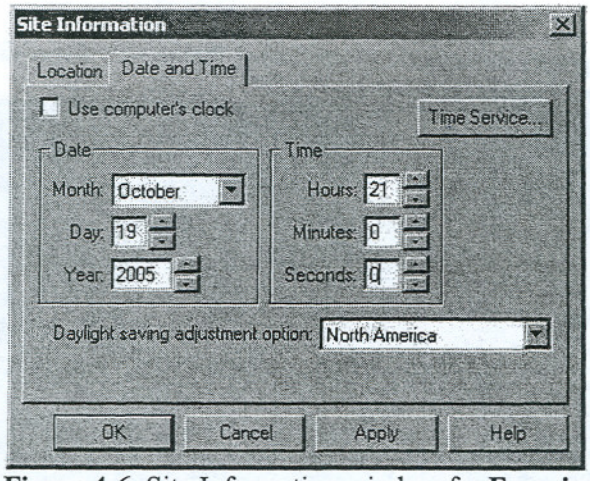

Figure 4-6 Site Information window for **Exercise C**

1. In what constellation is Aldebaran located? _____
2. At what time does Aldebaran appear to rise? ____:____
3. At what time does Aldebaran appear to set? ____:____
4. When is the best time to view Aldebaran? ____:____

Exercise D: Find the Bright Star Altair

Set your location for Golden, Colorado.
Set the date for October 1, 2010.
Set the time to 9:00 P.M.
Set Daylight Savings adjustment option to "North America."

1. In what constellation is Altair located? _____
2. At what time does Altair appear to rise? ____:____
3. At what time does Altair appear to set? ____:____
4. When is the best time to view Altair? ____:____

Bayer Letters

Because it is difficult for most of us to memorize the names of hundreds of stars, Johann Bayer developed a more convenient system in 1603. His system used Greek letters. The stars in the constellations in the northern sky were assigned letters according to their relative brightnesses.

Bayer used the Greek alphabet to designate the stars by their order of brightness in each constellation. Each naked-eye star is labeled with a Greek letter followed by the genitive case (possessive—second person singular) of the Latin name of the constellation in which it is found. This system started with the brightest star in the constellation and went to the faintest. In 1757 Nicholas Lacaille extended this system to include the southern constellations.

Figure 4-7 shows several stars with their Bayer letter designations displayed.

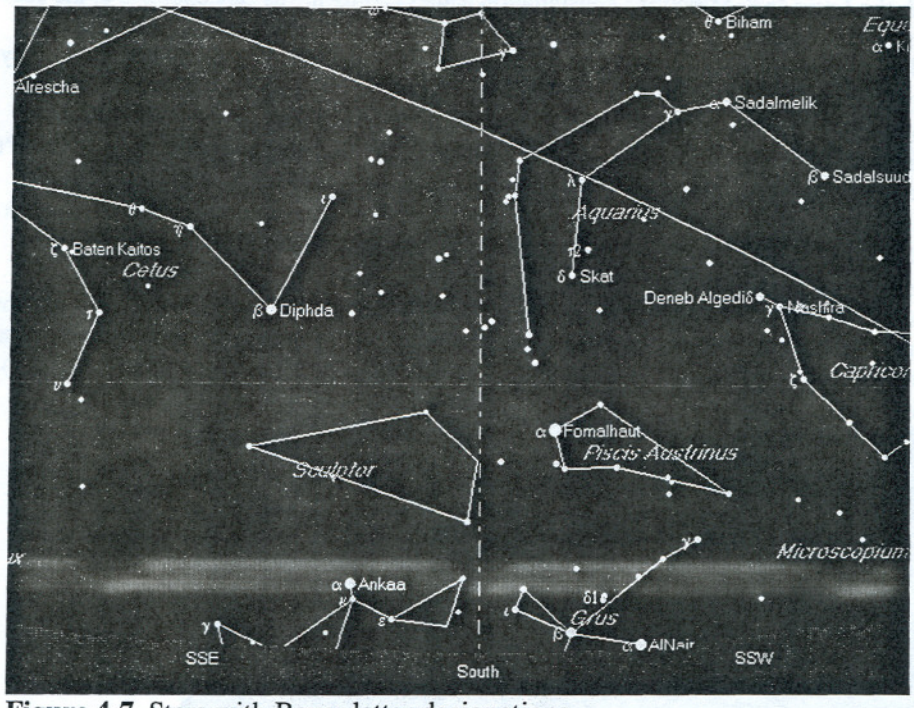

Figure 4-7 Stars with Bayer letter designations

For example, the brightest star in the constellation Lyra is shown in Figure 4-8. Its proper name is ***Vega***. Its Bayer designation is α Lyrae (or Alpha Lyrae). This is like saying "Alpha Lyree." The brightest star in the constellation of Cygnus is Deneb, which is Arabic for "Tail." Its Bayer designation is α Cygni ("Cygnee"). The second brightest star in Cygnus is named Albireo and has a Bayer designation of β Cygni (Beta "Cygnee"). Sometimes constellation names are abbreviated to the first three letters of the constellation name (for example, β Cyg) as in *TheSky*. Appendix B lists the constellation's Latin names, possessive forms and abbreviations of the constellations. The Greek alphabet is provided in Appendix C.

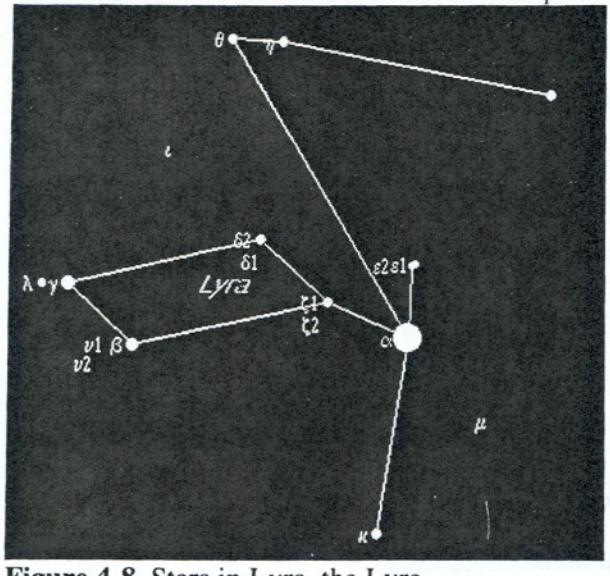

Figure 4-8 Stars in Lyra, the Lyre

After all the Greek letters have been used, the labeling continues with the lowercase letters of the Roman alphabet. If there are enough stars in a particular constellation, then the uppercase Roman alphabet letters are used up to and including the letter ***Q***.

In Latin, some words (nouns and adjectives) are considered to be either masculine or feminine. Masculine words, as a rule, usually end with the letters "us," whereas feminine words

end with the letter "a." Masculine constellation names ending in "us" are changed to the second person singular case (genitive) by replacing the letters "us" with the letter "i." Feminine constellation names ending in the letter "a" are changed to the second person singular case by adding the letter "e" to the end of the constellation name.

Note that these are general rules to be followed and by no means are valid in all cases. There are several exceptions. For example, Leo, the Lion is a masculine word. But it doesn't end in the letters "us." The genitive case for this constellation is Leonis. So, Denebola, the second brightest star in Leo, is designated as β Leonis. The same is true for the constellation Virgo, the Virgin. The second personal singular for this constellation is Virginis. So, the brightest star in Virgo is α Virginis. Its proper name is Spica.

