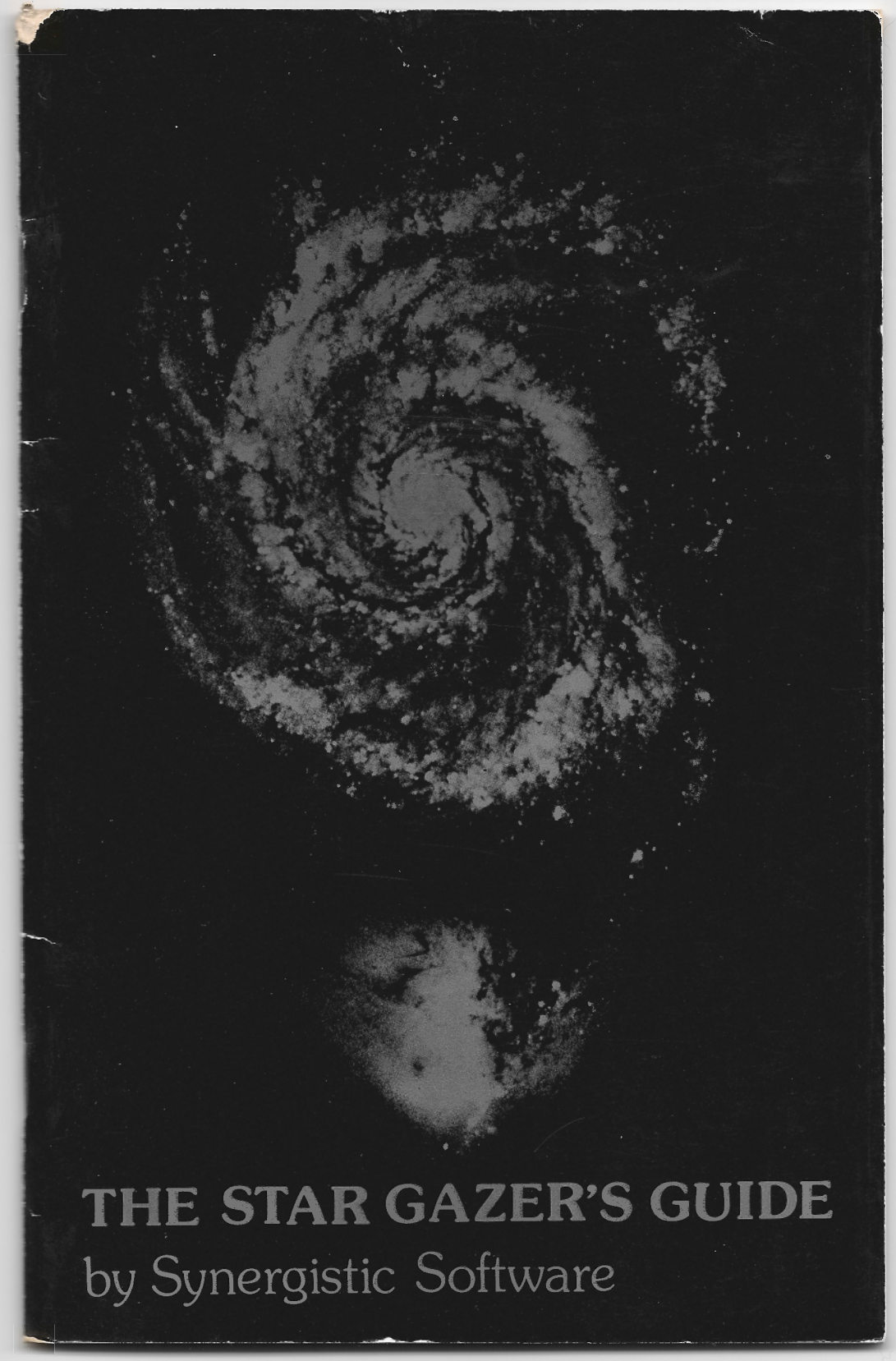

THE STAR GAZER'S GUIDE

by Synergistic Software

THE STAR

GAZER'S GUIDE

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SECTION I. INTRODUCTION

The Star Gazer's Guide is meant for people who wish to learn enough about the heavens to be able to go out at night and identify the major constellations and stellar objects for the mere pleasure of it. The programs are oriented to teach you painlessly by putting the universe at your fingertips, letting you display at will the entire summer or winter sky (or any part thereof) of the northern hemisphere. The Star Gazer's Guide makes it easy to find in the night sky the objects you have studied. Alternatively, when you find something unfamiliar in the sky, the programs will help you identify your sighting by working from general sky orientation to detailed section.

All major constellations of the northern hemisphere are presented using both high resolution graphics and supplementary text. For ease of visualization, the constellations are displayed both with and without outlines. The brightest stars of each constellation are identified. Major galaxies, nebulae, clusters, double stars, etc. are pinpointed by special symbol and described by the separate text. The programs are menu-driven, allowing rapid access to any section of the heavens.

Sections II, III, and IV on the following pages describe how to use the programs. Sections V, VI, and VII provide additional information for those desiring greater detail.

Several appendices are included at the end of the document listing information about the constellations, major stars, galaxies, clusters, and nebulae. A glossary of terms defines terminology that may be unfamiliar to the user. Finally, a bibliography is presented to direct the user to additional sources of information on astronomy.

SECTION II. SYSTEM REQUIREMENTS

The Star Gazer's Guide requires an Apple II with Applesoft firmware, 48K RAM, and one disk drive. The programs are on a DOS 3.2 format diskette with no DOS as the programs alone use all of the available disk space. The programs can be MUFFINed to DOS 3.3 at which time DOS can be restored to the disk. The disk should not be updated or booted before being MUFFINed.

SECTION III. DISK CONTENTS

The Star Gazer's Guide includes 49 Applesoft programs and one binary file. They are:

HELLO	Titles and copyright notice
KEY	Main Menu
STAR CHART	Constellation Menu
SUMMER12	Summer sky chart
WINTER12	Winter sky chart
GALAXY	Description/symbol/example of a galaxy
GLOBULAR CLUSTER	Description/symbol/example of a globular cluster
OPEN CLUSTER	Description/symbol/example of an open cluster
NEBULAE	Description/symbol/example of a nebulae
DOUBLE STAR	Description/symbol/example of a double star
LETTERS	Shape table of alphanumeric characters
CONSTELLATION PROGRAMS (39)	Each of the constellation programs displays the pertinent section of the sky, outlines the constellation, and describes its nature, location, and the important stellar objects in the vicinity. Program names are the same as the constellation names. Refer to Table 2.

SECTION IV. PROGRAM OPERATION

Commands

To begin using The Star Gazer's Guide, one should insert a disk with DOS 3.2 (such as the System Master) into the disk drive and boot it according to the directions in the DOS manual. Then one inserts The Star Gazer's Guide diskette and types RUN HELLO (press RETURN). *Note that the disk must stay in the disk drive while using the programs.*

When HELLO is run, the Main Menu illustrated in Figure 1 will appear. At any time, from any of the programs comprising The Star Gazer's Guide, the user can return to the Main Menu by pressing 'M'. From the Main Menu, the user can display information on any of the topics listed by pressing the appropriate number. It is not necessary to press RETURN after selecting a choice, either at the Main Menu or elsewhere in the programs. Only when inputting a constellation number is a RETURN required since this may be a one or two digit number.

