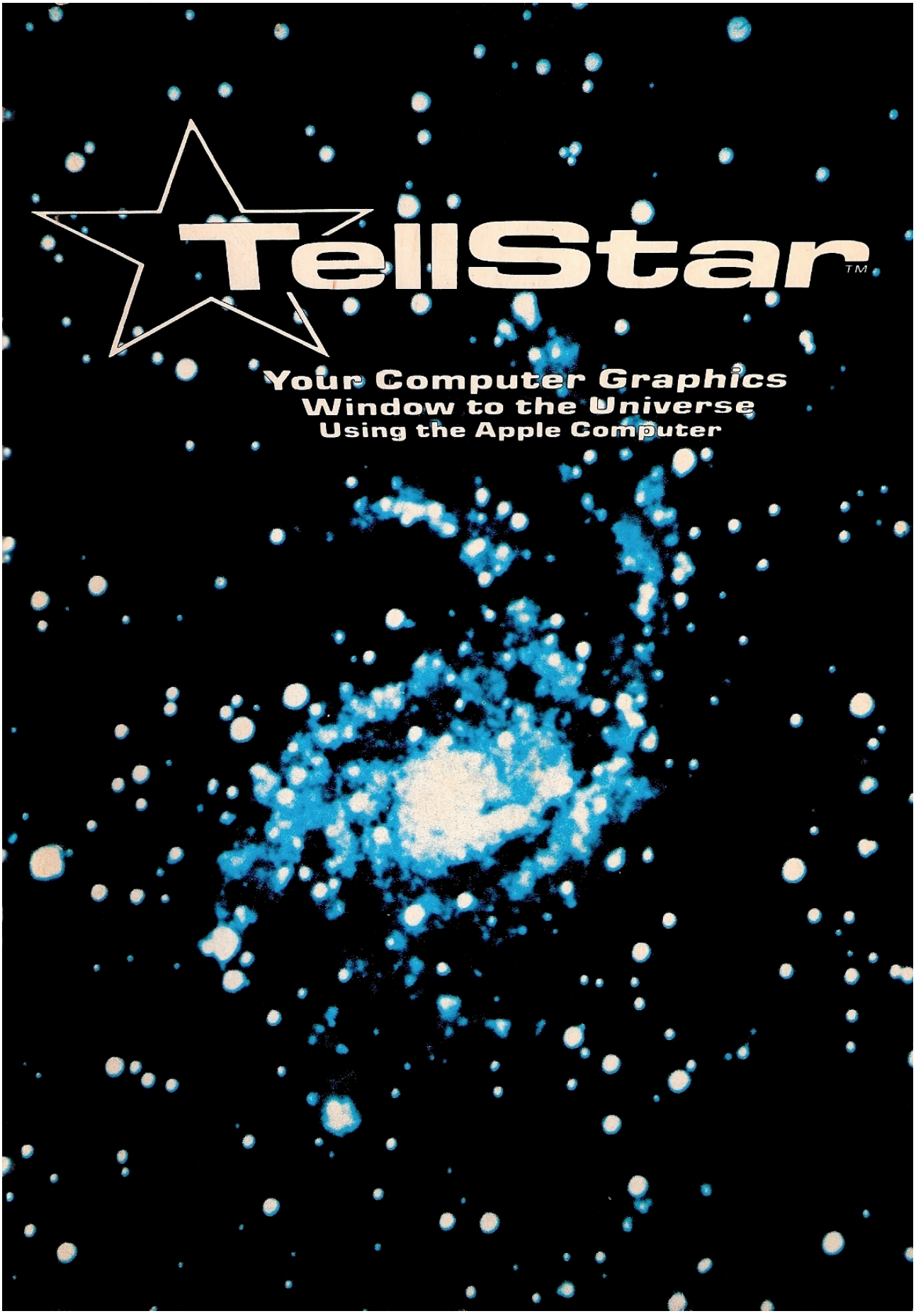
TellStar™
Your Computer Graphics
Window to the Universe
Using the Apple Computer

“If the end of all wisdom
is to add star to star,
our foolishness is pleasing."

The Seven Pillars of Wisdom
T.E. Lawrence

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revised 7/81

Acknowledgments:

Star Light,
Star Bright,
Which Stars,
Can I see
Tonight?

I often wondered what stars, planets and other objects I could see on a given night. Even when looking at them, they were often difficult to identify. The star charts were hard to use, often confusing, and didn't provide useful information on the moon and planets.

I had an Apple II computer, a telescope, and lots of curiosity. The result is this program which I hope you find useful and educational.

A number of my friends provided technical assistance, suggestions, proofreading and encouragement:

Mark Davison Bob Hustwit Hank Reinders
Bob Fritz Mike and Pam Lingle Arnie Rosner

My thanks to all of you,

ABOUT THE COVERS

Pinwheel Galaxy

One of the closest spiral galaxies (M33) is only 2.4 million light years away and is one of the very few galaxies moving towards our own Milky Way through space. Studies of its light reveals that the Pinwheel takes 200 million years to make a single complete turn on its axis. The blue color indicates that there are many bright hot blue stars being formed within its gas clouds.

INTRODUCTION

Welcome to TellStar™, your computer window to the celestial objects as they appear at your home, or any location on the Earth you desire.

TellStar consists of four main sections:

VIEWING LOCATION — You are greeted by this section when the program is first run. You are requested to choose a standard. random. or new standard viewing location.

VIEWING TIME AND DATE — The date and time are entered in this section. A series of statistical data is presented which is useful and interesting. New times, dates, and locations can be selected.

DISPLAY — The high resolution graphics displays are presented in this section. Celestial objects can be interactively located and identified. Constellations are uniquely presented and drawn.

CALCULATION — A series of astronomical calculations utilities are available in this section. These routines will be of immediate use to amateur astronomers.

Each of the above functions will be thoroughly explained in the following chapters of this manual. An appendix containing Star Table data and other pertinent information is at the end of the manual.

TellStar is available in two versions, LEVEL I and LEVEL II. The LEVEL II version supports multiple Star Tables. Your diskette will be labelled with its level and an additional appendix will be included with the LEVEL II manual.

This program is quite accurate, depending upon the celestial object in question. Accuracy is typically within fifteen seconds of arc, but may vary up to several minutes at the extremes. The results compare favorably with both the Astronomical Ephemeris and the American Ephemeris.

The processing load on the computer is quite heavy. Occasionally the computer needs several seconds to complete your request. If it seems to have stopped, just wait a minute or so. Delays may occur at any time, however, it usually happens during the display of statistical data.

VIEWING LOCATION

TellStar has been written to minimize the need to remember facts and figures. The program requires the user to enter his 'standard' viewing location only once, using data from Appendix A (World Wide Cities).

The Viewing Location Section begins with this display:

LOCATION FOR VIEWING
S - STANDARD
R - RANDOM
N - NEW STANDARD
D - DEMONSTRATION

S — **STANDARD** - The program will immediately proceed to the next section using the previously defined standard location.

R — **RANDOM** - The VIEWING TIME AND DATE section will be loaded, requesting the latitude and longitude for this random viewing. The responses must follow the format presented below under New Standard.

N — **NEW STANDARD** - This function allows you to create a standard location once, and not have to enter this data every time you run the program. The required information is presented below.

D — **DEMONSTRATION** - A predetermined location, date, and time display will be loaded. AII system capabilities may be fully utilized.

ENTER LOCATION CITY

Enter the name of the city using 30 characters or less. Do not use commas or special characters.

ENTER YOUR LATITUDE
DEGREES: (0 to 90)
MINUTES: (0 to 60)
SECONDS: (0 to 60)
NORTHERN OR SOUTHERN
HEMISPHERE (N OR S)

The requested information can be obtained from the appendix or any atlas. You can select any spot on the earth. The North and South Poles are located at 90 degrees. Because of the peculiarities of Applesoft, these latitudes are adjusted to 89.99 degrees. This is obviously close enough for most uses.

ENTER YOUR LONGITUDE
DEGREES: (0 to 180)
MINUTES: (0 to 60)
SECONDS: (0 to 60)
EAST OR WEST (E OR W)

This information can be obtained as indicated above for the latitude.

PRINTER SLOT DESIGNATION
ENTER 0 IF NO PRINTER (0 to 7)

SILENTYPE (Y/N)

Answering Y (yes) if you do not have a Silentype printer will cause unpredictable results.

Statistical information is presented in numerous displays while running TellStar. This information is followed by a flashing cursor, or a line stating 'press any key to return to display'. If a 'P' is pressed at this time, the data will be printed. Further discussion of this feature will be addressed where appropriate in this manual.

Error messages in this section are self-explanatory and generally relate to invalid latitudes and longitudes.

VIEWING TIME AND DATE

The VIEWING TIME AND DATE section is the main program of TellStar. The functions of the program are directed from this section. The user has a choice of changing time and date, location, display, or calculation. Any function selected will always return here for your next function.

ENTER VIEWING TIME
(24) HOUR FORMAT)

HOURS : (0 to 24)
MINUTES : (0 to 60)
SECONDS : (0 to 60)

DAYLIGHT SAVINGS TIME (Y/N)

The requested data must be entered in the above format. Error checking is performed on the responses. It is possible to enter a time greater than 24 hours by entering 24 hours, XX minutes, XX seconds. If the time is invalid, the message 'View Time Error' will appear and the entire time must be re-entered.