And, if this were not confusing enough, a few constellations contain stars that are of about the same brightnesses. In these rare instances, the letters are assigned sequentially as one traces the pattern of the constellation. An example is the constellation Ursa Major (the Great Bear), which is shown in Figure 4-9. Appendix B will help you with the constellation names.

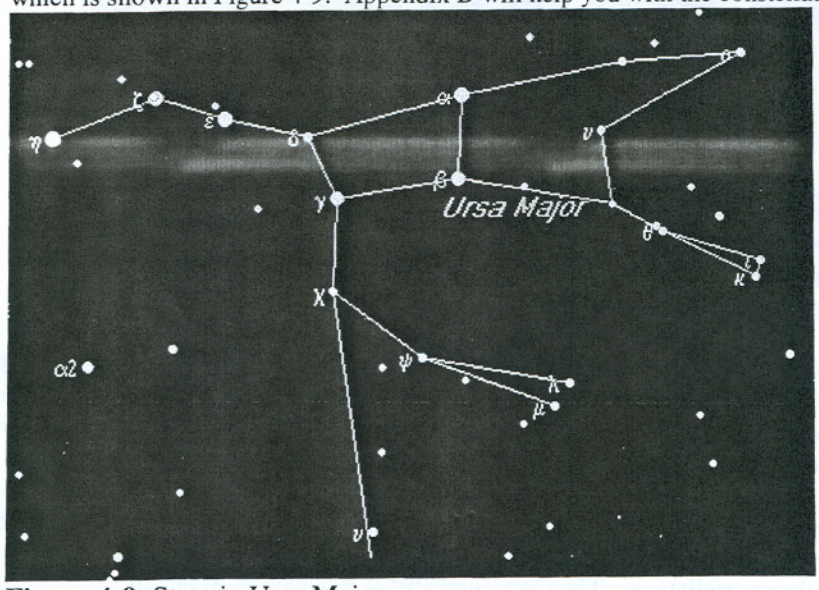

Figure 4-9 Stars in Ursa Major

Exercise E: Find the Bright Star Wasat

Set your location for Atlanta, Georgia.
Set the date for December 19, 2005.
Set the time to 9:00 P.M.
Set Daylight savings adjustment option to "North America."

1. In what constellation is Wasat located? _____
2. What is its Bayer designation? _____
3. What is its magnitude? _____
4. Is Wasat the brightest star in the constellation? _____
5. At what time does Wasat appear to rise? ____:____
6. What time does Wasat appear to set? ____:____
7. What is the best time to view Wasat? ____:____

Exercise F: Find the Brightest Star in the Constellation of Gemini

Set your location for Portland, Maine.
Set the date for January 15, 2020.
Set the time to 9:00 P.M.
Set Daylight Savings adjustment option to "North America."

Find the constellation Gemini.

1. What is the brightest star's proper name? _____
2. What is its Bayer designation? _____
3. What is its magnitude? _____
4. At What time does it appear to rise? ____:____
5. At what time does it appear to set? ____:____
6. When is the best time to view it? ____:____

Flamsteed Numbers

In 1712 astronomer John Flamsteed devised a simple system to designate stars. His system identified many more stars in a given constellation than the letters that Bayer had introduced a century earlier.

Flamsteed assigned numbers to the various stars in each constellation. The major difference in his system is that he ignored stars' apparent brightnesses in the constellation. Each star designated in the constellation is based on its position in the constellation. Figure 4-10 illustrates several constellations and stars with their Flamsteed designations displayed.

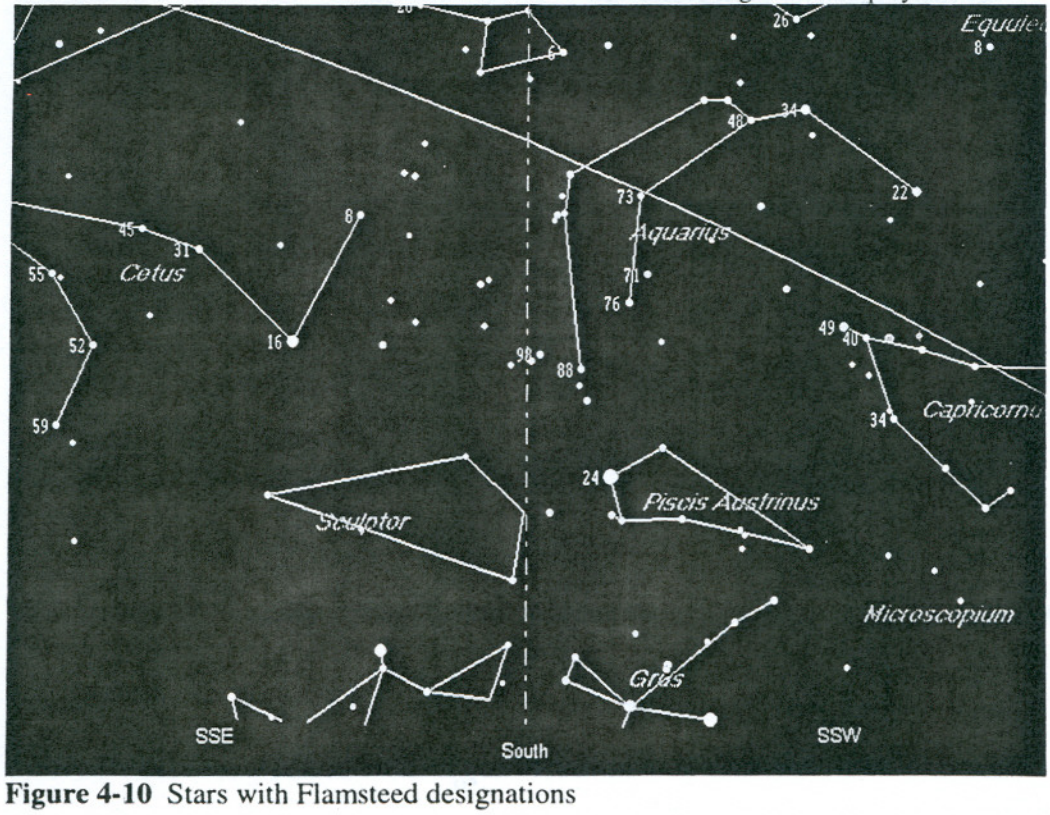

Figure 4-10 Stars with Flamsteed designations

The numbers are assigned in order of their location in the constellation. They are labeled from west to east in each constellation; that is, in the order by which they appear to cross the local celestial meridian. The possessive form of the constellation name follows the number, as in the Bayer system. 6 Cygni is the Flamsteed designation for the second brightest star in Cygnus and is known as β Cygni. Its proper name is Albireo and is displayed in Figure 4-11.

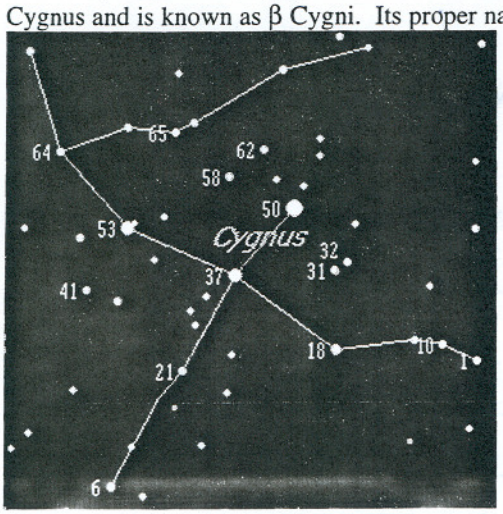

Figure 4-11 6 Cygni, β Cygni, or Albireo

Flamsteed numbers are frequently used to identify stars that are much fainter than the naked-eye stars in each constellation. It is common practice to use the Bayer letters for the brighter stars in the constellations, because they provide some useful information about the apparent brightness of each star. *TheSky* displays both proper names and Flamsteed numbers for the stars visible in the nighttime sky.