At all other points throughout the included programs, menus will be displayed allowing entry of the appropriate commands as listed in Table 1. The user can quickly and easily jump to any other program segment with a single keystroke. In addition to those commands listed in Table 1, while viewing the summer skies, winter skies, or Constellation List, one may display any single constellation by inputting its number (see Table 2) and pressing RETURN.

Outlines

In viewing the constellations, The Star Gazer's Guide provides the option of outlines to identify the stars included in a given grouping. These outlines aid in learning the constellations by providing both boundaries and shapes. Two different outlining techniques are included in the programs. Actually, three techniques have been used historically. These are illustrated in Figure 2 with the stars of the constellation Gemini. Figure 2a shows the stars involved. Figure 2b presents the allegorical outlining method which was used extensively in the past. While decorative, it does little to help one identify the stars involved. Finding the constellation in the heavens (sorry, no outlines there) is, therefore, quite difficult.

Figure 2c presents the geometrical outlining method that is utilized in most charts and books of the present day. The lines simply point to the specific stars involved in the constellation but do not in any way suggest the picture that the constellation's name implies. This method does, however, highlight the principal stars and so helps find them outside.

Figure 1
Main Menu

THE STAR GAZER'S GUIDE
MAIN MENU

1. GALAXY
2. GLOBULAR CLUSTER
3. OPEN CLUSTER
4. NEBULAE
5. DOUBLE STAR
6. SUMMER SKIES ATLAS
7. WINTER SKIES ATLAS
8. VIEW CONSTELLATIONS
9. TERMINATE

TABLE 1
COMMAND SUMMARY

M =	RETURN TO MAIN MENU
C =	DISPLAY CONSTELLATION LIST
S =	DISPLAY SUMMER SKY
W =	DISPLAY WINTER SKY
O =	DISPLAY OUTLINES
R =	REMOVE OUTLINES
SPACE=	DISPLAY DESCRIPTION

Finally, the outlining technique utilized in Figure 2d both highlights the principal stars and suggests the shape implied by the constellation's name. This technique, popularized by H.A. Rey (see bibliography), makes finding and remembering the star patterns much easier.

The techniques illustrated in Figures 2c and 2d are both presented in this program. To see the outlines while displaying a constellation, the user need simply press the 'O' (for outline) key. The geometrical outline will first be displayed. Pressing 'O' again will display the graphical outlines for the 21 constellations for which a picture can be made. The former outlines are included because of their widespread use and the latter because of their simplicity of visualization. The user is welcome to whichever technique appeals most. In some cases, the graphical technique makes use of stars dimmer that magnitude 6 (See discussion in Section VI.). These stars are not shown when the outlines are removed.

The overall summer and winter sky charts also use the geometrical outlining technique in order to demonstrate the relative sky positions of the constellations. Pressing 'O' for outlines will display the outlines. Pressing 'O' a second time displays the ecliptic, the path followed by the planets (see discussion under Section V.).

FIGURE 2
OUTLINE SAMPLE (GEMINI)

Figure 2a
THE STARS

Figure 2b
ALLEGORICAL

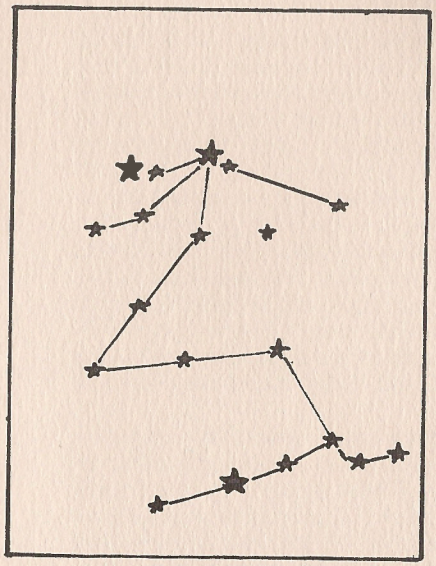


Figure 2c
GEOMETRICAL

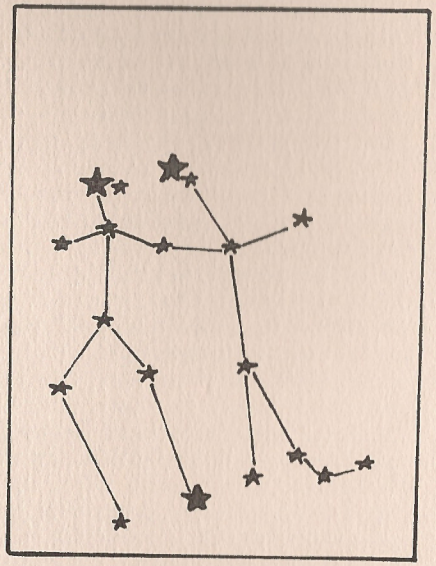
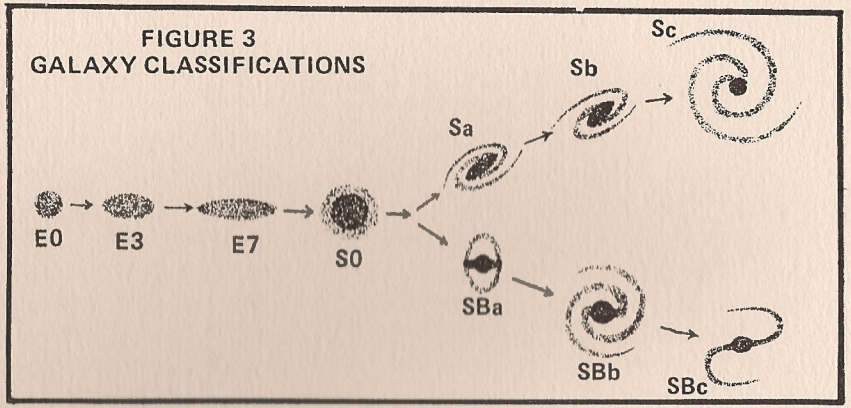


Figure 2d
GRAPHICAL

FIGURE 3
GALAXY CLASSIFICATIONS



Recommended Procedure

When the Main Menu is first displayed, it is recommended that the user display each subject in the order listed. Menu items '1' through '5' will present general background information about galaxies, globular clusters, open clusters, nebulae, and double stars which will make the more detailed discussions under each constellation more meaningful.

The user should then move to either the summer or winter sky (whichever is more appropriate at the current time). Observing the locations of the constellations in relation to each other will aid greatly in locating them in the real sky. Note that the constellations are identified on the summer and winter sky maps using the numbers shown in Table 2.

After choosing the constellation(s) of greatest interest for a given session, the user should display its detailed star chart and information. Detailed constellation programs can be accessed by inputting the constellation number while viewing the summer or winter sky. Alternatively, these programs can be entered via the Constellation List which provides the name and number of all of the included constellations. (Note that the Constellation List can be displayed at any time by pressing 'C'.) These individual constellation programs display the stars of the constellations, other stars of magnitude 6 or brighter (refer to Section VI.), and any interesting stellar objects in the vicinity (i.e. galaxies, nebulae, etc.). It should be noted that the brighter stars in the sky appear brighter on the display also. One to six dots are used to represent stars of magnitude 6 (faintest stars detectable by the human eye, see Section VI) to magnitude 1 (brightest stars in the sky) respectively. The accompanying text also gives hints to aid in locating the constellations as well as their English and Latin Names.