ENTER VIEWING TIME

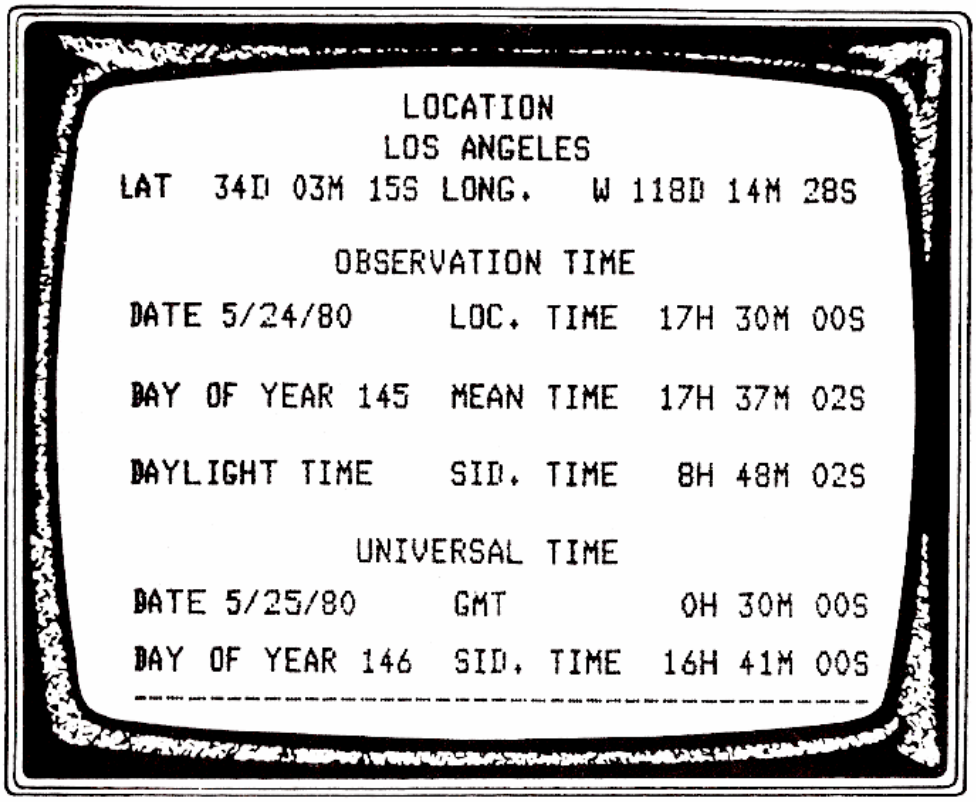
MONTH : (1 to 12)
DAY : (1 to 31)
YEAR 1975 to 1999

USE LAST TWO DIGITS
OF THE YEAR

YEAR : (75 to 99)

The requested data must be entered in the above format. Error checking is performed on the responses. The program does not verify the number of days in the month but functions accurately with allowable answers.

On the rare occasion when the program loaded incorrectly, or there is an anomaly with your equipment, you may get a message stating 'Sidereal Time Error' and the program will terminate. Re-running the program will usually eliminate the problem.



The above statistical data is the result of the information you have provided. Each of the entries will be explained so you can refer to this table of information during your viewing.

LAT 34D 03M 15S

The latitude as entered from the standard location (or your 'random' entry) is indicated in degrees, minutes, and seconds. If the latitude is for the southern hemisphere, it will be preceded by a minus sign.

LONG. W 118D 14M 28S

The longitude is preceded by a 'W' for longitude West of Greenwich or an 'E' for longitude East of Greenwich.

DATE 5/24/80

The date specified for your viewing is presented. Please make sure you entered the date you actually wanted; the displays are accurate only for the date entered.

LOC. TIME 17H 30M 00S

This is the time you specified for your viewing. It is the standard time for your time zone, no matter what your location within that zone. If you entered the time as Daylight Savings Time, it will be indicated as such in a field.

DAY OF YEAR 145

The day of year is presented for use in referencing astronomical charts and tables.

MEAN TIME 17H 37M 02S

This is the Local Mean Time (LMT) used to locate celestial objects, Standard time is adjusted for your position relative to the central meridian of your time zone yielding LMT. The correction is 4 minutes for each degree away from the meridian.

DAYLIGHT TIME

If this notation appears, the astronomical times are adjusted for the extra hour added to your Standard time.

SID. TIME 8H 48M 02S

The Sidereal Time is based on one rotation of the Earth relative to any given star. Sidereal Time is divided into 24 hours but is 4 minutes shorter than the 'normal' day. This 4 minute difference is due to the Earth's movement in its orbit around the Sun. When the Sun crosses the equator going South, about September 23rd, Sidereal time and Standard time are in unison. Astronomical charts and data reference Sidereal Time.

UNIVERSAL TIME

Universal Time (sometimes called Greenwich Time) is an unambiguous system of 24 hour time centered on the zero meridian. The data presented here is similar in nature to that above. The 'Date' and 'Day of Year' may be different than your specified data because of the geographical distance between your location and the zero meridian.

COMMAND 1 - DISPLAY
2 - CALCULATE
3 - NEW TIME
4 - NEW LOCATION
5 - END PROGRAM

DISPLAY — Entering this command will load the Display section of TellStar. There will be status messages describing the various processes taking place. The entire cycle may take as long as six minutes. There will be a 'ticking' sound to let you know that all is well.

CALCULATE — The Calculation section of TellStar will be loaded with this command. The Calculation command menu will be presented for your selection when the section is loaded.

NEW TIME - This command allows you to change the viewing time and date specified. A new display of statistical information will be presented. When you change the time and re-enter the Display section, the six minutes of astronomical adjustment must take place again.

NEW LOCATION - A new 'random' viewing location can be entered when this command is used. After the new latitude and longitude are entered, a new time and date as indicated in '3' above will be automatically performed.

END PROGRAM - This command will terminate TellStar.

P. The statistical data will be printed to the slot indicated when the 'New Standard' location was established.

The display and Calculation sections will return to this display when they are exited. You can return here and then go to either of the other functions without the six minutes of adjustment if you do not change the date, time, or location.

DISPLAY

The DISPLAY section of TellStar presents high resolution displays of the heavens with interactive inquiries and commands. The interactive commands are entered from both the keyboard and a joystick (or game paddles).

When the Display function is chosen from the Viewing Time and Date portion, the following processes will take place:

While the Display section is being loaded, a status message will appear on the screen.

1. If using LEVEL II, you will be asked which Star Table should be loaded.
2. The Star Table will be loaded as indicated on the display.
3. A series of calculations will be performed for Solar system Objects. The first calculation is termed 'Initial Planetary Calculations' with the next being 'Sun and Inner Planet Calculations' (Sun, Mercury, Venus, and the Earth).
   The Earth's orbital position must be calculated in order to determine its spacial relationship to all other Solar System Objects.
   Finally, there are the 'Outer Planet Calculations' for Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto.
4. The Moon calculations are now performed to determined lunar position, rise, set, and phase.
5. Precession calculations are performed next. The Earth's precession (or wobble about its axis) is caused by the effect of the Moon and Sun. The formal name for this phenomena is 'luni solar precession'. The effect is small, the North Pole of the Earth making one complete revolution every 25,800 years. Still, it is of concern to astronomers and TellStar adjusts its Star Tables for the specified view date.
6. Finally, TellStar calculates the azimuth (compass heading) and elevation for the Sun, Moon, Planets, Stars, and other Celestial objects for the location, time, and date you have requested. The message 'Celestial objects being calculated for your time and location' appears on the screen during this time.

These calculations require about six minutes. During this time the computer 'ticks' to let you know that all is well and it's working properly. This accurate calculation technique is not available from 'static' star charts. The ability to dynamically determine the locations and statistical information of celestial objects is only available with a computer and TellStar.

There are two display modes, Horizontal and Overhead. Horizontal presents a view covering 90 degrees of azimuth and from the horizon to straight overhead (the zenith). When displaying a spherical surface on a two dimensional plane such as your terminal, there is distortion, increasing as you approach the zenith. This phenomenon has plagued cartographers for centuries and is the reason for the many different types of maps.

The Overhead view displays 360 degrees of azimuth from the zenith down to 40 degrees of elevation. This view significantly reduces the distortion at the higher elevations.

Both views and a detailed discussion of their components will be presented after the Display Commands.

CMD L I C ← → O D P S E

The command line appears at the bottom line of the screen whenever the Display mode is ready to accept new commands. Only a single command key needs to be pressed; a return is not necessary. The commands perform their functions as follows:

L The L mode is used to locate any object in the Star Tables. You will be requested to enter the object's name, which must be followed with a 'return'. If you have chosen an object not in the tables, you will be notified and the Horizontal view will reappear.

If the object you have requested is in the tables, you will be given a page of statistical information. The explanation of this data is given later in this chapter. You will see one of two prompts on the bottom of the screen:

HIT ANY KEY TO RETURN TO DISPLAY

or

OBJECT BELOW HORIZON AT THIS TIME

If you press the 'P' key. the data on the screen will be printed as described earlier.

Press any key to return to the view mode. If the object was above the horizon, you will be shifted to a Horizontal view with the requested object within 30 degrees of the center of the screen. The celestial objects will be plotted and a set of cross-hairs will blink to locate the selected object.

If the object was below the horizon. you will be returned to the last Horizontal view presented. whether you came from a Horizontal view or not.

I The Identify mode allows you to move the cross-hairs around the screen to identify any of the objects present on the screen. A joystick is the most effective device for this interactive technique.