Exercise G: Find the Brightest Star in the Constellation of Taurus

Set your location for Chicago, Illinois.
Set the date for February 3, 2005.
Set the time to 9:00 P.M.
Set Daylight savings adjustment option to "North America."

1. What is its proper name? _____
2. What is its Bayer designation? _____
3. What is its Flamsteed number? _____
4. What is its magnitude? _____
5. At what time does it appear to rise? ____:____
6. At what time does it appear to set? ____:____
7. When is the best time to view it? ____:____

Exercise H: Find the Third Brightest Star in the Constellation of Orion

Set your location for Indianapolis, Indiana.
Set the date for December 19, 2005.
Set the time to 9:00 P.M.

Set Daylight savings adjustment option to "Not observed."

1. What is its proper name? _____
2. What is its Bayer designation? _____
3. What is its Flamsteed number? _____
4. What is its magnitude? _____
5. At what time does it appear to rise? ____:____
6. At what time does it appear to set? ____:____
7. When is the best time to view it? ____:____

Binary and Multiple Stars

With the increased use of the telescope by astronomers in the 17th and 18th centuries, another problem arose relating to stellar designation. Astronomers found many individual stars composed of two or more stars that were very close together. They appear as a single star to the naked eye but as two or perhaps three separate stars through the telescope.

Binary stars are most often referred to as "double stars" but this is a misnomer! Astronomers do make a distinction between a double star and a binary star. A double star is two stars that appear very close to each other in the sky. They share the *same direction* in space, but are at *different distances* from us. In other words, they are not gravitationally attached to each other. Binary stars, in contrast, not only share the *same direction* in space but both stars are at the *same distance* from us and orbit each other.

Because it would be a futile task to completely revise all the systems in use today, it is sometimes more suitable to just use the original designation. However, when a star is found to have more than one component, letters are assigned to the various components, in order of their decreasing brightness, after their Bayer designation.

In a binary system, the Roman letter A is assigned to the brighter component (primary component) and the Roman letter B is assigned to the fainter component (secondary component). The possessive form of the constellation name follows the letters, as in the Bayer and Flamsteed designations. If there are more than two stars, then subsequent letters are used (C, D, E, etc.) and the possessive form of the constellation name. There are exceptions to this general rule as well. For example, ζ Ursae Majoris (Mizar) is a well-known binary system. Mizar is the middle star in the handle of the "Big Dipper." The stars in this system are often referred to as Mizar A and Mizar B.

The closest star system to Earth is the α Centauri system (or Alpha Centauri). This star system is actually a tertiary system. The primary component of this system is designated as α Centauri A. The secondary and fainter component is designated as α Centauri B. The faintest component of this system is denoted α Centauri C. The brightest member, A, in this system is very much like our Sun in its size and temperature.

Another famous visual binary system is in the constellation of Cygnus the Swan. It is designated as β Cygni or Albireo. The two stars in this system are separated by 54 seconds of arc and are easily resolved in a small telescope. They are also two stars that have very different surface temperatures and thus very different colors. In a small telescope, they appear as a blue and a yellow star. Figure 4-12 shows the location of Albireo as located in *TheSky*.

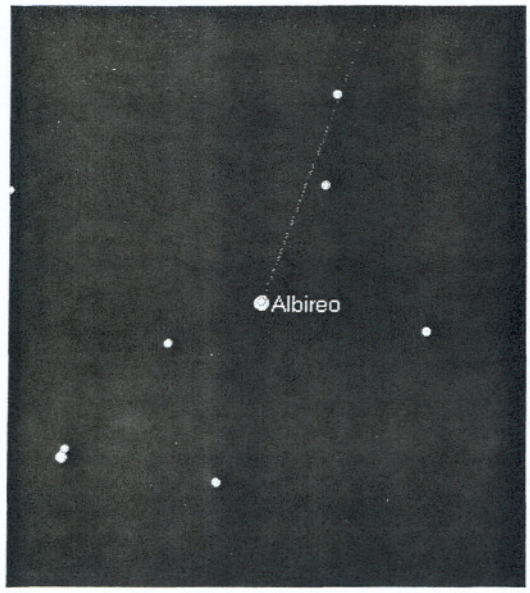

Figure 4-12 – Albireo in the constellation Cygnus

Figure 4-13 is a CCD (Charge-Coupled Device) image of Albireo taken at the Ball State Observatory. It is an electronic, digitized image of Albireo taken in three colors. The images were taken with a Photometrics Star 1 camera. Three images were taken through a Red, Green, and Blue filter and later combined to produce the tricolor image displayed in Figure 4-13.

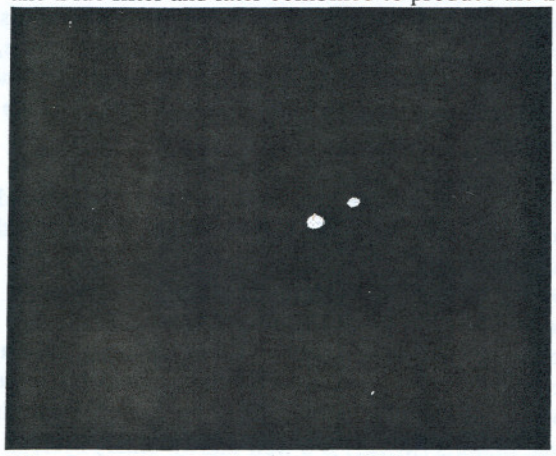

Figure 4-13 CCD image of Albireo taken at Ball State Observatory
(Image provided by Author)

Variable Stars

Another problem, that arose about the same time that astronomers found many stars to be multiple star systems, was that many of these stars appeared to vary in brightness. This change in brightness may be due to a variety of reasons. It may be something intrinsic to the star, such as the very nature of the star itself. Or there may be an extrinsic cause, such as the star being a member of an eclipsing binary system. For whatever reason, the cause of the brightness variation in stars is still designated in a special way.

The last Roman letter used in Bayer's notation was the letter Q. So variable stars begin their designations with the Roman letter R. They are designated by the order of their discovery in the constellation. Thus the first variable star in any constellation is designated with the Roman letter R, then S, T, U, V, W, X, Y, and Z followed by the possessive form of the constellation name. After the letter Z, the letters are doubled RR, RS, RT, to RZ; then SS, ST, SU, to SZ; then TT, TU, TV, to TZ; then UU, UV, UW, to UZ through ZZ and all followed by

the possessive form of the constellation name. After the letters ZZ, additional variable stars may be designated with the letters AA, AB, AC, to AZ; then BB, BC, BD, to BZ; then CC, CD, CE, to CZ all the way through QZ each followed by the possessive form of the constellation name in which they are discovered. Note: because there is no letter J in the Roman alphabet, it does not appear in any of the designations. The designations R through QZ take care of the first 334 variable stars discovered in any constellation. If subsequent variable stars are discovered in a constellation, they are designated with a number preceded by the capital letter **V** (for *variable*). Thus, the 335th variable star in any constellation is designated as V335 followed by the possessive form of the constellation name in which it is found. In other words, the 335th variable star discovered in the constellation of Capricornus is designated as V335 Capricorni.