To really learn the location and appearance of the constellations and other stellar objects, the user should concentrate on just a few per session. Perhaps the easiest place to start is with a well-known formation such as the Big Dipper or Orion and work outwards from those groupings. One should study several constellations in detail, go outside and find them himself, then verify his performance by again referring to the program. With this simple, unhurried approach, one can quickly master enough of the heavens to be able to find his way around any part of the night sky.

SECTION V. THE CONSTELLATIONS

A constellation is a group of stars visually near each other in the sky whose relative placements suggest a picture or image to the viewer. Most of the major constellations in the northern hemisphere that we know today were well known by the time of the ancient Greeks and Romans. They supplied most of the designations that are still in use today, naming groups of stars after animals, mythological beings, and heroes of legends.

The names of several constellations were often tied to each other in rather complex legendary interrelationships. For example, the mythological characters Cassiopeia, Cepheus, Andromeda, Cetus, Perseus, and Pegasus are all related in one legend. According to myth, Cassiopeia and Cepheus had a daughter, Andromeda. Cassiopeia's boasting about Andromeda's beauty so angered the sea nymphs that they prevailed upon the sea god, Poseidon, to send a sea monster, Cetus, to punish them. Cepheus then had Andromeda chained to a rock as an offering to appease Cetus. Fortunately, the hero Perseus happened by, killed Cetus, freed and married Andromeda, and they flew off on his winged horse, Pegasus, to live happily ever after. All of the characters of this myth have constellations named after them which are located near each other in the heavens.

Today, constellations are no longer just intriguing figures seen in the stars. In 1930, the International Astronomical Union standardized a new nomenclature system for stars (see discussion in Section VI.) involving a Greek letter followed by the name of the constellation in which the star appears. Since not all stars were within the existing constellations, new constellations, termed "modern," had to be generated to provide complete coverage of the sky. This expanded list now includes 88 constellations (see Appendix B), 40 of which are discussed in detail by The Star Gazer's Guide. Of the omitted constellations, many, such as Crux, the famous Southern Cross, are always below the horizon of the northern hemisphere. Others, such as Coma Berenices, are too faint for easy observation. Still others, the modern constellations, such as Sculptor, are both faint and do not readily suggest a discernable picture.

Twelve of the constellation names are probably best known because they are members of the Zodiac, the constellations which lie in the ecliptic. The ecliptic is the path which the sun, the moon, and visible planets all follow in their path across the skies. The twelve constellations through which the ecliptic passes have astrological significance. The constellations of the Zodiac are Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, and Pisces. The groupings themselves are not the best defined or brightest stars but are well known due to their ecliptic position.

Another informal class of constellations are those known as circumpolars. These circumpolar constellations never set. The northern circumpolar constellations are Ursa Major, Ursa Minor, Draco, Cepheus, and Cassiopeia. These constellations rotate around the North Star (currently Polaris), the star most directly over the earth's north pole. The North Star is the only star in the northern hemisphere which has no apparent motion due to the rotation of the earth. Its altitude is equal to the observer's latitude. All the other stars in the sky appear to rotate around this fixed point.

Most constellations, being away from the north celestial pole, rise and set each night they are visible. They can more readily be observed during different seasons and hence are known as seasonal constellations. The constellations included in The Star Gazer's Guide are listed in Table 2. In this table, the constellations are ordered by: (1) circumpolar, (2) summer, (3) fall, (4) winter, and (5) spring constellations, thus grouping them such that constellations that might be seen on any given night are numbered adjacent to each other. For a list of all constellations, refer to Appendix B.

TABLE 2

LIST OF INCLUDED CONSTELLATIONS

#	Name	Summer/ Winter*	#	Name	Summer/ Winter*
1.	Ursa Major	S, W	21.	Leo Minor	S
2.	Ursa Minor	S, W	22.	Leo	S
3.	Cassiopeia	S, W	23.	Virgo	S
4.	Cepheus	S, W	24.	Aquila	S
5.	Draco	S, W	25.	Cygnus	S, W
6.	Orion	W	26.	Delphinus	S, W
7.	Auriga	W	27.	Hercules	S
8.	Canis Major	W	28.	Libra	S
9.	Canis Minor	W	29.	Lyra	S
10.	Eridanus	W	30.	Ophiuchus	S
11.	Gemini	S, W	31.	Sagitta	S
12.	Lepus	W	32.	Sagittarius	S
13.	Perseus	S, W	33.	Scorpio	S
14.	Taurus	W	34.	Pegasus	W
15.	Columba	W	35.	Andromeda	W
16.	Bootes	S	36.	Aries	W
17.	Cancer	S	37.	Aquarius	W
18.	Corona Borealis	S	38.	Capricornus	S
19.	Corvus	S	39.	Cetus	W
20.	Hydra	S	40.	Pisces	W

* Indicates on which overall star chart each constellation appears.

SECTION VI. THE STARS

Throughout the programs of The Star Gazer's Guide, prominent stars are identified and described. The programs may mention such facts as their common or modern names, their relative brightness or magnitude, and their color or spectral type. The programs also disclose whether they are variable stars or binary stars. The meaning and significance of these terms will be discussed below. A complete list of the brightest stars through magnitude 3 with relevant information is presented in Appendix C.

Nomenclature

Two independent techniques are utilized to name the stars. Many of the brightest stars have a common name dating from antiquity, while all stars, including faint ones visible only through telescopes, are named by the modern system. While the Greeks and Romans provided the names for the northern hemisphere's constellations, the common names of most of the individual stars come from the Arabs. During the Middle Ages, when European science underwent an eclipse, the Arabs preserved astronomical knowledge, giving their own names (e.g. Aldebaran, Deneb, Altair, etc.) to many objects.

The modern names for stars consist of a Greek letter followed by the name of the constellation or area of the sky in which the stars appear. Two of the brightest stars in the constellation Orion, for example, have the common names Betelgeuse and Rigel. Their modern names are Alpha (α) and Beta (β) Orion respectively. All of the stars in the vicinity of the constellation Orion are named similarly. Since all areas of the sky are included in a constellation, the modern method of naming stars provides a systematic nomenclature techinque that not only provides a unique name for every star, but also gives its approximate position.

Magnitude

The magnitude of a stellar object is mentioned repeatedly throughout the programs, the documentation, and the field of astronomy in general and refers to its comparative brightness. Stars have both an absolute magnitude which indicates the actual amount of light being emitted and an apparent magnitude that ranks stars by their brightness as seen from earth. Obviously, more distant stars will have a lower apparent magnitude than similar stars that are closer.

To the casual astronomer, apparent magnitude is the more important. The system of ranking began 2000 years ago when the 20 brightest stars were assigned to the first magnitude. The faintest stars that the human eye could detect were called sixth magnitude. Since the difference in brightness of these two extremes is about 100 times, the scale was fixed such that a difference of 5 magnitudes is equivalent to a difference of 100 times in brightness. One magnitude, therefore, corresponds to a difference in brightness of 2.512 times. The variation in brightness corresponding to differences in magnitudes is indicated in Table 3.