When you have the cross-hair over the object you wish to identify. press Switch O. A display and results identical to the 'Locate' data will appear. If the cross-hairs are not centered on the object, a message will appear and you may try again.

The Identify mode remains active until you press Switch 1. After the switch is pressed, the command line will reappear.

If you are using game paddles. turn the knobs to move the crosshairs over the object. When centered, press the button on Paddle 0 to obtain the data. Use the button on Paddle 1 to return to the command line.

C The Constellation mode draws lines between stars giving you a life-like view of the constellations in the sky. After the lines are drawn, you are back in the command mode.

The 'C' command works with either the Horizontal or Overhead display. As described earlier. there is distortion in the upper elevations of the Horizontal mode. If the constellations you are interested in are distorted, go to the Overhead mode as described later in this chapter.

← Pressing the '←' (Left Arrow) key shifts the Horizontal display 45 degrees to the left. After the shift, the command line will reappear.

→ Pressing the '→' (Right Arrow) key shifts the Horizontal display 45 degrees to the right. After the shift, the command line will reappear.

O The Overhead view is presented when the 'O' key is pressed. The Overhead view is fully described later in this chapter. You can use the 'Identify' and 'Constellation' modes with this view as described above.

The '←' and '→' (Arrow) keys can be used to exit the Overhead view and return to the previous Horizontal view shifted to the left or right respectively. The Overhead view can al so be exited by the 'D' command below.

D The Direction command allows you to select any of eight compass headings. The Horizontal view for that heading is presented. Please note that you must press the 'return' key after you have entered the desired heading.

P Pressing 'P' will print high resolution graphics to a Silentype printer. The Silentype must be specified in the standard location if graphic printing is desired.

A view can only be printed if the Silentype definition was in effect at the time the view was created.

S The 'S' command will allow you save the views and data from a time you have specified. The next time you run a "Demonstration" your location, date, and time will be presented.

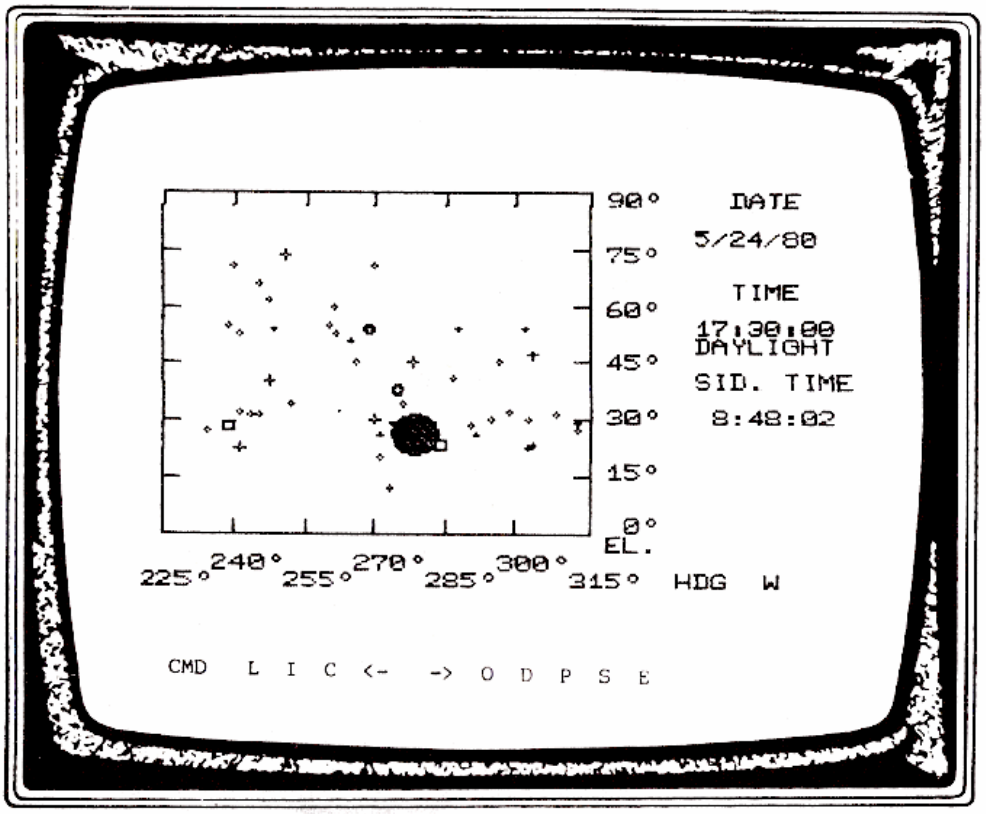
If you change the printer slot or Silentype configuration after you save a view, the results when you run the demonstration will be unpredictable if you attempt to access the printer.

E Pressing the E key enters the End mode of the Display section. The VIEWING TIME AND DATE portion of TellStar will be loaded and its command mode will be ready.

You can return to the Display mode without six minutes of calculations if you do not change ANY of the parameters. If you change the time, date, or location, the calculations will be performed upon entering the Display mode.

This completes the description of the Display section commands. The Horizontal and Overhead view descriptions and their symbols follow with the Statistical text display at the end of the chapter.

HORIZONTAL VIEW MODE



The Horizontal view mode is extremely accurate for determining the position of celestial objects. The scales presented on the screen are linear and positions can be easily interpreted.

The bottom scale represents azimuth in 15 degree increments, while the HDG indicator shows the direction of view for the center of the screen. As can be seen, the horizontal view is 90 degrees wide. The '←' and '→' (Arrow) commands shift the view 45 degrees allowing all objects to appear near the center.

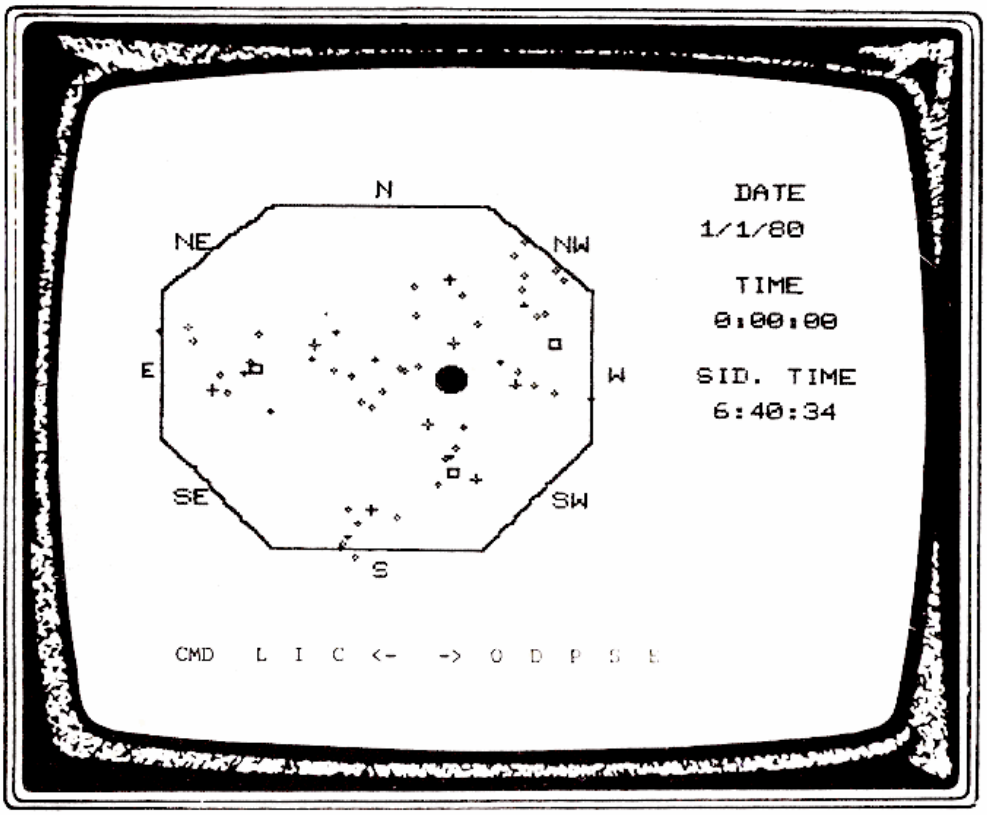
The elevation scale goes from 0 degrees at the horizon to 90 degrees at the zenith. Although there is distortion of shapes at higher elevations, the elevation shown is accurate. Some object with an elevation of 5 degrees or less may not plot. This restriction prevents large objects from overlaying the heading scale.

Objects can be located using the scales on the display or the statistical data from the Locate or Identify requests. If you are viewing with a telescope that has alti-azimuth locating circles, this data is just what you need.

The statistical data provides the right ascension and declination adjusted for the Earth's precession at the viewing time and date specified.

The date, time, and sidereal time are presented with the display for your convenience. You can use the sidereal time to coordinate other star charts with TellStar displays.

OVERHEAD VIEW MODE



The Overhead view mode is useful for determining the relative position of celestial object between 40 degrees of elevation and the zenith.

The display shows eight compass headings with the zenith in the center of the display. This display should be visualized as facing South with the display over your head. With this orientation, the compass headings and the relative positions of these directions are correct.

You may use the 'C' and 'I' commands exactly as described earlier. If the 'L' command is used, the display will revert to the Horizontal view mode.

Objects can be located using the headings on the display or the statistical data from the Locate or Identify requests. If you are viewing with a telescope that has alti-azimuth locating circles, the heading and elevation data is just what you need.