TheSky does not explicitly display variable stars on the desktop window. However, if you are interested in observing variable stars you may contact the American Association of Variable Stars Observers (AAVSO) at 25 Birch Street, Cambridge, Massachusetts 02138-1205. It is a nonprofit scientific and educational international organization of amateur and professional astronomers who study and catalog variable stars. You can also visit their Website at www.aavso.org.

Non-Stellar Objects

Most of the nonstellar objects lie well beyond our Solar System and are a mixed bag of astronomical objects. There are three basic categories of nonstellar objects. They are star clusters, nebulae, and galaxies. Usually these objects are designated with a letter and a number signifying the catalog in which they are found.

Star Clusters

There are two types of star clusters. The type of cluster is indicative of its location in the Milky Way. *Open clusters* are located *in* the spiral arms, and *globular clusters* are *centered on* and *around* the nucleus of our galaxy. The Jewel Box Cluster is an excellent example of an open cluster. It is displayed as the left-hand image in Figure 4-14. Its designation is NGC 4755. Unfortunately, it is not visible from midnorthern latitudes. The second image displayed in Figure 4-14 is one of several hundred globular clusters surrounding the nucleus of the Milky Way. It is displayed as the right-hand image in Figure 4-14 and is designated NGC 1904.

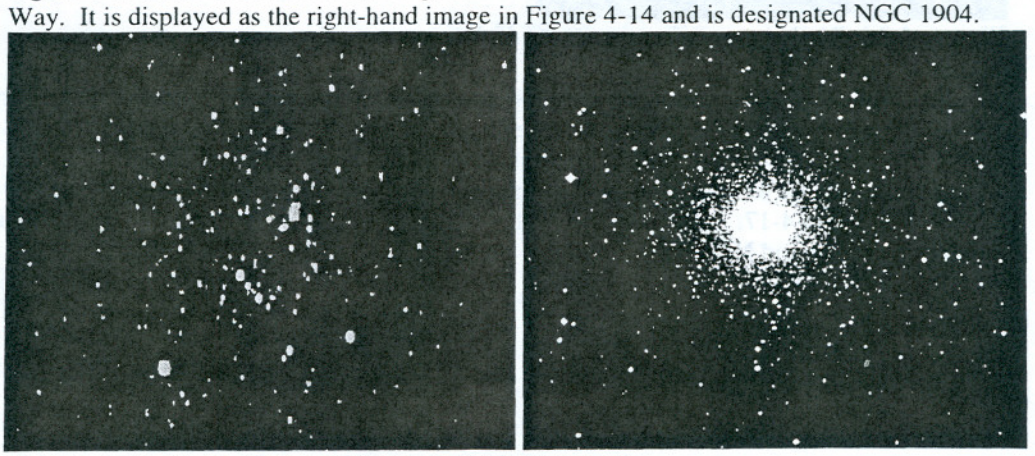

Figure 4-14 NGC 4755 (left), and NGC 1904 (right)

Nebulae

Nebulae are more diversified in nature. They range from objects that are associated with early stages of star formation to those of stellar death.

Dark nebulae are cold regions of gas and dust that loom between the stars in the Milky Way and may harbor *protostars* (infrared stars). This type of nebula is only seen when silhouetted against a bright background of stars or a glowing nebula. One of the best examples of this type of nebula is located in Orion, the Hunter. It is called the Horsehead Nebula, because of its appearance, and is designated as IC 434. An image of it taken from *TheSky's* database is shown in Figure 4-15.

Figure 4-15 Horsehead nebula in Orion, IC 434

Figure 4-16 displays a black-and-white digitized image taken from *TheSky* showing IC 434 and a more extensive view of the region around and near the Horsehead Nebula.

Figure 4-16 Region around and near IC 434

Emission nebulae are associated with newborn stars and sometimes clusters of stars. They glow because the gases in the nebulae are excited by the ultraviolet radiation produced by the surrounding stars. As a result of the ultraviolet excitation, the nebula glows faintly with a pinkish-red color due to the hydrogen in the cloud. A good example of this type of nebula is displayed in Figure 4-17. It is called the Eagle Nebula because of its appearance. This nebula is designated as M16 and NGC 6611.

Figure 4-17 Eagle Nebula, M16, or NGC 6611 in Serpens

Reflection nebulae, in contrast, appear bluish in color. In addition to gas, the cloud contains dust grains that reflect visible light from newly formed stars near the cloud. The Pleiades cluster (Seven Sisters) in the constellation of Taurus is perhaps the best known example of this type of nebulosity. It is a cluster that contains a few dozen stars surrounded by bluish nebulosity. Figure 4-18 shows a picture of the Pleiades taken by Dr. Jordan. It is designation as M 45.

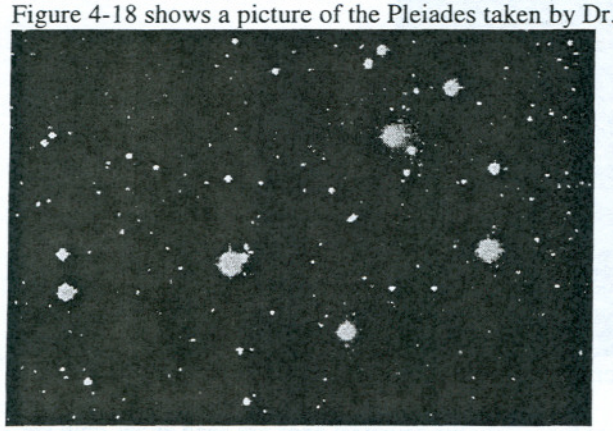

Figure 4-18 Reflection nebula and cluster in Taurus
(Photo courtesy of the author)

Other types of nebulae are associated with the death of elderly stars. When stars like our Sun reach the end of their life cycle, they go through a series of expansions and contractions. Eventually, they shed the outer layers of their atmosphere into space. These nebulae become planetary nebulae.

The most extreme expulsion of stellar material occurs when massive stars reach the end of their lives. They have a tendency to detonate and blow themselves apart. This event causes a sudden brightening of the star, and as a result, a supernova appears in the sky. These nebulae become supernova remnants. The last visible supernova occurred in the Large Magellanic Cloud in 1987. In any case, it is quite a traumatic event for a star.

Planetary nebulae result from stars that were once like our Sun that have gone through their entire life cycle. These nebulae are spherical shells of gas moving outward from the central part of the star. They usually appear as ring-shaped objects with a faint star in the center of the nebula. The planetary nebula in Figure 4-19 is known as the Ring Nebula. It is located in the constellation of Lyra and is usually referred to as M57. It is also designated NGC 6720. The image is a CCD image taken at the Ball State Observatory.

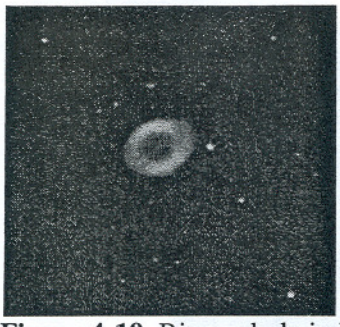

Figure 4-19 Ring nebula in Lyra
(CCD image provided by the author)

Supernova remnants, on the other hand, appear as twisted knots of gas and serve as evidence of violent explosions—to put it mildly. They are more catastrophic than violent! Figure 4-20 displays the supernova remnant in Taurus (the Bull) known as the *Crab Supernova Remnant*. This explosion was observed and recorded by Chinese astronomers in 1054 C.E. It was bright enough, according to historical accounts, to be seen in broad daylight. It is designated as NGC 1952 or as the first object in the Messier Catalogue.