Modern refinements in measuring brightness reveal some celestial objects to be brighter than the designated first magnitude. These objects, therefore,

have magnitudes less than one. The apparent magnitude of Sirius, our brightest star, for instance, is -1.6 while that of the sun is -26.6.

The sun's enormous apparent magnitude is due solely to its extreme closeness to the earth. If observed from elsewhere in our galaxy, our sun would appear as a dim, undistinguished star. The sun's distance from the earth is only .000016 light years (the most commonly used measure of stellar distance) while the next nearest star, Alpha (α) Centauri, is over 4 light years away. The sun is thus 266,000 times closer than the next nearest star. Even these small numbers of light years represent enormous distances since a light year is the distance that light can travel in one year or 5,880,000,000,000 (5.88 trillion) miles.

TABLE 3
MAGNITUDE VS. BRIGHTNESS

DIFFERENCE IN MAGNITUDES BETWEEN 2 OBJECTS	=	RELATIVE DIFFERENCE IN BRIGHTNESS
1		2.5
2		6.3
3		15.9
4		39.8
5		100.0
6		250.0
10		10,000.0
20		100,000,000.0

TABLE 4
SPECTRAL CLASSES AND STAR COLORS

Type of Spectrum	Star Color	Symbol for Color	Surface Temperature
O	very Blue	v Bl	50,000
B	Blue	Bl	25,000
A	Green	Gr	11,000
F	White	W	7,600
G0	Yellow	Y1	6,000
G5-K	Orange	Or	5,100
M, R, N, S	Red	Rd	3000–3600

Spectral Class

To the trained scientist, spectral class provides clues to the star's temperature, age, the nature of its planets, and its evolutionary fate. For the casual observer, however, a star's spectral class merely gives an approximation of the star's color. While at a glance, all stars appear simply white, a comparison of two with different spectral classes will make the color variations apparent. For example, in the constellation Orion, Rigel has a distinctive bluish hue, while Betelgeuse is red. Table 4 lists the possible spectral classes, their associated color, and the surface temperature required to produce that apparent color. The individual constellation programs will point out a number of stars that have distinctive colors.

Variable and Binary Stars

The Star Gazer's Guide identifies some of the more unusual stars in the heavens, such as variable stars and binary or double stars. A variable star is one whose magnitude (brightness) appears to change over time. Many variable stars pulse for unknown reasons, either on a regular or an irregular basis. These variables are broken down into three subclasses:

1) Long period variables which pulse at an average of 280 days per cycle.
2) Short period or Cepheid variables (named for Delta (δ) Cephei, the first of this type discovered) which average 5.6 days for classical Cepheids and 13.5 days for "cluster" types (so named because they appear often in globular clusters).
3) Nonperiodic variables which include all peculiar stars. Some stars of this type may change brightness by 6 orders of magnitude very rapidly, reverse after several months, then appear normal for several years. Novae, the cataclysmic destruction of stars, would be included in this class.

One additional type of variable star whose changes are explainable occur only in binary star systems.

Binary or double stars are two stars which appear near each other in the heavens. Some of these are actually only "optical doubles" which are in the same visual direction from earth but not physically near each other, one being much further away than the other. True double stars involve two or more stars within a common solar system, revolving about a common point. In some cases, the stars revolve in such a way that they periodically pass in front of each other causing variations in their mutual brightness. These variables or "eclipsing binaries" are the only variable stars whose mechanism is fully understood. A good example of an eclipsing binary variable star is Algol in Perseus. Its magnitude changes from 3.2 to 2.1 and back again in a cycle which takes 2 days, 20 hours, and 48 minutes.

SECTION VII. GALAXIES, CLUSTERS, AND NEBULAE

In addition to the stars and constellations, an infinite variety of other objects are evident in the heavens. Planets, moons, comets, galaxies, clusters, nebulae, black holes, quasars, neutron stars, and less familiar objects all travel through the night sky. Of these many objects, The Star Gazer's Guide includes locations and descriptions of prominent galaxies, globular clusters, open clusters, and nebulae. These objects are included because their locations are fixed, unlike solar system bodies such as planets, moons, and comets. Further, unlike quasars, black holes, and neutron stars, they can frequently be found with only minimal equipment such as binoculars or small telescopes. The basic characteristics of these included subjects are described below. Many prominent galaxies, clusters, and nebulae are listed in Appendix D, the Messier objects.

Galaxies

A galaxy is a loose association of stars comparatively near each other, travelling through space together. Our own galaxy, the Milky Way, is composed of 125,000,000,000 stars spread across 100,000 light years in a spiral pattern. As with most large numbers, these figures are difficult to appreciate. In order to realize just how many stars this involves, one might consider the task of simply counting them. Counting at a rate of two stars per second, a counter would require approximately 2000 years to finish his job.

Galaxies occur in the universe in a variety of forms, from irregularly shaped clusters to well-defined spirals. A classification system developed by Edwin P. Hubble in the 1920s is used to describe these varied forms. The forms are illustrated in Figure 3 and progress from globular ellipticals (E0) through ellipticals that are increasingly oval (E3) to some that are quite flat or lens shaped (E7). Flatter galaxies still become spirals, first with no arms at all (S0), then branching into normal spirals with arms (Sa, Sb, and Sc) and barred spirals (SBa, SBb, and SBc). Normal spirals have simple curving arms that vary from tightly would (Sa) to quite loose (Sc). Barred spirals have a wide, flat nucleus before the arms begin. Some galaxies do not fit this regular sequence of forms, however, and are, therefore, cleverly called "irregulars."

Galaxies identifiable using our best telescopes number in the millions. The vast majority of these galaxies are of the flat and spiralling types because the stars within a galaxy revolve at a rapid rate around the galaxy's center. Our own Milky Way galaxy is a Sb spiral type.

All of the constellations described by The Star Gazer's Guide are composed of stars found within the Milky Way. Other galaxies are so distant that without magnification their millions of stars appear to us as a single hazy point of light. The only other galaxy that can be readily identified by the unaided eye is the Andromeda galaxy, M.31, in the constellation Andromeda.

Globular Clusters

Globular clusters are closely packed, ball shaped groups of stars containing 100,000 stars on the average. Globular clusters observable from earth are found outside of the Milky Way proper, arranged in a huge spherical pattern surrounding the plane of the galaxy. They are composed primarily of older, reddish stars and are thought to have formed before the main part of the galaxy.

While the globular clusters are very distant (7500 to 250,000 light years), they are still quite brilliant and hence easily located. Their brightness is due to the extreme packing of stars in these clusters, so packed that stars near the center are less than a quarter of a light year apart. This density compares with an average distance of 8 light years between stars in our arm of the Milky Way.

Because of their brilliance, almost all of the hundred globulars now known were discovered before the end of the 18th century. Considering the quality of the telescopes in those days, today's amateur astronomer should easily be able to identify a number of globular clusters. The list of objects in Appendix D includes many globular clusters and the constellations in which they appear. Some are naked eye objects such as M.13 in Hercules, M.4 in Scorpius, and Omega (Ω) Centauri.