The statistical data provides the right ascension and declination adjusted for the Earth's precession at the viewing time and date specified.

The date, time, and sidereal time are presented with the display for your convenience. You can use the sidereal time to coordinate other star charts with TellStar displays.

DISPLAY SYMBOLS

A standard set of symbols is used in both the Horizontal and Overhead displays. This symbol set allows easy identification of the type of celestial objects on the display.

This symbol represents stars with a magnitude of equal to or greater than 1.5. The magnitude for the brightest stars are negative with Sirius, the brightest star, having a value of -1.4. The dimmest objects visible in the largest telescopes have a value of +24. The dimmest objects usually seen with the unaided eye in clear skies are +5. A magnitude change of signifies a brightness ratio of about 2.5.

The larger star symbol seen on the left represents stars with magnitudes of less than 1.5. A number of these brighter stars are contained in the star tables.

The symbol for planets is presented on the left. When any planets are visible, they are indicated with this enclosed cross.

A small square represents Messier objects. Charles Messier (1730-1817) located and catalogued over 100 celestial objects of extreme interest and beauty. These can be found on all star charts by an 'M' followed by the number (for example, M31).

The sun is represented by the large symbol on the left. When you ... specify daylight hours for your viewing, the sun and the stars are both plotted even though the stars will not be visible.

A new moon is graphically represented by the symbol on the left. The new moon is dark because the moon's night side is facing the Earth.

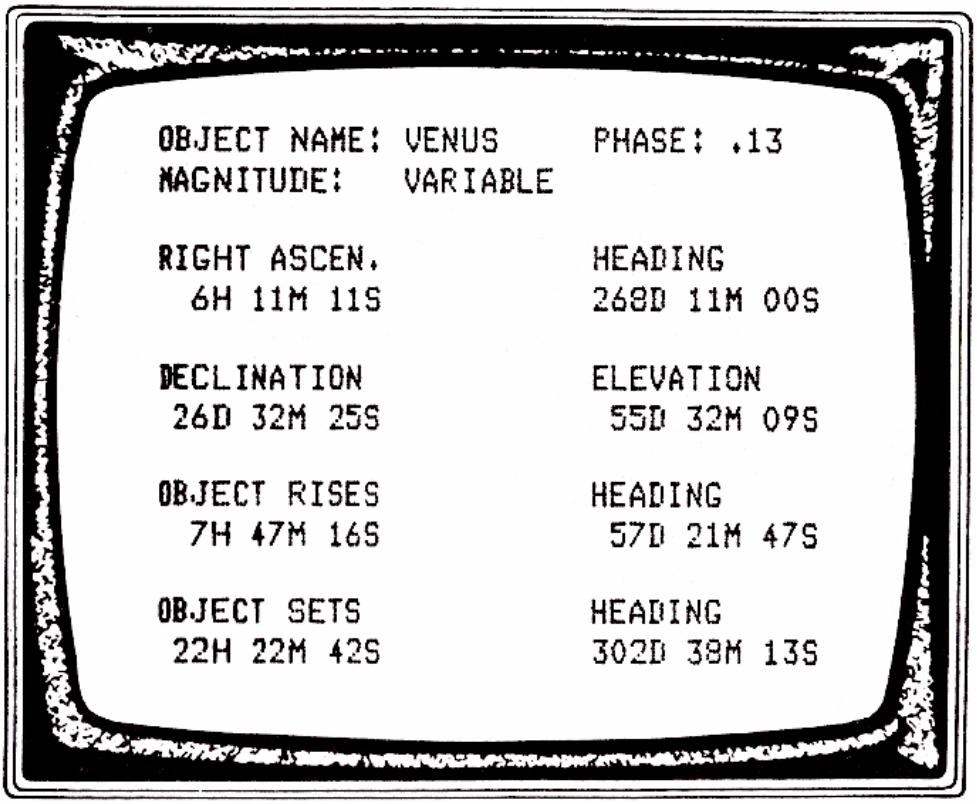
The gibbous moon is displayed by the shape on the left. The moon may be waxing (from new moon to full moon) or waning (from full moon to new moon). This shape represents approximately a 1/4 moon.

A half moon, which may be waxing or waning, is indicated by this shape.

The 3/4 moon (waxing or waning) is displayed as indicated on the left .

A full moon shape is shown on the left. The time required for the moon to repeat its phases is called the 'synodic month' and is precisely 29 days, 12 hours, 44 minutes, and 2.9 seconds.

STATISTICAL TEXT DISPLAY EXAMPLE



This statistical text display appears in response to requests from both the Identify and Locate modes. A portion of this display appears with the Calculation section results.

OBJECT NAME: VENUS PHASE: .13

Data on the requested object appears in the above format. The name indicated is exactly as it appears in the Star Tables. The 'Phase' or illuminated portion as viewed from the Earth is presented for the planets and moon.

MAGNITUDE: VARIABLE

Magnitude is generally only applicable to individual stars or star clusters. Planets, the moon, constellations, and most Messier objects will be indicated as 'Variable'.

RIGHT ASCEN. HEADING
6H 11M 11S 268D 11M 00S

Right Ascension and Declination are astronomical coordinates similar to longitude and latitude. Projecting the Earth's standard coordinate system outward yields a 'celestial' coordinate system consisting of a

north celestial pole, south celestial pole, and a celestial equator from the base point (0 degrees longitude, also known as the vernal equinox) is right ascension and is expressed in hours, minutes, and seconds. One hour is equivalent to 15 degrees of longitude.

The 'Heading' indicated is the compass heading for the object in question at the location, time, and date you have specified.

DECLINATION	ELEVATION
26D 32M 25S	55D 32M 09S

Declination is the angular distance above or below the celestial equator and varies from -90 degrees through 0 degrees on the celestial equator to +90 degrees. Negative declination is preceded with a minus sign.

Elevation varies from 0 degrees on your horizon to 90 degrees, your zenith. Remember, right ascension and declination are an absolute coordinate system while the heading and elevation are specifically for your location, time, and date.

OBJECT RISES	HEADING
7H 47M 16S	57D 21M 47S

The time the object rises and the direction at which it first appears on the horizon are defined with this data. The time is your local time, TellStar adjusts for daylight savings time. The program does not correct for the refraction of light caused by the Earth's atmosphere. This effect may cause the time to vary by several minutes and the heading by several degrees.

OBJECT SETS	HEADING
22H 22M 42S	302D 38M 13S

The setting time and heading for the specified object are presented as shown. When objects have a declination within your latitude of the celestial pole, the objects are circumpolar and never set. For example, if your latitude is 40 degrees north, all objects with a declination 50 degrees or more are circumpolar.

Objects that are very close to being circumpolar have unusual rise and set times. An object may rise at 4H 18M 00S and set at 4H 17M 00S. At first glance it appears that it set 1 minute before it rose. It actually does set 1 minute before it rises, it remains below the horizon for 1 minute, and is above the horizon for 23H 59M.

CALCULATION

The Calculation Section is a series of five utilities to perform astronomical conversions and provide data on Solar System objects. These routines will be of immediate use to the astronomer and even the casual observer. When entering the Calculation Section you are presented with the following display:

```
********* CALCULATION SECTION *********

COMMAND     1 - EQUATORIAL TO HORIZONTAL
            2 - HORIZONTAL TO EQUATORIAL
            3 - ECLIPTIC TO EQUATORIAL
            4 - PRECESSION SINCE 1950
            5 - SOLAR SYSTEM OBjECTS
            6 - EXIT CALCULATIONS
```

1. **EQUATORIAL TO HORIZONTAL** — This routine allows you to enter astronomical data using right ascension and declination and obtain an immediate conversion to horizontal (azimuth and elevation) coordinates. Note that the horizontal coordinate data is accurate for the latitude, longitude, time, and date you have already provided to TellStar.

   This routine will allow you to enter data from star charts, magazines, etc. and be able to convert this information to readily useable format. You may wish to adjust this data for precession prior to coordinate system conversion. Please see '4' below for precession adjustment.

   The data required for the conversion is requested as follows:

   ```
   ENTER OBJECTS RIGHT ASCENSION

   HOURS    : (0 to 24)
   MINUTES  : (0 to 60)
   SECONDS : (0 to 60)
   ```

   Right ascension errors may occur if a value greater than 24 hours is entered by inputting 24 hours, XX minutes, XX seconds. This same type of error can occur when degrees are entered.

   ```
   ENTER OBJECTS DECLINATION

   DEGREES  : (-90 to 90)
   MINUTES  : (0 to 60)
   SECONDS : (0 to 60)
   ```

Declination errors may occur if a value greater than 90 degrees is entered.

Entering 'P' while the conversion data is on the screen will print the screen contents. Pressing any other key will cause the display to return to the Calculation command mode. This applies to all data displayed in the Calculation Section.

2. **HORIZONTAL TO EQUATORIAL** — Actual viewing coordinates of azimuth and elevation can be converted to astronomical coordinates with this routine. You can take the results of this conversion and locate the objects in star tables by their right ascension and declination.

   The data necessary for this conversion is requested as follows:

   ENTER COMPASS HEADING

   DEGREES : (0 to 360)
   MINUTES : (0 to 60)
   SECONDS : (0 to 60)

   Azimuth errors may occur if a value greater than 360 degrees is entered.