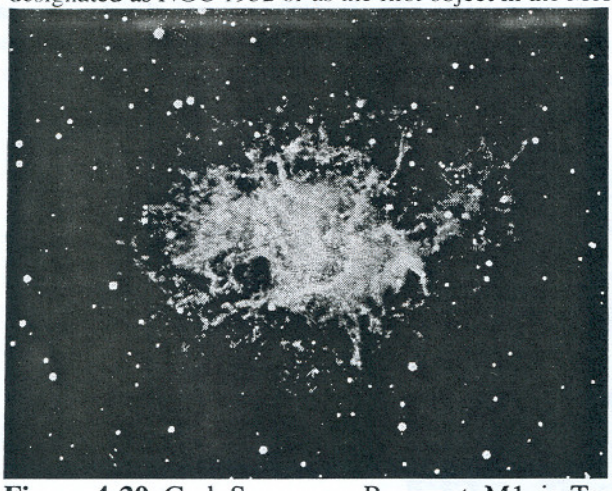

Figure 4-20 Crab Supernova Remnant, M1, in Taurus

Of the types of nebulae discussed here, only the brightest ones are seen either with the naked eye or in binoculars and small telescopes. They appear as smudges, or more often as diffuse faint blurs in a telescope eyepiece. However, they are among some of the most interesting objects in our Galaxy. The brightest nebulae that can be observed and photographed with a small or moderate-size telescope are listed in some of the catalogs that are discussed hereafter.

The Messier Catalogue

In 1781 Charles Messier compiled a list of (cataloged) 110 faint, diffuse, nonstellar objects. He did so to assist those amateur astronomers who were specifically searching for comets. He published the positions of these objects so that other comet hunters would not waste their time making additional observations of them. Messier basically stated that objects in his catalog did *not* move and therefore were *not* comets! Several Messier objects are shown in Figure 4-21.

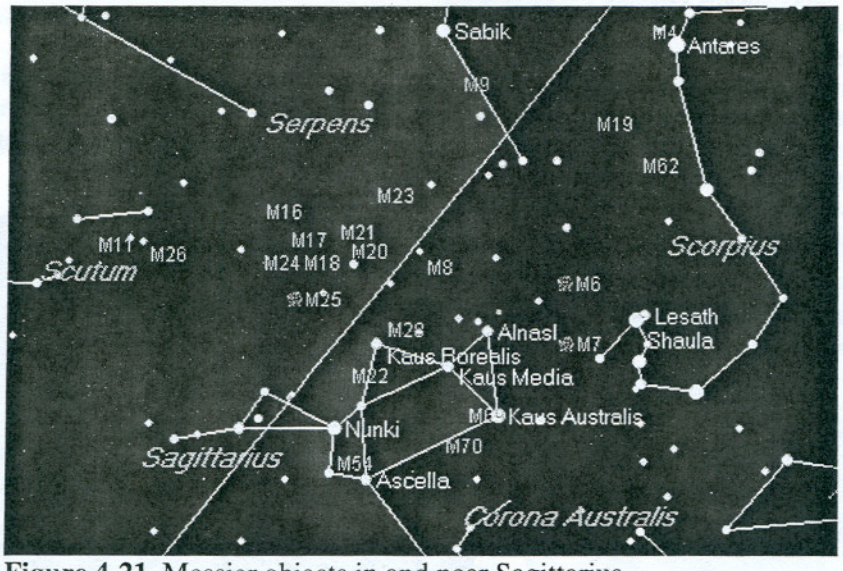

Figure 4-21 Messier objects in and near Sagittarius

The objects in this catalog are numbered from 1 to 110 preceded by the capital letter **M**. A list of the Messier objects is provided in Appendix D.

The New General Catalog

William Herschel made several sky surveys near the end of the 18th century and into the beginning of the 19th century. He used larger and larger telescopes in his observations. Herschel did star gauging or counting measurements of stars in the Milky Way. He also recorded the positions and descriptions of thousands of faint nonstellar objects. In 1888 Herschel's observations were combined with the observations of many other astronomers into what is called the New General Catalogue of Non-Stellar Objects. Several thousand NGC Objects have been compiled for this catalog. The Sombrero Galaxy gets its name from its appearance. It is designated as Object 4594 in the New General Catalog. This particular object is also in Messier's Catalogue and listed as Object 104. With the Object Information window, an image of the Sombrero Galaxy is displayed in Figure 4-22.

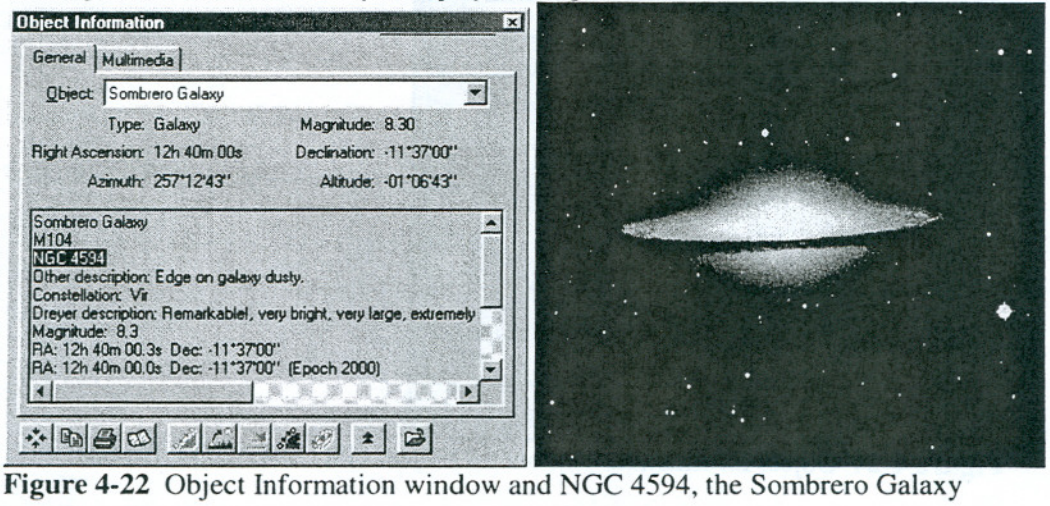

Figure 4-22 Object Information window and NGC 4594, the Sombrero Galaxy

The NGC list of nonstellar objects is too large to include in this workbook. You can easily generate a complete observing list of NGC objects by visiting one of the following Websites: *www.ngcic.org* or *www.ngic.org/oblstgen.htm*. It is possible to create a complete list of NGC objects in any constellation at this Website.

Later two supplemental catalogs were published. They contained information on more recently discovered objects (other than NGC objects). They are called the First and the Second Index Catalogues, respectively. The objects contained in both of these catalogs are denoted with a number preceded by the letters "IC." The astronomical objects listed in the IC catalogs are, as a rule, fainter than many of those listed in the NGC catalog. The IC lists contain several thousand more nonstellar objects. You can also create an observer's list of the IC objects in any constellation by accessing the same website as for the NGC objects. With the Object Information window, an image of the IC 5152 is displayed in Figure 4-23.