Open Clusters

Open clusters are concentrations of 12 to 350 stars which appear as loosely arranged groups with no particular pattern, but travelling with a common motion. Because they all appear within our own galaxy, they are also known as "galactic clusters." While there may be as many as 500 such clusters in our galaxy, most cannot be viewed without the aid of a powerful telescope due to their own faintness, intervening dust clouds, or being buried in the glowing background of the Milky Way. A few open clusters can, however, easily be seen with the naked eye, even in bright moonlight. One can always find the Pleiades (or Seven Sisters) and Hyades, both in Taurus, Praesepe (or Beehive) in Cancer, or the double cluster in Perseus because they are composed of bright, gemlike stars, well spaced and easily distinguishable. Other open clusters can be spotted using binoculars or low-power telescopes.

Nebulae

Nebulae (a Latin term meaning clouds) are indeed clouds of dust or gas within our galaxy. Two types of nebulae are identified — planetary and diffuse. Planetary nebulae are so named because they form "smoke rings" around stars. Most planetary nebulae are very faint, but the Ring Nebula in Lyra and Owl Nebula in Ursa Major, for example, are spectacular as they appear in time exposure photographs, Diffuse nebulae are loose clouds of gas with no definite shape. One of the most prominent of these clouds is the Great Nebula in the sword of Orion (hanging below his belt). The entire region of Orion has the faint glow of nebulous gases, but here the glow is strongest. Most such nebulae are quite faint, and only long exposure photography brings out their details.

All the nebulae mentioned above are luminous or emission nebulae. Luminous nebulae are found close to bright stars which stimulate the gas molecules to glow like fluorescent lamps. Other diffuse nebulae, having no bright stars nearby, may appear as dark, obscuring clouds. Often called "coal sacks," they appear as silhouettes against star fields in the background. Most spectacular of the dark nebulae is the Horsehead Nebula in Orion. Another is in Cygnus near the star Deneb.

Messier Objects

Many galaxies, clusters, and nebulae are identified in several prominent lists. The New General Catalog (NGC) provides one commonly used listing of stellar objects. Another, even more popular catalog, is the list of Messier objects. No, the Messier objects are not the more untidy residents of the heavens. Charles Messier was a comet hunter of the 1700s who began a list now numbering 104 stellar objects notable for their historical interest, even distribution throughout the heavens, and variety. Since Messier was primarily interested in comets, he began this list of objects that might be mistaken for comets to help prevent other astronomers from generating false comet reports. The list is composed of galaxies, globular clusters, open clusters, nebulae, etc.

Messier objects are of particular interest to the amateur astronomer since almost all can be observed with even a simple telescope and many with only binoculars. All can be observed from the United States, and they are so evenly distributed that some should be visible on any night of the year. The list in Appendix D specifies the constellation in which each object appears.

The Messier objects are referred to by the letter 'M' followed by their number, such as M.31 for the Andromeda galaxy or M.45 for the Pleiades. Many of the constellation descriptions will reference such objects by their Messier number.

APPENDIX A
THE STELLAR COORDINATE SYSTEM

An alternative to the method of finding an object by visualizing its position relative to a few key landmarks is to find it using its actual stellar coordinates. Stellar locations can be specified using right ascension and declination values. These values give an angular separation from the defined object or location to fixed reference points in the sky. These reference points are the celestial equator for declination and the vernal equinox for right ascension.

The celestial equator is merely an extension of the earth's equator onto the heavens. Latitude is a measure of the angular separation between a location on the earth's surface and the earth's equator. In the same way, declination is a measure of the angle from a location in the sky to the celestial equator.

The vernal equinox is one of the two points in the sky where the ecliptic and celestial equator intersect. The ecliptic (as mentioned earlier) is the plane in which all the planets orbit. Since the earth tilts 23.5 degrees from vertical with respect to this plane, it can be seen that the earth's equator is not parallel to the ecliptic. The celestial equator, therefore, is also at a 23.5 degree angle to the ecliptic. The intersections between the ecliptic and the celestial equator are known as the vernal and autumnal equinoxes and are relatively fixed locations in the sky. Right ascension is the angle around the celestial equator from the specified location to the vernal equinox (akin to the measurement of longitude).

Since the motion of the stellar bodies is not visually discernible over periods of time meaningful to an observer, the right ascension and declination of the bodies can be considered constant. If the observer notes a change in position of an object viewed over a period of hours, days, or months, he can be sure that it is a planet, moon, asteroid, comet, or some other member of the solar system. If an observer knows his exact latitude, longitude, time of day, and the right ascension and declination of a stellar object, he can set his telescope to point directly at the target object.

APPENDIX B
LIST OF CONSTELLATIONS

Name	Abbrev.	English Equivalent	Index * Number
Andromeda	And	Daughter of Cepheus	35
Antila	Ant	Air Pump	M
Apus	Aps	Bird of Paradise	S,F
Aquarius	Aqr	Water Bearer	37
Aquila	Aql	Eagle	24
Ara	Ara	Altar	S
Aries	Ari	Ram	36
Auriga	Aur	Charioteer	7
Bootes	Boo	Bear Driver	16
Caelum	Cae	Sculptor's Chisel	M
Camelopardus	Cam	Giraffe	F,M
Cancer	Cnc	Crab	17
Canes Venatici	CVn	Hunting Dogs	M
Canis Major	CMa	Greater Dog	8
Canis Minor	CMi	Lesser Dog	9
Capricornus	Cap	Goat	38
Carina	Car	Keel	S
Cassiopeia	Cas	Cassiopeia	3
Centaurus	Cen	Centaur	S
Cepheus	Cep	Cepheus	4
Cetus	Cet	Whale	39
Chamaeleon	Cha	Chameleon	S
Circinus	Cir	Compasses	S,M
Columba	Col	Dove	15
Coma Berenices	Com	Berenice's Hair	F
Corona Australis	CrA	Southern Crown	S,F
Corona Borealis	CrB	Northern Crown	18
Corvus	Crv	Crow or Raven	19
Crater	Crt	Cup	F
Crux	Cru	Southern Cross	S
Cygnus	Cyg	Swan	25
Delphinus	Del	Dolphin	26
Dorado	Dor	Swordfish	S
Draco	Dra	Dragon	5
Equuleus	Equ	Foal	F
Eridanus	Eri	River	10
Fornax	For	Furnace	S
Gemini	Gem	Twins	11
Grus	Gru	Crane	S
Hercules	Her	Hercules	27
Horologium	Hor	Clock	S
Hydra	Hya	Water Serpent	20
Hydrus	Hyi	Water Snake	S