   ENTER ELEVATION

   DEGREES : (0 to 90)
   MINUTES : (0 to 60)
   SECONDS : (0 to 60)

   Elevation errors may occur if a value greater than 90 degrees is entered.

3. **ECLIPTIC TO EQUATORIAL** — Conversions between the Ecliptic. or solar system coordinates. and the Equatorial system are provided with this routine. For the most part, only astronomers will be concerned with this function. Data for conversion is requested as follows:

   ENTER ECLIPTIC LONGITUDE

   DEGREES : (0 to 360)
   MINUTES : (0 to 60)
   SECONDS : (0 to 60)

   Longitude errors may occur if a value greater than 360 degrees is entered.

ENTER ECLIPTIC LATITUDE

DEGREES : (-90 to 90)
MINUTES : (0 to 60)
SECONDS : (0 to 60)

Latitude errors may occur if a value greater than 90 degrees is entered.

3. **PRECESSION SINCE 1950** — Almost all star tables list right ascension and declination with precession adjusted for the 1950 Epoch. With this routine, you can still use your 1950 tables, books, and manuals and have 'up to the minute' results. This routine adjusts the data and input to match the date provided to TellStar.

   The required input data is identical to the 'Equatorial to Horizontal' conversion above.

4. **SOLAR SYSTEM OBJECTS** — This function is provided to allow these objects to be located easily without the full Display section calculations. Only the planetary calculations are performed for this function. If you return to the View Time and Date section and then go to the Display section, the planetary calculations will be preserved and the Display start-up will be less than 6 minutes.

   You are presented with a table of available Solar System objects after the initial calculations. The program will ask you to choose as indicated below:

   ENTER SELECTION (0 - 10):

   Entering the desired selection will provide the requested data. You can print the data with a 'P' or return to the Calculation command mode with any other key. You can return to the Solar System Objects without the need for additional calculations at any time, as long as you have not changed the location, time, or date. Please remember that the data presented is only accurate for the specified time and date.

5. **EXIT CALCULATIONS** - To exit and return to the View Time and Date section enter a '6'.

This completes the operational instructions for the Calculation section of TellStar.

APPENDIX - A
World Wide Cities

UNITED STATES	LATITUDE	LONGITUDE
Albuquerque, NM	35 05 01 N	106 39 05 W
Atlanta, GA	33 45 10 N	84 23 37 W
Atlantic City, NJ	39 21 32 N	74 25 53 W
Baltimore, MO	39 17 26 N	76 36 45 W
Birmingham, AL	33 31 01 N	86 48 36 W
Boise, ID	43 37 07 N	116 11 58 W
Boston, MA	42 21 24 N	71 03 25 W
Boulder, CO	40 00 13 N	105 15 42 W
Buffalo, NY	42 52 52 N	78 52 21 W
Burlington, VT	44 28 34 N	73 12 46 W
Butte, MT	46 01 06 N	112 32 11 W
Charleston, SC	32 46 35 N	79 55 53 W
Cheyenne, WY	41 08 09 N	104 49 07 W
Chicago, IL	41 52 28 N	87 38 22 W
Cleveland, OH	41 29 51 N	81 41 50 W
Dalias, TX	32 47 09 N	96 47 37 W
Denver, CO	39 44 58 N	104 59 22 W
Des Moines, IA	41 35 14 N	93 37 00 W
Detroit, MI	42 19 48 N	83 02 57 W
Fairbanks, AK	64 48 00 N	147 51 00 W
Fargo, NO	46 52 30 N	96 47 18 W
Hartford, CT	41 46 12 N	72 40 49 W
Honolulu, HI	21 18 22 N	157 51 35 W
Indianapolis, IN	39 46 07 N	86 09 46 W
Jackson, MS	32 17 56 N	90 11 06 W
Las Vegas, NV	36 10 20 N	115 08 37 W
Little Rock, AR	34 44 42 N	92 16 37 W
Los Angeles, CA	34 03 15 N	118 14 28 W
Louisville, KY	38 14 47 N	85 45 49 W
Manchester, NH	42 59 28 N	71 27 41 W
Mauna Kea, HI	19 49 34 N	155 28 18 W
Miami, FL	25 46 37 N	80 11 32 W
Milwaukee, WI	43 02 19 N	87 54 15 W
Minneapolis, MN	44 58 57 N	93 14 43 W
Nashville, TN	36 09 33 N	86 46 55 W
New Orleans, LA	29 56 53 N	90 04 10 W
New York, NY	40 45 06 N	73 59 39 W
Omaha, NB	41 15 42 N	95 56 14 W
Philadelphia, PA	39 56 58 N	75 09 21 W

UNITED STATES	LATITUDE	LONGITUDE
Phoenix, AZ	33 27 12 N	112 04 28 W
Pierre, SO	44 22 18 N	100 20 54 W
Pittsburgh, PA	40 26 19 N	80 00 00 W
Portland, ME	43 39 33 N	70 15 19 W
Portland, OR	45 31 06 N	122 40 35 W
Providence, RI	41 49 32 N	71 24 42 W
Raleigh, NC	35 46 38 N	78 38 21 W
Richmond, VA	37 32 15 N	77 26 09 W
St. Louis, MO	38 37 45 N	90 12 22 W
Salt Lake City, UT	40 45 23 N	111 53 26 W
San Diego, CA	32 46 35 N	117 04 12 W
San Francisco, CA	37 46 39 N	122 24 40 W
Seattle, WA	47 36 32 N	122 20 12 W
Tulsa,OK	36 09 12 N	95 59 34 W
Washington, OC	38 53 51 N	77 00 33 W
Wheeling, WV	40 04 03 N	80 43 20 W
Wichita, KS	37 41 30 N	97 20 16 W
Wilmington, DE	39 44 46 N	75 32 51 W

CANADA	LATITUDE	LONGITUDE
Calgary, Alberta	51 02 46 N	114 03 24 W
Halifax, N. Scotia	44 38 39 N	63 34 34 W
Montreal, Quebec	45 30 30 N	73 33 20 W
Toronto, Ontario	43 39 12 N	79 23 00 W
Vancouver, BC	49 16 30 N	123 07 30 W
Winnipeg, Manitoba	49 53 56 N	97 08 20 W

WORLDWIDE	LATITUDE	LONGITUDE
Athens, Greece	37 58 20 N	23 43 00 E
Barcelona, Spain	41 24 59 N	2 07 36 E
Berlin, Germany	52 28 30 N	13 25 30 E
Bern, Switzerland	46 57 13 N	7 25 42 E
Bogota, Columbia	4 35 55 N	74 04 54 W
Bologna, Italy	44 29 53 N	11 21 06 E
Bordeaux, France	44 50 07 N	0 31 36 W
Budapest, Hungary	47 29 59 N	18 57 54 E
Cambridge, England	52 12 52 N	0 05 42 E
Caracas, Venezuela	10 30 24 N	66 55 42 W
Copenhagen, Denmark	55 41 13 N	12 34 42 E
Dublin, Ireland	53 23 13 N	6 20 18 W
Geneva, Switzerland	46 11 59 N	6 09 12 E
Genoa, Italy	44 25 09 N	8 55 18 E
Helsinki, Finland	60 09 48 N	24 56 06 E

WORLDWIDE	LATITUDE	LONGITUDE
Innsbruck, Austria	47 16 05 N	11 22 54 E
Istanbul, Turkey	41 00 45 N	28 58 00 E
Johannesburg, S.A.	26 10 55 S	28 04 30 E
Kiev, U.S.S.R.	50 27 12 N	30 30 06 E
Kyoto, Japan	34 59 41 N	135 47 36 E
Lisbon, Portugal	38 43 04 N	9 08 54 W
Lyons, France	45 41 41 N	4 47 06 E
Madras, India	13 04 08 N	80 14 48 E
Madrid, Spain	40 24 30 N	3 41 18 W
Milan, Italy	45 27 59 N	9 11 30 E
London, England	51 36 46 N	0 14 24 W
Montevideo, Urag.	34 54 33 S	56 12 42 W
Moscow, U.S.S.R.	54 45 20 N	37 34 12 E
Nankins, China	32 04 00 N	118 49 18 E
New Plymouth, N.Ze	39 03 45 S	174 04 24 E
Nice, France	43 43 17 N	7 18 00 E
Rio de Janeiro, Bz	22 53 42 S	43 13 24 W
Rome, Italy	41 55 19 N	12 27 06 E
Santiago, Chile	33 23 50 S	70 32 54 W
Stockholm, Sweden	59 16 18 N	18 18 30 E
Sydney, Australia	33 51 41 S	151 12 18 E
Tokyo, Japan	35 40 21 N	139 32 30 E
Vienna, Austria	48 12 47 N	16 17 48 E
Wellington, N.Ze	41 17 04 S	174 45 54 E

APPENDIX - B

Star Tables (Level I)