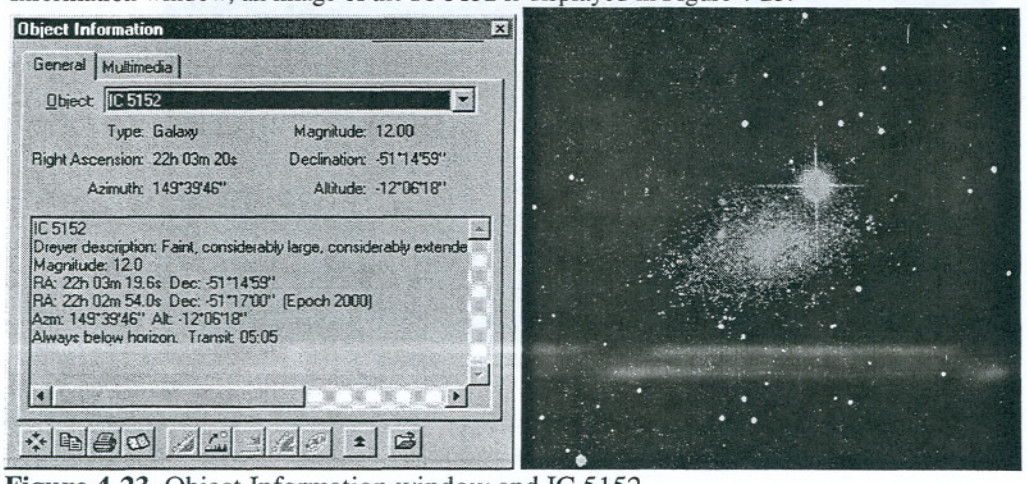

Figure 4-23 Object Information window and IC 5152

Hubble Space Telescope

Since its launch in April 1990, the Hubble Space Telescope has been quietly orbiting Earth and returning remarkable images and data on many astronomical objects. It has compiled and assimilated more information in the last decade than all earth-based optical telescopes have historically, combined! The Object Information window is displayed for the star GSC 5847:2333 in Figure 4-24. This star has the proper name Diphda and also has the designation of β or 16 Ceti.

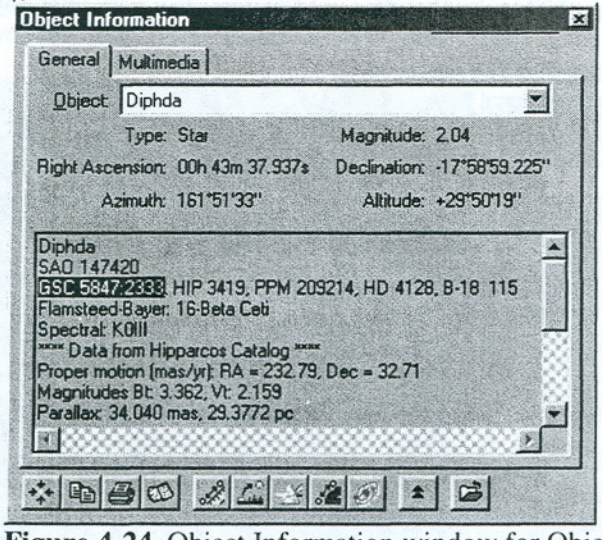

Figure 4-24 Object Information window for Object GSC 5847:2333, Diphda

Hubble has compiled data on millions of stars and non-stellar objects as well. The information about these stars is stored on about 100+ CD-ROMs. Each star is cataloged with a number preceded by the letters **GSC**, for Guide Star Catalog.

Other Catalogs

Other catalogs that list information about stars are used in *TheSky*. The Harvard Smithsonian Astrophysical Observatory published a catalog that is often used by astronomers. The Observatory compiled data on about 250,000 stars. Stars in this catalog are labeled with a number and preceded by the letters SAO. Figure 4-25 displays the Object Information window for the star SAO 147420. This is still the star β Ceti.

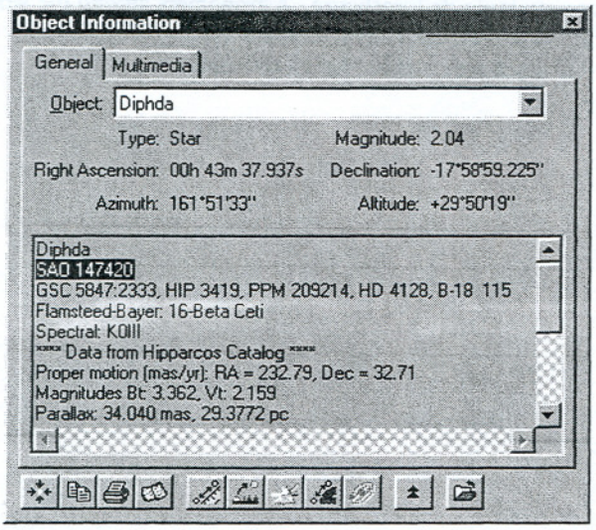

Figure 4-25 Object Information window for star SAO 147420, β Ceti, Diphda

Another catalog is the Henry Draper Catalog. This catalog, compiled between 1918 and 1924, contains spectral information on over 225,000 stars. Stars in this catalog are designated with a number preceded by the letters HD. The Object Information window for the star HD 4128 is displayed in Figure 4-26. Notice that this star is still β Ceti.

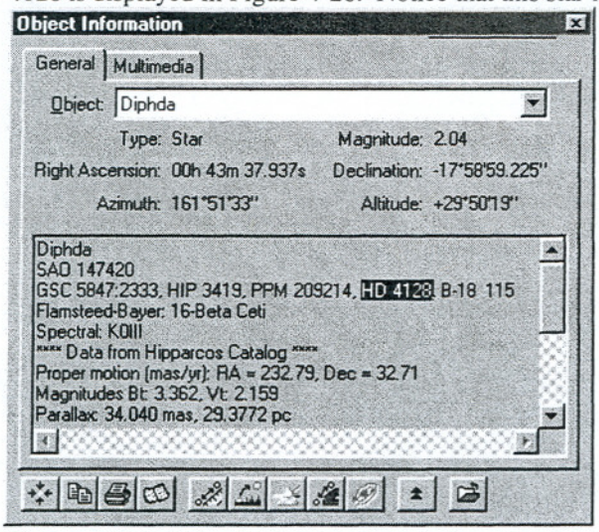

Figure 4-26 Object Information window for star HD 4128, Diphda, β Ceti

There are two other catalogs available in *TheSky* database. They are the PPM and HIPPARCOS catalogs. PPM is an acronym that stands for the Positions and Proper Motion catalog. The stars in this catalog are designated with a number preceded by the letters "PPM." Diphda is designated as Object PPM 209214. HIPPARCOS is an acronym that stands for "High Precision Parallax Collecting Satellite." The stars in this catalog are designated with a number preceded by the letters "HIP." Diphda is designated in the HIPPARCOS catalog as

Object HIP 3419. The distances listed, for many of stars in *TheSky*, have been derived from the data collected by the HIPPARCOS satellite.

Today we know of many diverse types of astronomical objects, and their designations can be confusing. Only computers have the ability and capacity to store and assimilate information about these objects. Every day more and more statistics are compiled and stored in databases. This is one reason why using *TheSky* is both convenient and resourceful.

Numerous catalogs are accessible to those of us interested in observational astronomy. Each is compiled for a specific reason or to detail specific information about certain groups of celestial objects. This information has been cross-referenced in a worldwide database such as the one at the Centre de Donnees Astronomiques de Strasbourg. Astronomers around the world can access this database via the World Wide Web each day (cdsweb.u-strasbg.fr/CDS.html). Most of the designations previously discussed are used in *TheSky* software.

#4 cont.

TheSky Review Exercises

Use *TheSky* to complete the following exercises. The first one has been done for you.

Before starting *TheSky*, insert the CD-ROM into your drive. If *TheSky* has already been started, close it, then insert the CD-ROM, and restart *TheSky*.