Indus	Ind	American Indian	S,M
Lacerta	Lac	Lizard	F,M
Leo	Leo	Lion	22
Leo Minor	LMi	Lion Cub	21
Lepus	Lep	Hare	12
Libra	Lib	Scales or Balance	28
Lupus	Lup	Wolf	S
Lynx	Lyn	Lynx	F,M
Lyra	Lyr	Lyre	29
Mensa	Men	Table Mountain	S,F
Microscopium	Mic	Microscope	S, M
Monoceros	Mon	Unicorn	M
Musca	Mus	Fly	S
Norma	Nor	Carpenter's Square	S,M
Octans	Oct	Octant	S,M
Ophiuchus	Oph	Serpent Holder	30
Orion	Ori	Great Hunter	6
Pavo	Pav	Peacock	S
Pegasus	Peg	Winged Horse	34
Perseus	Per	Perseus	13
Phoenix	Phe	Phoenix	S
Pictor	Pic	Painter's Easel	S
Pisces	Psc	Fishes	40
Piscis Austrinus	PsA	Southern Fish	S,F
Puppis	Pup	Stern	S
Pyxis	Pyx	Compass Box	S
Reticulum	Ret	Net	S
Sagitta	Sge	Arrow	31
Sagittarius	Sgr	Archer	32
Scorpius (Scorpio)	Sco	Scorpion	33
Sculptor	Scl	Sculptor's Workshop	M
Scutum	Sct	Shield	F, M
Serpens	Ser	Serpent	F
Sextans	Sex	Sextant	M
Taurus	Tau	Bull	14
Telescopium	Tel	Telescope	S,M
Triangulum	Tri	Triangle	.F
Triangulum Australe	TrA	Southern Triangle	S
Tucana	Tuc	Toucan	S
Ursa Major	UMa	Greater Bear	1
Ursa Minor	UMi	Lesser Bear	2
Vela	Vel	Sail	S
Virgo	Vir	Virgin	23
Volans	Vol	Flying Fish	S
Vulpecula	Vul	Fox	M

*Under Index Number, the constellation numbers used by the programs are listed. For those constellations not included in the Star Gazer's Guide, the letters F, M, and S are used. F indicates the constellation is too faint for the casual astronomer to find. M indicates modern constellations (see earlier text). S indicates southern constellations which are below the horizon from the northern hemisphere.

APPENDIX C
THE BRIGHTEST STARS

Star	Name	RA h	RA m	Dec °	Dec ′	Mag	Spect	Dist L-Y
α CMa	Sirius	6	42.9	-16	39	-1.42	AO*	8.7
α Car	Canopus	6	22.8	-52	40	-0.72	F0	230
α Cen	Rigil Kent	14	36.2	-60	38	-0.27	G0*	4.3
α Boo	Arcturus	14	13.4	+19	27	-0.06	K0	38
α Lyr	Vega	18	35.2	+38	44	0.04	A0	27
α Aur	Capella	5	13.0	+45	57	0.05	G0	46
β Ori	Rigel	5	12.1	-8	15	0.14	B8p	500
α CMi	Procyon	7	36.7	+5	21	0.38	F5	11
α Eri	Achernar	1	35.9	-57	29	0.51	B5	73
β Cen	Hadar	14	0.3	-60	8	0.63	B1	190
α Aql	Altair	19	48.3	+8	44	0.77	A5	16
α Ori	Betelgeuse	5	52.5	+7	24	Var.	Ma	300
α Tau	Aldebaran	4	33.0	+16	25	0.86	K5	64
α Cru	Acrux	12	23.8	-62	49	0.9	B1*	220
α Vir	Spica	13	22.6	-10	54	0.91	B2	190
α Sco	Antares	16	26.3	-26	19	0.92	Ma*	230
β Gem	Pollux	7	42.3	+28	9	1.16	K0	33
α PsA	Fomalhaut	22	54.9	-29	53	1.19	A3	23
α Cyg	Deneb	20	39.7	+45	6	1.26	A2p	650
β Cru	Becrux	12	44.8	-59	25	1.28	B1	500
α Leo	Regulus	10	5.7	+12	13	1.36	B8*	78
α Gem	Castor	7	31.4	+32	0	1.58	A0*	47
γ Cru	Gacrux	12	28.4	-56	50	1.61	Mb	
ε CMa	Adhara	6	56.7	-28	54	1.63	B1	330
ε UMa	Alioth	12	51.8	+56	14	1.68	A0p	49
γ Ori	Bellatrix	5	22.4	+6	18	1.70	B2	230
λ Sco	Shaula	17	30.2	-37	4	1.71	B2	200
ε Car	Avior	8	21.5	-59	21	1.74	K0*	330
ε Ori	Alnilam	5	33.7	-1	14	1.75	B0	
β Tau	El Nath	5	23.1	+28	34	1.78	B8	130
β Car	Mioplacidus	9	12.7	-69	31	1.80	A0	
α TrA	Atria	16	43.4	-68	56	1.88	K2	130
α Per	Mirfak	3	20.7	+49	41	1.90	F5	270
η UMa	Alkaid	13	45.6	+49	34	1.91	B3	190
γ Vel		8	8.0	-47	11	1.92	Oap	
γ Gem	Alhena	6	34.8	+16	27	1.92	A0	78
ε Sgr	Kaus Aust.	18	20.9	-34	25	1.95	A0	160
α UMa	Dubhe	11	0.7	+62	1	1.95	K0	105
δ CMa	Al Wazor	7	6.4	-26	19	1.98	F8p	650
β CMa	Murzim	6	20.5	-17	56	1.99	B1	300
δ Vel		8	43.3	-54	31	2.01	A0	70
θ Sco		17	33.7	-42	58	2.04	F0	140
ζ1 Ori	Alnitak	5	38.2	-1	58	2.05	B0*	400

Star	Name	RA h	RA m	Dec °	Dec ′	Mag	Spect	Dist L-Y
β Aur	Menkalinan	5	55.9	+44	57	2.07	A0p	84
α Pav	Peacock	20	21.7	-56	54	2.12	B3	160
α UMi	Polaris	1	48.7	+89	2	2.12	F8	470
α Oph	Rasalhague	17	32.6	+12	36	2.14	A5	67
σ Sgr	Nunki	18	52.2	-26	22	2.14	B3	160
α And	Alpheratz	0	5.8	+28	49	2.15	A0p	120
ζ UMa	Mizar	13	21.9	+55	11	2.16	A2p*	190
α Hya	Alphard	9	25.1	-8	26	2.16	K2	200
α Gru	Al Na'ir	22	5.1	-47	12	2.16	B5	91
κ Ori	Saiph	5	45.4	-9	41	2.20	B0	550
λ Vel	Suhail	9	6.2	-43	14	2.22	K5	220
β Per	Algol	3	4.9	+40	46	Var	B8	100
β Leo	Denebola	11	46.5	+14	51	2.23	A2	42
α Ari	Hamal	2	4.3	+23	14	2.23	K2	74
β Cet	Diphda	0	41.1	-18	16	2.24	K0*	57
β Gru		22	39.7	-47	9	2.24	Mb	270
β UMi	Kachab	14	50.8	+74	22	2.24	K5	120
γ Cas		0	53.7	+60	27	Var	B0p	200
ι Car		9	15.8	-59	4	2.25	F0	
θ Cen	Menkent	14	3.7	-36	7	2.26	K0	56
ζ Pup		8	1.8	-39	52	2.27	Od	800
γ1 And	Almach	2	0.8	+42	5	2.28	K0*	400
α CrB	Alphecca	15	32.6	+26	53	2.31	A0	67
γ Cyg	Sadr	20	20.4	+40	6	2.32	F8p	470
ε Sco		16	46.9	-34	12	2.36	K0	69
β And	Mirach	1	6.9	+35	21	2.37	Ma	76
γ Cen		12	38.7	-48	41	2.38	A0	130
γ Dra	Eltanin	17	55.4	+51	30	2.42	K5	150
β Cas	Caph	0	6.5	+58	52	2.42	F5	45
η CMa	Aludra	7	22.1	-29	12	2.43	Bsp	270
β UMa	Merak	10	58.8	+56	39	2.44	A0	76
α Phe	Ankaa	0	23.8	-42	35	2.44	K0	76
α Cas	Schedar	0	37.7	+56	16	Var	K0	230
δ Ori	Mintaka	5	29.5	-0	20	2.48	B0*	600
κ Sco		17	39.0	-39	0	2.51	B2	360
ε Peg	Enif	21	41.7	+9	39	2.54	K0	250
γ UMa	Phecda	11	51.2	+53	58	2.54	A0	88
α Peg	Markab	23	2.3	+14	56	2.57	A0	100
η Oph	Sabik	17	7.5	-15	40	2.63	A2	76
γ Crv	Gienah	12	13.2	-17	16	2.78	B8	130
α Cet	Menkar	2	59.7	+3	54	2.82	Ma	250
α2 Lib	Zuben'ubi	14	48.1	-15	50	2.90	A3*	62
θ1 Eri	Acamar	2	56.4	-40	31	3.42	A2*	120

†Asterisks indicate spectral type of brighter component where star is double.