1950 Epoch

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Alperatz	0 05 48	28 48 52	2.1
Caph	0 06 30	58 52 27	2.4
Mirach	0 06 56	35 21 22	2.4
Algenib	0 10 39	14 54 20	2.9
Ankaa	0 23 49	-42 34 39	2.4
Schedir	0 37 39	56 15 49	2.4
Dipda	0 41 05	-18 15 39	2.2
Cassiopeia Gamma	0 53 40	60 26 47	3.1
Ruchbah	1 22 32	59 58 34	2.8
Achernar	1 35 51	-57 29 25	-1.3
Polaris	1 48 49	89 01 44	2.1
North Star	1 48 49	89 01 44	2.1
Metallah	1 50 13	29 20 10	3.6
Segin	1 50 46	63 25 30	3.4
Mesarthim	1 50 47	19 03 06	4.8
Sheraton	1 51 52	20 33 52	2.7
Almak	2 00.49	42 05 27	2.3
Hamal	2 04 21	23 13 37	2.2
Triangulum Beta	2 06 34	34 45 06	3.1
Triangulum Gamma	2 14 20	33 37 01	4.1
Mira	2 16 49	-3 12 13	9.9
Aries 35	2 40 31	27 29 44	4.6
Aries 39	2 44 56	29 02 27	4.6
Perseus Eta	2 47 02	55 41 22	3.9
Aries 41	2 47 02	27 03 20	3.7
Perseus Tau	2 50 42	52 33 34	4.1
Menkar	2 59 40	3 53 41	2.8
Perseus Gamma	3 01 10	53 18 44	3.1
Perseus Rho	3 01 58	38 38 53	3.5
Algol	3 04 54	40 45 52	2.5
Perseus Iota	3 05 27	49 25 27	4.2
Mirfak	3 20 44	49 41 06	1.9
Taurus XI	3 24 27	9 33 35	3.7
Perseus Delta	3 39 21	47 37 47	3.1
Altiks	3 41 11	32 07 53	3.8
Perseus Upsilon	3 41 47	42 25 21	3.9
Perseus Zeta	3 50 59	31 44 12	2.9
Perseus Epsilon	3 54 30	39 52 02	3.0

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Perseus XI	3 55 43	35 38 56	4.0
Taurus Lambda	3 57 54	12 21 02	3.9
Taurus Gamma	4 16 57	15 30 31	3.9
Alin	4 25 42	19 04 16	3.6
Aldebaran	4 33 03	16 24 37	1.1
Taurus Tau	4 39 14	22 51 46	4.3
Auriga Iota	4 53 44	33 05 20	2.9
Auriga Eta	5 03 00	41 10 08	3.3
Rigel	5 12 08	-8 15 29	0.3
Capella	5 13 00	45 56 58	0.2
Bellatrix	5 22 27	6 18 22	1.7
Elnath	5 23 08	28 34 02	-1.5
Mintaka	5 29 27	0 20 04	2.5
Arneb	5 30 31	-17 51 24	2.7
Alnilam	5 33 41	-1 13 56	1.8
Taurus Zeta	5 34 39	21 06 50	3.0
Phact	5 37 50	-34 05 59	2.8
Alnitak	5 38 14	-1 58 03	2.1
Saiph	5 45 23	-9 41 09	2.2
Betelgeuse	5 52 28	7 23 58	0.0
Menkalinan	5 55 52	44 56 41	2.1
Auriga Theta	5 56 19	37 12 40	2.7
Gemini I	6 01 05	23 16 04	4.3
Tejat Prior	6 11 52	22 31 23	3.5
Tejat Posterior	6 19 56	22 32 28	3.2
Mirzam	6 20 30	-17 55 47	2.0
Canopus	6 22 51	-52 40 04	-.9
Alhena	6 34 49	16 26 37	1.9
Mebsuta	6 40 51	25 10 57	3.2
Gemini XI	6 42 29	12 57 04	3.4
Sirius	6 42 57	-16 38 46	-1.4
Gemini E	6 51 50	13 14 35	4.7
Canis Major Pi	6 53 27	-20 04 17	4.6
Adhara	6 56 40	-28 54 10	1.6
Canis Major Omicron	7 00 56	-23 45 33	3.1
Mekbuda	7 01 09	20 38 43	3.9
Canis Major Gamma	7 01 30	-15 33 29	4.1
Wesen	7 06 22	-26 18 45	2.0
Canis Major Omega	7 11 47	-26 41 05	3.8
Wasat	7 17 08	22 04 34	3.5
Castor	7 21 35	31 59 58	1.6
Aludra	7 22 07	-29 12 16	2.4

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Procyon	7 36 41	5 21 16	0.5
Gemini Kappa	7 41 26	24 31 11	3.7
Pollux	7 42 16	28 08 55	1.2
Suhail	8 06 09	-43 13 48	2.2
Regor	8 08 00	-47 11 18	2.2
Cancer Beta	8 13 48	9 20 28	3.8
Avior	8 21 29	-59 20 53	1.7
Ascellus Bor.	8 40 24	21 38 59	4.7
Ascellus Aust.	8 41 51	18 20 22	4.2
Cancer Iota	8 43 41	28 56 39	4.2
Sertan	8 55 45	12 03 09	4.3
Leo Eta	9 04 37	17 00 26	3.6
Regulus	9 05 43	12 12 44	1.3
Alphard	9 25 08	-8 26 27	2.2
Ras Elased Austr.	9 43 01	24 00 19	3.1
Ras Elased Bor.	9 49 55	26 14 36	4.1
Adhafera	10 13 55	23 40 02	3.6
Algieba	10 17 13	20 05 43	2.6
Merak	10 58 50	56 39 03	2.4
Dubhe	11 00 40	62 01 17	2.0
Zosma	11 11 27	20 47 52	2.6
Coxa	1 11 37	15 42 11	3.4
Denebola	11 46 31	14 51 06	2.2
Phecda	11 51 13	53 58 22	2.5
Crux Delta	12 12 29	-58 28 15	3.1
Megrez	12 12 58	57 28 15	3.4
Giena	12 13 14	-17 15 52	2.8
Acrux	12 23 48	-62 49 20	1.6
Gacrux	12 28 23	-56 50 01	1.6
Muhlifain	12 38 45	-48 41 08	2.4
Mimosa	12 44 47	-59 24 57	1.5
Alioth	12 51 50	56 13 51	1.7
Mizar	13 21 55	55 11 09	2.4
Spica	13 22 33	-10 54 04	1.2
Bootes Tau	13 44 53	17 42 19	4.5
Alkaid	13 45 34	49 33 44	1.9
Mufrid	13 52 18	18 38 51	2.8
Hadar	14 00 17	-60 07 58	0.9
Libra Sigma	14 01 08	-25 05 13	3.4
Menkent	14 03 44	-36 07 30	2.3
Acrturus	14 13 23	19 26 31	0.2

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Haris	14 30 04	38 31 34	3.0
Rigel Kent	14 36 11	-60 37 49	0.1
Izar	14 42 48	27 17 02	2.7
Zubenelgenubi	14 48 07	-15 50 07	2.9
Bootes XI	14 49 05	19 18 27	4.6
Kochab	14 50 50	74 21 35	2.2
Nekkar	15 00 04	40 35 12	3.6
Bootes Delta	15 13 29	33 30 01	3.5
Zubenschamal i	15 14 19	-9 11 59	2.7
Pherkad	15 20 47	72 00 43	3.1
Alkaluropis	15 22 36	37 33 05	4.5
Alphecca	15 32 34	26 52 54	2.3
Zubenelakrab	15 32 44	-14 37 28	4.0
Unuk	15 41 48	6 34 53	2.7
Ursa Minor Zeta	15 45 48	77 56 57	4.3
Scorpius Rho	15 53 48	-29 04 11	4.0
Scorpius Pi	15 55 49	-25 58 18	3.0
Dschubba	15 57 22	-22 28 52	2.5
Acrab	16 02 32	-19 40 13	2.9
Lesath	16 09 05	-19 19 57	4.3
Scorpius Sigma	16 18 09	-25 28 29	3.0
Ursa Minor Eta	16 18 56	75 52 16	5.0
Antares	16 26 20	-26 19 22	1.2
Rutilicus	16 28 04	21 35 50	2.8
Scorpius Tau	16 32 46	-28 06 51	2.9
Hercules Zeta	16 39 24	31 41 32	3.0
Hercules Eta	16 41 11	39 00 58	3.6
Scorpius Epsilon	16 46 55	-34 12 16	2.4
Scorpius Mu	16 48 29	-37 57 49	3.0
Ursa Minor Epsilon	16 51 01	82 07 21	5.0
Hercules Epsilon	16 58 23	30 59 55	3.9
Graphias	16 51 04	-42 16 40	3.7
Sabik	17 07 31	-15 39 53	2.6
Scorpius Eta	17 08 34	-43 10 31	3.4
Ras Algethi	17 12 22	14 26 45	3.5
Sarin	17 12 59	24 53 48	3.2
Hercules Pi	17 13 18	36 51 51	3.4
Shaula	17 30 13	-37 04 16	1.7
Ras Alhague	17 32 37	12 35 42	2.1
Scorpius Theta	17 33 43	-42 58 05	2.0
Scorpius lota	17 44 01	-40 06 35	3.1
Pherkard	17 48 19	86 36 35	4.4