TheSky Exercise 1: Let's Find Object NGC 7000

1. Set Date to ***October 25, 2006***.
   Set Time to 8:00 P.M.
   Make sure that the "Daylight saving adjustment option" is set to "Not observed."

   Set Location to Ball State Observatory
   Longitude: 85°21′ 38″ West Latitude: 40° 11′ 58″ North
   Set Time Zone to +5.0.
   Set Elevation to 322 meters.

   Note: If you wish to save this location for future exercises, the properties must be change in the United States cities.loc file in the folder C:\ProgramFiles\Software Bisque\TheSky\User (see Chapter 1 Figures 1-23 and 1-24 or Chapter 2 Exercise A).
   When finished, the settings should look like those displayed in Figure 4-27.

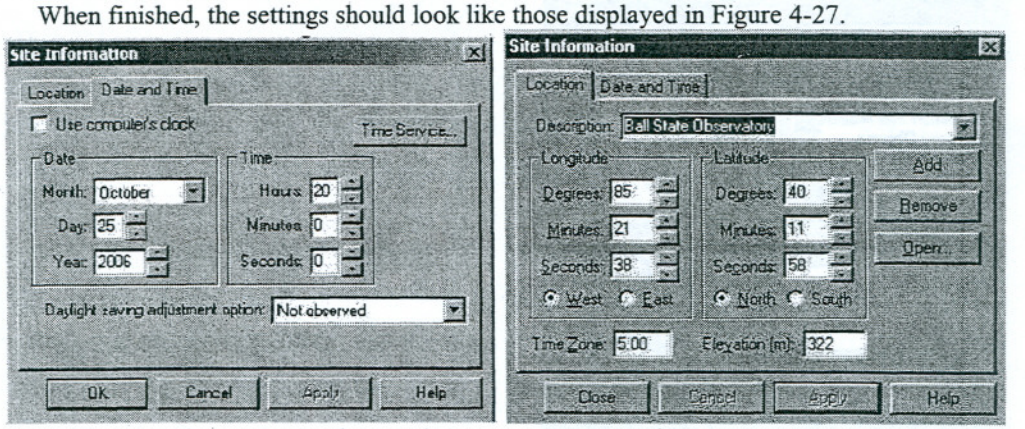

Figure 4-27 Changing the date and time

2. Click Edit on the toolbar at the top of the sky window, then click *Find*.

3. A shortcut to this command is to just type the letter "F." Or, right click mouse anywhere in the sky window. Either way, the Find window appears, like the one shown in Figure 4-28.

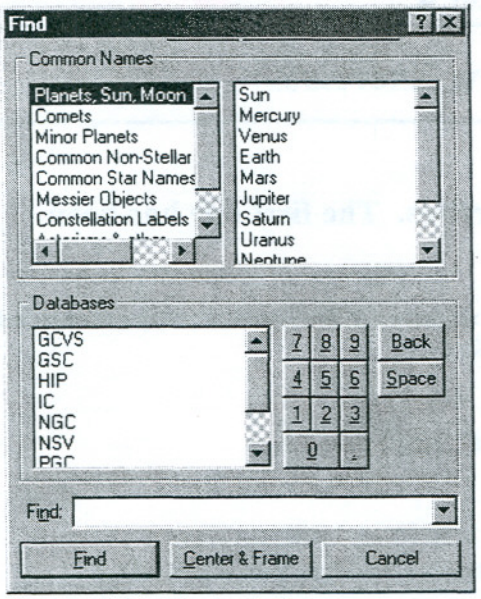

Figure 4-28 Find window

4. Let's find an NGC object, say NGC 7000.

5. In the Databases box of the Object Information window, click "NGC," and then click the number 7000 on the keypad provided at the right. The Databases box will then look like Figure 4-29.

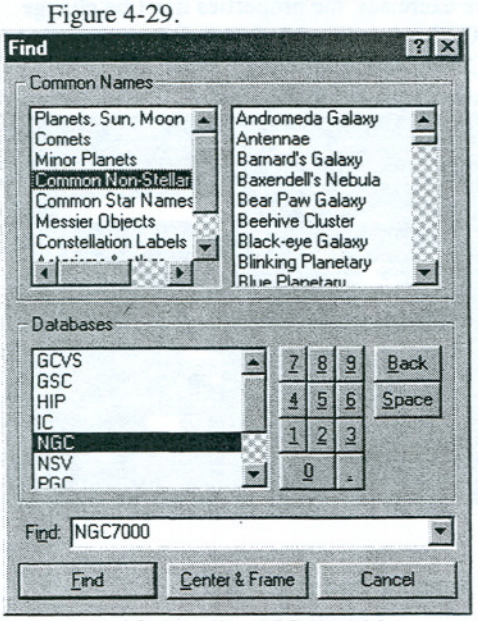

Figure 4-29 Finding NGC 7000

6. Click the Find button below the Databases index.

7. After clicking Find, an Object Information window opens like the one that is shown in Figure 4-30.

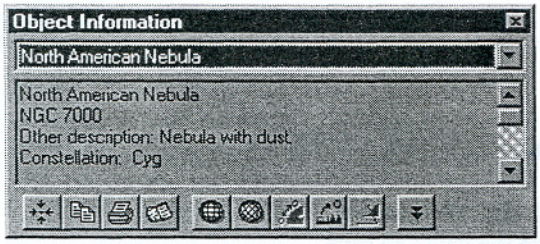

Figure 4-30 Object Information window for NGC 7000

7. Click the More Information button () in the Object Information window and data in regard to NGC 7000 will appear. This is displayed in **Figure 4-31**.

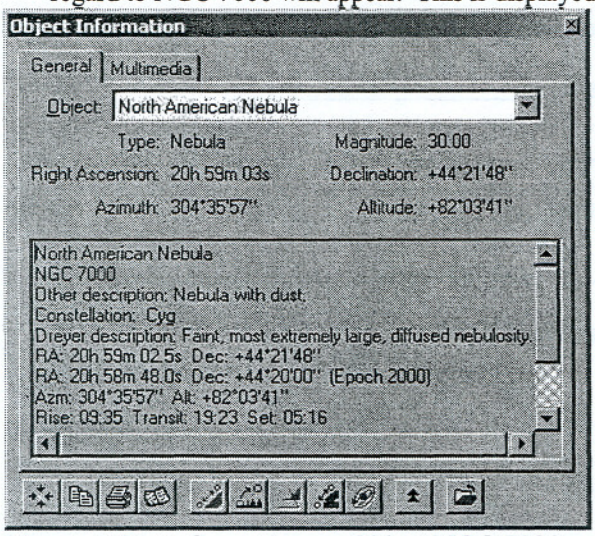

Figure 4-31 Information on Object NGC 7000

8. Use the scroll bar to look at the data provided on NGC 7000.

9. Click the  button to center NGC 7000 on your desktop.

10. Now click the Multimedia tab. When your CD is inserted into your PC's CD-ROM drive, an image of NGC 7000 is displayed like the one shown in **Figure 4-32**.