APPENDIX D—THE MESSIER CATALOG

M	NGC OR (IC)	RIGHT ASCENSION (1950)		DECLINATION (1950)		APPARENT VISUAL MAGNITUDE	DESCRIPTION
1	1952	5	31.5	+22	00	11.3	"Crab" nebula in Taurus remains of SN 1054
2	7089	21	30.9	—1	02	6.4	Globular cluster in Aquarius
3	5272	13	39.8	+28	38	6.3	Globular cluster in Canes Venatici
4	6121	16	20.6	-26	24	6.5	Globular cluster in Scorpio
5	5904	15	16.0	+2	17	6.1	Globular cluster in Serpens
6	6405	17	36.8	-32	10		Open cluster in Scorpio
7	6475	17	50.7	-34	48		Open cluster in Scorpio
8	6523	18	00.6	-24	23	—	"Lagoon" nebula in Sagittarius
9	6333	17	16.3	-18	28	8.0	Globular cluster in Ophiuchus
10	6254	16	54.5	-4	02	6.7	Globular cluster in Ophiuchus
11	6705	18	48.4	-6	20		Open cluster in Scutum Sobieskii
12	6218	16	44.7	-1	52	7.1	Globular cluster in Ophiuchus
13	6205	16	39.9	+36	33	5.9	Globular cluster in Hercules
14	6402	17	35.0	-3	13	8.5	Globular cluster in Ophiuchus
15	7078	21	27.5	+11	57	6.4	Globular cluster in Pegasus
16	6611	18	16.1	-13	48		Open cluster with nebulosity in Serpens
17	6618	18	17.9	-16	12		"Swan" or "Omega" nebula in Sagittarius
18	6613	18	17.0	-17	09		Open cluster in Sagittarius
19	6273	16	59.5	-26	11	7.4	Globular cluster in Ophiuchus
20	6514	17	59.4	-23	02		"Trifid" nebula in Sagittarius
21	6531	18	01.6	-22	30		Open cluster in Sagittarius
22	6656	18	33.4	-23	57	5.6	Globular cluster in Sagittarius
23	6494	17	54.0	-19	00		Open cluster in Sagittarius
24	6603	18	15.5	-18	27		Open cluster in Sagittarius
25	(4725)	18	28.7	-19	17		Open cluster in Sagittarius
26	6694	18	42.5	-9	27		Open cluster in Scutum Sobieskii
27	6853	19	57.5	+22	35	8.2	"Dumbbell" planetary nebula in Vulpecula
28	6626	18	21.4	-24	53	7.6	Globular cluster in Sagittarius
29	6913	20	22.2	+38	21		Open cluster in Sagittarius
30	7099	21	37.5	-23	24	7.7	Globular cluster in Capricornus
31	224	0	40.0	+41	00	3.5	Andromeda galaxy
32	221	0	40.0	+40	36	8.2	Elliptical galaxy; companion to M31
33	598	1	31.0	+30	24	5.8	Spiral galaxy in Triangulum
34	1039	2	38.8	+42	35		Open cluster in Perseus
35	2168	6	05.7	+24	21		Open cluster in Gemini
36	1960	5	33.0	+34	04		Open cluster in Auriga
37	2099	5	49.1	+32	33		Open cluster in Auriga
38	1912	5	25.3	+35	47		Open cluster in Auriga
39	7092	21	30.4	+48	13		Open cluster in Cygnus
40		12	20	+59			Close double star in Ursa Major
41	2287	6	44.9	-20	41		Loose open cluster in Canis Major
42	1976	5	32.9	-5	25		Orion nebula
43	1982	5	33.1	-5	19		Northeast portion of Orion nebula
44	2632	8	37	+20	10		Praesepe; open cluster in Cancer
45		3	44.5	+23	57		The Pleiades; open cluster in Taurus
46	2437	7	39.5	-14	42		Open cluster in Puppis
47	2478	7	52.4	-15	17		Loose group of stars in Puppis
48		8	11	-1	40		"Cluster of very small stars"; not identifiable
49	4472	12	27.3	+8	16	8.5	Eliptical galaxy in Virgo
50	2323	7	00.6	-8	16		Loose open cluster in Monoceros
51	5194	13	27.8	+47	27	8.4	"Whirlpool" spiral galaxy in Canes Venatici
52	7654	23	22.0	+61	20		Loose open cluster in Cassiopeia