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Eltanin	17 55 27	51 29 38	2.4
Nushuba	18 02 36	-30 25 36	3.1
Kaus Medius	18 17 48	-29 51 05	2.8
Kaus Australis	18 20 51	-34 24 37	1.9
Kaus Borealis	18 24 53	-25 27 04	2.9
Vega	18 35 15	38 44 09	0.1
Sagittarius Phi	18 42 32	-27 02 39	3.3
Nunki	18 52 10	-26 21 39	2.1
Ascella	18 59 26	-29 57 13	2.7
Sagittarius Tau	19 03 49	-27 44 43	3.4
Albireo	19 28 42	27 51 12	3.2
Cygnus Delta	19 43 25	45 00 28	3.0
Tarazed	19 43 53	10 29 24	2.8
Altair	19 48 21	8 44 05	0.9
Cygnus Eta	19 54 26	34 56 58	4.0
Gredi	20 15 17	-12 42 05	3.7
Dabih	20 18 12	-14 56 27	3.2
Sadr	20 20 26	40 05 44	2.3
Deneb	20 39 44	45 06 03	1.3
Capricornus Psi	20 43 08	-25 27 07	4.2
Gienah	20 44 11	33 46 55	2.6
Capricornus Omega	20 48 51	-27 06 28	4.2
Capricornus Theta	21 03 08	-17 25 58	4.2
Alderamin	21 17 23	62 22 24	2.6
Capricornus Iota	21 19 28	-17 02 55	4.3
Capricornus Zeta	21 23 49	-22 37 45	3.9
Cepheus Beta	21 28 01	70 20 28	3.3
Nashira	21 37 19	-16 53 21	3.8
Capricornus Kappa	21 39 52	-19 05 43	4.8
Enif	21 41 44	9 38 41	2.5
Scheddi	21 44 17	-16 21 19	3.0
Al Nair	22 05 05	-47 12 15	2.2
Cepheus Zeta	22 09 07	57 57 15	3.6
Cepheus Iota	22 47 54	65 56 14	3.7
Formalhaut	22 54 54	-29 53 16	1.3
Scheat	23 01 21	27 48 40	2.6
Markab	23 02 16	14 56 09	2.6
Alrai	23 37 17	77 21 12	3.4

Name	Right Ascension	Declination
	hrs/min/sec	deg/min/sec
Constellations		
Ursa Minor	0 00 00	77 48 00
Cassiopeia	1 16 00	61 57 00
Triangulum	2 08 30	31 12 00
Cepheus	2 15 30	70 48 00
Aries	2 35 30	20 33 00
Perseus	3 06 00	44 54 00
Taurus	4 39 00	15 30 00
Orion	5 32 00	6 00 00
Auriga	6 01 00	42 00 00
Canis Major	6 48 30	-22 06 00
Gemini	7 01 30	21 39 00
Canis Minor	7 36 30	6 39 00
Cancer	8 36 00	20 03 00
Leo	10 37 00	13 27 00
Ursa Major	11 16 00	51 03 00
Crux	12 24 00	-60 00 00
Bootes	14 40 00	31 24 00
Libra	15 08 30	-15 06 00
Scorpius	16 49 30	-26 51 00
Hercules	17 21 30	27 36 00
Sagittarus	19 03 00	-28 36 00
Cygnus	20 34 00	44 27 00
Capricornus	21 00 30	-18 15 00
Pegasus	22 39 30	19 15 00
Messier Objects		
M31	0 40 00	41 00 00
M45	3 43 54	23 58 00
M42	5 32 54	-5 25 00
M41	6 44 54	-20 42 00
M44	8 37 30	19 52 00
M104	12 37 18	-11 21 00
M94	12 48 36	41 23 00
M64	12 54 18	21 57 00
M10	16 54 30	-4 02 00
M16	18 16 00	-13 48 00
M57	18 51 42	32 58 00
M55	19 36 54	-31 03 00
M15	21 27 36	11 57 00

APPENDIX - C

Messier Descriptions

1950 Epoch

Mes. Num	R.A. hrs/min	Dec. deg/min	Messier Description
M1	05 32	+21 59	Supernova remnant in Taurus (Crab Nebula)
M2	21 31	-01 03	Globular cluster in Aquarius
M3	13 40	+28 38	Globular cluster in Canes Venatici
M4	16 21	-26 24	Globular cluster in Scorpius
M5	15 16	+02 16	Globular cluster in Serpens
M6	17 37	-32 11	Open cluster in Scorpius
M7	17 51	-34 48	Open cluster in Scorpius
M8	18 02	-24 20	Diffuse nebular in Sagittarius (Lagoon Neb.)
M9	17 16	-18 28	Globular cluster in Ophiuchus
M10	16 55	-04 02	Globular cluster in Ophiuchus
M11	18 48	-06 20	Cluster and nebula in Serpens
M12	16 45	-01 52	Globular cluster in Ophiuchus
M13	16 40	+36 33	Globular cluster in Hercules
M14	17 35	-03 13	Globular cluster in Ophiuchus
M15	21 28	+11 57	Globular cluster in Pegasus
M16	18 16	-13 48	Cluster and nebla in Seraens
M17	18 18	-16 12	Nebula in Sagittarius (Horseshoe Nebula)
M18	18 17	-17 09	Galactic cluster in Sagittarius
M19	17 00	-26 11	Globular cluster in Ophiuchus
M20	17 59	-23 02	Diffuse nebula in Sagittarius (Trifid Neb.)
M21	18 02	-22 30	Galactic cluster in Sagittarius
M22	18 33	-23 58	Globular cluster in Sagittarius
M23	17 54	-19 01	Galactic cluster in Sagittarius
M24	18 16	-18 27	Milky Way patch in Sagittarius
M25	18 29	-19 17	Open cluster in Sagittarius
M26	18 43	-09 27	Galactic cluster in Sagittarius
M27	19 57	+22 35	Planetary nebula in Vulpecula (Dumbell Neb)
M28	18 22	-2454	Globular cluster in Sagittarius
M29	20 22	+38 21	Open cluster in Cygnus
M30	21 38	-23 25	Globular cluster in Capricornus
M31	00 40	+41 00	Spiral galaxy in Andromeda (Great And Gal.)
M32	00 40	+40 36	Elliptical galaxy in Andromeda
M33	01 31	+30 24	Spiral galaxy in Triangulum
M34	02 39	+42 34	Galactic cluster in Perseus
M35	06 06	+24 20	Open cluster in Gemini
M36	05 32	+34 07	Galactic cluster in Auriga
M37	05 49	+32 33	Open cluster in Auriga

Mes. Num	R.A. hrs/min	Dec. deg/min	Messier Description
M38	05 25	+35 48	Galactic cluster in Auriga
M39	21 30	+48 13	Galactic cluster in Cygnus
M40	12 20	+58 22	Double star in Ursa Major
M41	06 45	-20 42	Open cluster in Canis Major
M42	05 33	-05 25	Diffuse nebula in Orion (The Orion Nebvula)
M43	05 33	-05 18	Diffuse nebula in Orion
M44	08 38	+19 52	Galactic cluster in Cancer (The Beehive)
M45	03 44	+23 58	Open cluster in Taurus (The Pleiades)
M46	07 40	-14 42	Galactic cluster in Puppis
M47	07 34	-14 22	Open cluster in Puppis
M48	08 11	-05 38	Open cluster in Hydra
M49	12 27	+08 16	Elliptical galaxy in Virgo
M50	07 01	-08 16	Galactic cluster in Monoceros
M51	13 28	+47 27	Spiral galaxy in Canes Venatici (Whirlpool)
M52	23 22	+61 20	Open cluster in Cassiopeia
M53	13 11	+18 26	Globular cluster in Coma Berenices
M54	18 52	-30 32	Globular cluster in Sagittarius
M55	19 37	-31 03	Globular cluster in Sagittarius
M56	19 15	+30 05	Globular cluster in Lyra
M57	18 52	+32 58	Planetary nebula in Lyra (Ring Nebula)
M58	12 35	+12 05	Spiral galaxy in Virgo
M59	12 40	+11 55	Elliptical galaxy in Virgo
M60	12 41	+11 49	Elliptical galaxy in Virgo
M61	12 19	+0445	Spirla galaxy in Virgo
M62	16 58	-30 03	Globular cluster in Ophiuchus
M63	13 14	+42 17	Spiral galaxy in Canes Venatici
M64	12 54	+21 57	Spiral galaxy in Coma Berenices (Black-eye)
M65	11 16	+13 23	Spiral galaxy in Leo
M66	11 18	+13 17	Spiral galaxy in Leo
M67	08 48	+12 00	Galactic cluster in Cancer
M68	12 37	-26 29	Globular cluster in Hydra
M69	18 28	-32 23	Globular cluster in Sagittarius
M70	18 40	-32 21	Globular cluster in Sagittarius
M71	19 52	+18 39	Globular cluster in Sagittarius
M72	20 51	-12 44	Globular cluster in Sagittarius
M73	20 56	-12 50	Asterism in Aquarius
M74	01 34	+15 32	Spiral galaxy in Pisces
M75	20 03	-22 04	Globular cluster in Sagittarius
M76	01 39	+51 19	Planetary nebula in Perseus
M77	02 40	-00 14	Spiral galaxy in Cetus
M78	05 44	+00 02	Diffuse nebula in Orion