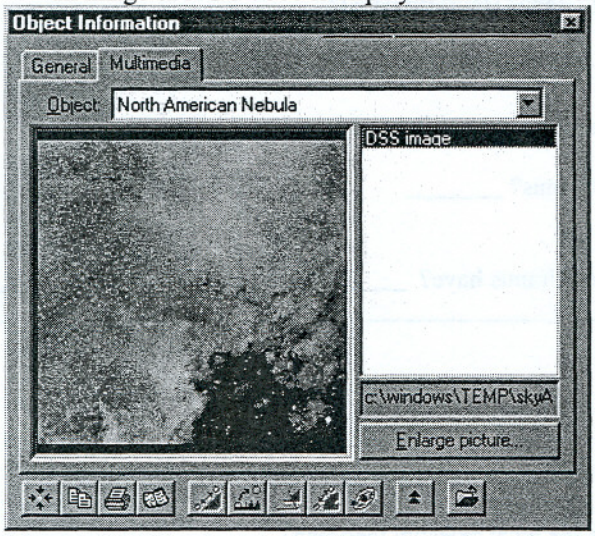

Figure 4-32 Image of the North American Nebula, NGC 7000

Now, it's your turn!

Complete the following exercises using *TheSky*.

If you wish, leave the location set to the Ball State Observatory. Otherwise, set it to your location. The important thing is *not* to change the date and time.

TheSky Exercise 2: Find Object M30

1. What is the NGC number associated with M30? _____
2. In what constellation is M30 located? _____
3. What is its apparent magnitude? _____
4. What type of non-stellar object is this? _____
5. Does it have a common name? ____ If so, what is it? _____
6. Click the Multimedia tab to view an image of M30.

TheSky Exercise 3: Find Uranus

1. What time does Uranus appear to rise? ____:____ Transit? ____:____ Set? ____:____
2. What is the apparent magnitude and phase of Uranus? _____
3. Click the Multimedia tab in the Object Information window to view images of Uranus. Now click and open the file named "Uranus.txt" at the bottom of the list and answer the following questions.

   a) What is the orbital period of Uranus (in Earth years)? _____

   b) What is the rotational period of Uranus (in Earth days)? _____

   c) What is the mass of Uranus (in Earth masses)? _____

   d) The atmosphere of Uranus is made up primarily of what gas? _____

   e) What is the surface gravity on Uranus? _____
   (G is in Earth's gravity)

   f) What *special* characteristics does Uranus have? _____
   _____

TheSky Exercise 4: Find Jupiter

1. What time does Jupiter appear to rise? ____:____ Set? ____:____
2. When does Jupiter appear to cross the local celestial meridian? _____
3. What is the apparent magnitude and phase of Jupiter? _____

4. Click the Multimedia tab in the Object Information window and view images of Jupiter. Now click and open the file named "Jupiter.txt" at the bottom of the list.

   a) What is the orbital period of Jupiter (in Earth years)? _____

   b) What is the rotational period of Jupiter (in Earth days)? _____

   c) What is the mass of Jupiter (in Earth masses)? _____

   d) The atmosphere of Jupiter is made up primarily of what gas? _____

   e) What is the surface gravity on Jupiter? _____

   f) What *special* characteristics does Jupiter have? _____
   _____

TheSky Exercise 5: Find Object M42

1. What time does M42 appear to rise? ____:____
2. What is its apparent magnitude? _____
3. What is its NGC number? _____
4. In what constellation is it located? _____
5. What type of object is it? _____
6. Click the Multimedia tab to view a few pictures of this object.

TheSky Exercise 6: Find Object NGC 224

1. What time does NGC 224 appear to rise? ____:____
2. What is its apparent magnitude? _____
3. What Messier number does it have? _____
4. In what constellation is it located? _____
5. What type of object is it? _____
6. Does it have a common name? _____
7. Click the Multimedia tab to view a few pictures of this object.

TheSky Exercise 7: Find Object IC 446

1. What time does IC 446 appear to rise? _____:_____
2. When does this object transit your local meridian? _____:_____
3. In what constellation is it located? _____

4. What type of object is it? _____

5. What is its apparent magnitude? _____

6. Click the Multimedia tab to view a picture of this object.

TheSky Exercise 8: Find Object NGC 2244

1. What time does NGC 2244 appear to rise? _____:_____

2. When does this object transit your local meridian? _____:_____

3. In what constellation is it located? _____

4. What type of object is it? _____

5. What is its apparent magnitude? _____

6. Click the Multimedia tab to view a picture of this object.

TheSky Exercise 9: Find Object M79

1. What time does M79 appear to rise? _____:_____

2. When does this object transit your local meridian? _____:_____

3. In what constellation is it located? _____

4. Does it have an NGC number? _____ If so, what is it? _____

5. What type of object is it? _____

6. What is its apparent magnitude? _____

7. Click the Multimedia tab to view a picture of this object.

TheSky Exercise 10: Find Object M13

1. What time does M13 appear to rise? _____:_____

2. When does this object transit your local meridian? _____:_____

3. In what constellation is it located? _____

4. Does it have an NGC number? _____ If so, what is it? _____

5. What type of object is it? _____

6. What is its apparent magnitude? _____

7. What is the object's angular size? _____

8. Click the Multimedia tab to see a picture of this object.

TheSky Exercise 11: Locate and Identify an Object

1. On the toolbar at the top of the sky window click on Orientation, then click on Move To, or right click the mouse button and click on Move To. Now enter the following information into the Move To dialog box:

   Right Ascension: $13^H\ 30^M\ 00^S$ Declination: 48° 00′ 00″ North
   Epoch: 2000

2. What object is located at the following coordinates? Right Ascension $=13^H\ 29^M\ 53^S$ and Declination = +47° 11′ 54″ _____

3. What is its Messier Number? _____

4. Does it have a Common Name? _____

5. What is its NGC Number? _____

6. What time does this object appear to rise? _____:_____

7. When does this object transit your local meridian? _____:_____

8. In what constellation is it located? _____

9. What type of object is it? _____

10. What is its apparent magnitude? _____

11. What is the object's angular size? _____

12. Click the Multimedia tab to see a picture of this object.

TheSky Exercise 12: Locate and Identify an Object

1. Set date to July 4, 2017.
   Set time to 9:30 P.M.
   Make sure that the "Daylight saving adjustment option" is set to "North America."

   On the toolbar at the top of the sky window click on Orientation, then click on Move To and enter the following information into the Move To dialog box:

   Right Ascension: $20^H\ 45^M\ 5.0^S$ Declination: 40° 15′ 15.0″ North
   Epoch: Current

   Now click on the Orientation, then click on Zoom To and then on Binocular 50°.

2. What constellation is located in the center of the field of view? _____

3. Are there any Messier Objects in this constellation? _____

4. List some of them: _____, _____, _____, _____, _____, _____, _____, _____.

5. Do any of them have Common Names? _____

6. What are the coordinates of M 29?

R.A. = ____H ____M _____S Declination = ___ _____° _____′ _____″

7. What time does this object appear to rise? _____:_____

8. When does this object transit your local meridian? _____:_____

9. What type of object is it? _____

10. What is its apparent magnitude? _____

11. Does it have an NGC Number? _____. If so, what is it? _____

12. Click the Multimedia tab to see a picture of this object.

Chapter 4

TheSky Review Questions

Answer the following review questions:

1. In what order are the Bayer letters assigned to stars? _____
2. Is δ-Capricorni brighter than α-Capricorni? _____
   How do you know? _____
3. In what order were Flamsteed numbers assigned to stars? _____
4. How many nonstellar objects did Messier include in his catalogue? _____
5. Why did Messier compile his list, and how were these objects selected?
   _____
   _____
6. What nomenclature is used to identify variable stars? _____
7. Is V 143 Cyg a valid variable star designation? _____ If not, why not?
   _____. What is its correct designation?
   _____.
8. Is V469 Lyrae a valid variable star designation? _____
9. If a star is found to be multiple, how are its various components designated?
   _____
10. What is the order of discovery of TZ Orionis? _____