53	5024	13	10.5	+18	26	7.8	Globular cluster in Coma Berenices
54	6715	18	51.9	-30	32	7.8	Globular cluster in Sagittarius
55	6809	19	36.8	-31	03	6.2	Globular cluster in Sagittarius
56	6779	19	14.6	+30	05	8.7	Globular cluster in Lyra
57	6720	18	51.7	+32	58	9.0	"Ring" nebula; planetary nebula in Lyra
58	4579	12	35.2	+12	05	9.6	Spiral galaxy in Virgo
59	4621	12	39.5	+11	56	10.0	Spiral galaxy in Virgo
60	4649	12	41.1	+11	50	9.0	Elliptical galaxy in Virgo
61	4303	12	19.3	+4	45	9.6	Spiral galaxy in Virgo
62	6266	16	58.0	-30	02	7.3	Globular cluster in Scorpio
63	5055	13	13.5	+42	17	8.6	Spiral galaxy in Canes Venatici
64	4826	12	54.2	+21	57	8.5	Spiral galaxy in Coma Berenices
65	3623	11	16.3	+13	22	9.4	Spiral galaxy in Leo
66	3627	11	17.6	+13	16	9.0	Spiral galaxy in Leo; companion to M65
67	2682	8	48.4	+12	00		Open cluster in Cancer
68	4590	12	36.8	-26	29	8.2	Globular cluster in Hydra
69	6637	18	28.1	-32	24	8.0	Globular cluster in Sagittarius
70	6681	18	40.0	-32	20	8.1	Globular cluster in Sagittarius
71	6838	19	51.5	+18	39		Globular cluster in Saggitta
72	6981	20	50.7	-12	45	9.3	Globular cluster in Aquarius
73	6994	20	56.2	-12	50		Open cluster in Aquarius
74	628	1	34.0	+15	32	9.3	Spiral galaxy in Pisces
75	6864	20	03.1	-22	04	8.6	Globular cluster in Sagittarius
76	650	1	39.1	+51	19	11.4	Planetary nebula in Perseus
77	1068	2	40.1	-0	12	8.9	Spiral galaxy in Cetus
78	2068	5	44.2	+0	02		Small emission nebula in Orion
79	1904	5	22.1	-24	34	7.5	Globular cluster in Lepus
80	6093	16	14.0	-22	52	7.5	Globular cluster in Scorpio
81	3031	9	51.7	+69	18	7.0	Spiral galaxy in Ursa Major
82	3034	9	51.9	+69	56	8.4	Irregular galaxy in Ursa Major
83	5236	13	34.2	-29	37	8.3	Spiral galaxy in Hydra
84	4374	12	22.6	+13	10	9.4	Elliptical galaxy in Virgo
85	4382	12	22.8	+18	28	9.3	Elliptical galaxy in Coma Berenices
86	4406	12	23.6	+13	13	9.2	Elliptical galaxy in Virgo
87	4486	12	28.2	+12	40	8.7	Elliptical galaxy in Virgo
88	4501	12	29.4	+14	42	9.5	Spiral galaxy in Coma Berenices
89	4552	12	33.1	+12	50	10.3	Elliptical galaxy in Virgo
90	4569	12	34.3	+13	26	9.6	Spiral galaxy in Virgo
91			omitted				
92	6341	17	15.6	+43	12	6.4	Globular cluster in Hercules
93	2447	7	42.4	-23	45		Open cluster in Puppis
94	4736	12	48.6	+41	24	8.3	Spiral galaxy in Canes Venatici
95	3351	10	41.3	+11	58	9.8	Barred spiral galaxy in Leo
96	3368	10	44.1	+12	05	9.3	Spiral galaxy in Leo
97	3587	11	12.0	+55	17	11.1	"Owl" nebula; planetary nebula in Ursa Major
98	4192	12	11.2	+15	11	10.2	Spiral galaxy in Coma Berenices
99	4254	12	16.3	+14	42	9.9	Spiral galaxy in Coma Berenices
100	4321	12	20.4	+16	06	9.4	Spiral galaxy in Coma Berenices
101	5457	14	01.4	+54	36	7.9	Spiral galaxy in Ursa Major
102			omitted				
103	581	1	29.9	+60	26		Open cluster in Cassiopeia
104	4594	12	37.4	-11	21	8.3	Spiral galaxy in Virgo
105	3379	10	45.2	+13	01	9.7	Elliptical galaxy in Leo
106	4258	12	16.5	+47	35	8.4	Spiral galaxy in Canes Venatici
107	6171	16	29.7	-12	57	9.2	Globular cluster in Ophiuchus

GLOSSARY

BINARY STAR – Two stars which appear near each other in the sky. *Physical binary stars* are two stars within a single solar system which revolve around their mutual center. *Optical double stars* merely look like binaries because they are on the same line of sight from earth. 1/3 of all stars are physical binaries.

BLACK HOLE – The theoretical fate of a star having more than double the mass of the sun. As it ages, the star collapses on itself till it becomes so small and incredibly dense that its powerful gravitational field prevents even light from escaping.

CELESTIAL EQUATOR – The extension into space of the earth's equator.

CEPHEIDS – Short term variable stars with periods of 5.6 days. Cepheids are named after Delta (δ) Cepheus, the first of the type observed.

CIRCUMPOLAR – Constellations in the vicinity of the celestial pole which never set in their own hemisphere. The northern hemisphere circumpolar constellations are Ursa Major, Ursa Minor, Draco, Cepheus, and Cassiopeia.

CONSTELLATION – The stars in a given area of the sky, regardless of their relative distances from earth. The 88 constellations include ancient constellations which appear to form figures in the heavens and *modern constellations* designated solely to aid in naming stars.

DECLINATION – The angular distance, north or south, from the celestial equator, corresponding to a projection of earthly latitude. With *right ascension,* it is used to specify a celestial object's fixed location.

DOUBLE STAR – See BINARY STAR.

ECLIPSING BINARIES – A binary star system in which the stars periodically pass in front of each other, causing a variation in their apparent brightness.

ECLIPTIC – The path followed by the sun, moon, and planets across the sky; technically, an extension of the plane of orbit of the solar system. See ZODIAC.

GALACTIC CLUSTER – See OPEN CLUSTER.

GALAXY – A collection of gravitationally bound stars in space. Galaxies are classified into four types: irregulars, ellipticals, regular spirals, and barred spirals.

GLOBULAR CLUSTER – Close packed, ball shaped group of hundreds of thousands of densely packed stars. The more than 100 globular clusters are found in a loose sphere around the bulk of our galaxy proper.

LIGHT YEAR – The distance that light travels in one year; approximately 5.88 trillion miles.

MAGNITUDE – The relative brightness of stars, ranging from the brightest (1st magnitude or less) to the faintest detectable by the human eye (6th magnitude) and beyond to stars only visible in telescopes (>6th magnitude).

MESSIER OBJECTS – List of prominent galaxies, clusters, nebulae, etc. first compiled by Charles Messier in the 1700s.

MILKY WAY – Our galaxy which includes 100 billion stars plus the more than 100 globular clusters surrounding them. To earth, the Milky Way appears as a region of particularly dense star fields looking cloudy or milky.

NEBULAE – A cloud of gas and/or dust. Near a bright star, *emission nebulae* become luminous and emit light of their own, while *reflection nebulae* glow from reflected light. Dust clouds not near a bright star may be visible only in silhouette, blocking out stars beyond them. These are known as *dark nebulae.* A last type, *planetary nebulae,* appear as diffuse rings around stars.

NEUTRON STAR – A collapsed star, only several miles in diameter, which pulsates at radio frequency due to its high rate of spin.

NORTH STAR – The star located at the north celestial pole. Other stars appear to rotate around it. The North Star is currently Polaris in Ursa Minor.

NOVA – Latin for "new star" made conspicuous by its explosive destruction. Magnitude may increase a hundredfold for a few months or years then fade out again.

OPEN CLUSTER – Loosely arranged group of 12 to 350 stars travelling with a common motion within the Milky Way proper. Also called *galactic clusters,* they have no distinctive pattern, size, concentration, or brightness.

OPTICAL DOUBLES – See BINARY STAR.

QUASAR – Faint starlike objects with strong radio emissions. Quasars are believed to be the most remote objects known.

RIGHT ASCENSION – The angular distance around the celestial equator from the vernal equinox to an object or location. Right ascension corresponds to longitude on earth. With *declination,* it is used to specify a celestial object's location in the heavens.

SEASONAL CONSTELLATIONS – All constellations other than circumpolars. They are visible only during certain seasons.

SPECTRAL TYPE – The groups into which stars are divided according to their color which varies primarily by temperature. The chief classes in descending terperature order are designated O, B, A, F, G, K, M, N.

STELLAR COORDINATE – See RIGHT ASCENSION and DECLINATION.

VARIABLE STARS – Stars whose apparent brightness varies with time. They include *eclipsing binaries, cepheids, long term variables,* and *irregular variables.* The latter category includes *novae.*

VERNAL EQUINOX – One of the two intersections of the ecliptic with the celestial equator. This point, between Cetus and Pisces, is used as a reference point for calculating *right ascension.*

ZODIAC – A band 8 degrees on each side of the ecliptic containing twelve constellations.

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