Mes. Num	R.A. hrs/min	Dec. deg/min	Messier Description
M79	05 22	-24 34	Globular cluster in Lepus
M80	16 14	-22 52	Globular cluster in Scorpius
M81	09 52	+69 18	Spiral galaxy in Ursa Major
M82	09 52	+69 56	Spiral galaxy in Ursa Major
M83	13 34	-29 37	Spiral galaxy in Hydra
M84	12 23	+13 10	Elliptical galaxy in Virgo
M85	12 23	+18 28	Elliptical galaxy in Coma Berenices
M86	12 24	+13 13	Elliptical galaxy in Virgo
M87	12 28	+12 40	Elliptical galaxy in Virgo
M88	12 30	+14 42	Spiral galaxy in Coma berenice
M89	12 33	+12 50	Elliptical galaxy in Virgo
M90	12 34	+13 26	Spiral galaxy in Virgo
M91	12 33	+14 46	Spiral galaxy in Coma Berenices
M92	17 16	+43 12	Globular cluster in Hercules
M93	07 42	-23 45	Galactic cluster in Puppis
M94	12 49	+41 23	Spiral galaxy in Canes Ventici
M95	10 41	+11 58	Spiral galaxy in Leo
M96	10 44	+12 05	Spiral galaxy in Leo
M97	11 12	+55 18	Planetary nebula in Ursa Major (Owl Nebula)
M98	12 11	+15 11	Spiral galaxy in Coma Berenices
M99	12 16	+14 42	Spiral galaxy in Coma Berenices
M100	12 20	+16 06	Spiral galaxy in Coma Berenices
M101	14 01	+54 35	Spiral galaxy in Ursa Major
M102	14 01	+54 35	Messier duplicate - same as M101
M103	01 30	+60 27	Galactic cluster in Cassiopeia
M104	12 37	-11 21	Spirla galaxy in Virgo (Sombrero Galaxy)
M105	10 45	+12 51	Elliptical galaxy in Leo
M106	12 17	+47 35	Spiral galaxy in Canes Venatici
M107	16 30	-12 57	Globular cluster in Ophiuchus
M108	11 09	+55 57	Spiral galaxy in Ursa Major
M109	11 55	+53 39	Spiral galaxy in Ursa Major
M110	00 38	+41 25	Elliptical galaxy in Andromeda

APPENDIX - D

Star Tables (Level II)

Messier Objects

1950 Epoch

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Alpheratz	0 05 48	28 48 52	2.1
Caph	0 06 30	58 52 27	2.4
Algenib	0 10 39	14 54 20	2.9
Schedir	0 37 39	56 15 49	2.4
Cassiopedia Gamma	0 53 40	60 26 47	3.1
Ruchbah	1 22 32	59 58 34	2.8
Polaris	1 48 49	89 01 44	2.1
North Star	1 48 49	89 01 44	2.1
Segin	1 50 46	63 25 30	3.4
Hamal	2 04 21	23 13 37	2.2
Algol	3 04 54	40 45 52	2.5
Mirfak	3 20 44	49 41 06	1.9
Taurus XI	3 24 27	9 33 35	3.7
Taurus Lambda	3 57 54	12 21 02	3.9
Taurus Gamma	4 16 57	15 30 31	3.9
Alin	4 25 42	19 04 16	3.6
Aldebaran	4 33 03	16 24 37	1.1
Taurus Tau	4 39 14	22 51 46	4.3
Auriga Iota	4 53 44	33 05 20	2.9
Auriga Eta	5 03 00	41 10 08	3.3
Rigel	5 12 08	-8 15 29	0.3
Capella	5 13 00	45 56 58	0.2
Bellatrix	5 22 27	6 18 22	1.7
Elnath	5 23 08	28 34 02	-1.5
Mintaka	5 29 27	0 20 04	2.5
Alnilam	5 33 41	-1 13 56	1.8
Taurus Zeta	5 34 39	21 06 50	3.0
Alnitak	5 38 14	-1 58 03	2.1
Saiph	5 45 23	-9 41 09	2.2
Betelgeuse	5 52 28	7 23 58	0.0
Menkalinan	5 55 52	44 56 41	2.1
Auriga Theta	5 56 19	37 12 40	2.7
Mirzam	6 20 30	-17 55 47	2.0
Alhena	6 34 49	16 26 37	1.9
Sirius	6 42 57	-16 38 46	-1.4
Canis Major PI	6 53 27	-20 04 17	4.6
Adhara	6 56 40	-28 54 10	1.6
Canis Major Omicron	7 00 56	-23 45 33	3.1
Canis Major Gamma	7 01 30	-15 33 29	4.1

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Wesen	7 06 22	-26 18 45	2.0
Canis Major Omega	7 11 47	-26 41 05	3.8
Castor	7 21 35	31 59 58	1.6
Aludra	7 22 07	-29 12 16	2.4
Procyon	7 36 41	5 21 16	0.5
Pollux	7 42 16	28 08 55	1.2
Cancer Beta	8 13 48	9 20 28	3.8
Aseellus Bor.	8 40 24	21 38 59	4.7
Aseellus Aust.	8 41 51	18 20 22	4.2
Cancer Iota	8 43 41	28 56 39	4.2
Sertan	8 55 45	12 03 09	4.3
Leo Eta	9 04 37	17 00 26	3.6
Regulus	9 05 43	12 12 44	1.3
Ras Elased Austr.	9 43 01	24 00 19	3.1
Ras Elased Bor.	9 49 55	26 14 36	4.1
Adhafera	10 13 55	23 40 02	3.6
Algieba	10 17 13	20 05 43	2.6
Merak	10 58 50	56 39 03	2.4
Dubhe	11 00 40	62 01 17	2.0
Zosma	11 11 27	20 47 52	2.6
Coxa	11 11 37	15 42 11	3.4
Denebola	11 46 31	14 51 06	2.2
Phecda	11 51 13	53 58 22	2.5
Megrez	12 12 58	57 18 37	3.4
Alioth	12 51 50	56 13 51	1.7
Mizar	13 21 55	55 11 09	2.4
Spica	13 22 33	-10 54 04	1.2
Alkaid	13 45 34	49 33 44	1.9
Arcturus	14 13 23	19 26 31	0.2
Kochab	14 50 50	74 21 35	2.2
Pherkad	15 20 47	72 00 43	3.1
Ursa Minor Zeta	15 45 48	77 56 57	4.3
Scorpius Pi	15 55 49	-25 58 18	3.0
Dschubba	15 57 22	-22 28 52	2.5
Acrab	16 02 32	-19 40 13	2.9
Scorpius Sigma	16 18 09	-25 28 29	3.0
Ursa Minor Eta	16 18 56	75 52 16	5.0
Antares	16 26 20	-26 19 22	1.2
Rutilicus	16 28 04	21 35 50	2.8
Scorpius Tau	16 32 46	-28 06 51	2.9
Hercules Zeta	16 39 24	31 41 32	3.0
Hercules Eta	16 41 11	39 00 58	3.6
Scorpius Epsilon	16 46 55	-34 12 16	2.4

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	dec/min/sec	
Scorpius Mu	16 48 29	-37 57 49	3.0
Ursa Minor Epsilon	16 51 01	82 07 21	5.0
Graphias	16 51 04	-42 16 40	3.7
Hercules Epsilon	16 58 23	30 59 55	3.9
Scorpius Eta	17 08 34	-43 10 31	3.4
Sarin	17 12 59	24 53 48	3.2
Hercules Pi	17 13 18	36 51 51	3.4
Shaula	17 30 13	-37 04 16	1.7
Scorpius Theta	17 33 43	-42 58 05	2.0
Scorpius lota	17 44 01	-40 06 35	3.1
Pherkard	17 48 19	86 36 35	4.4
Eltanin	17 55 27	51 29 38	2.4
Nushaba	18 02 36	-30 25 36	3.1
Kaus Medius	18 17 48	-29 51 05	2.8
Kaus Australis	18 20 51	-34 24 37	1.9
Kaus Borealis	18 24 53	-25 27 04	2.9
Vega	18 35 15	38 44 09	0.1
Sagittarius Phi	18 42 32	-27 02 39	3.3
Nunki	18 52 10	-26 21 39	2.1
Ascella	18 59 26	-29 57 13	2.7
Sagittarius Tau	19 03 49	-27 44 43	3.4
Albireo	19 28 42	27 51 12	3.2
Cygnus Delta	19 43 25	45 00 28	3.0
Altair	19 48 21	8 44 05	0.9
Cygnus Eta	19 54 26	34 56 58	4.0
Sadr	20 20 26	40 05 44	2.3
Deneb	20 39 44	45 06 03	1.3
Gienah	20 44 11	33 46 55	2.6
Scheat	23 01 21	27 48 40	2.6
Markab	23 02 16	14 56 09	2.6
	CONSTELLATIONS		
Ursa Minor	0 00 00	77 48 00	
Cassiopeia	1 16 00	61 57 00	
Taurus	4 39 00	15 30 00	
Orion	5 32 00	6 00 00	
Auriga	6 01 00	42 00 00	
Canis Major	6 48 30	-22 06 00	
Canis Minor	7 36 30	6 39 00	
Cancer	8 36 00	2 00 30	
Leo	10 37 00	13 27 00	
Ursa Major	11 16 00	51 03 00	

Name	Right Ascension	Declination
	hrs/min/sec	dec/min/sec
Scorpius	16 49 30	-26 51 00
Hercules	17 21 30	27 36 00
Sagittarius	19 03 00	-28 36 00
Cygnus	20 34 00	44 27 00
Pegasus	22 39 30	19 15 00
	MESSIER OBJECTS	
M110	0 37 36	41 25 00
M32	0 40 00	40 36 00
M31	0 40 00	41 00 00
M103	1 29 54	60 27 00
M33	1 31 06	30 24 00
M74	1 34 00	15 32 00
M76	1 38 48	51 19 00
M34	2 38 48	42 34 00
M77	2 40 06	0 14 00
M45	3 43 54	23 58 00
M79	5 22 12	-24 34 00
M38	5 25 18	35 48 00
M1	5 31 30	21 59 00
M36	5 32 00	34 07 00
M42	5 32 54	-5 25 00
M43	5 33 06	-5 18 00
M78	5 44 12	0 02 00
M37	5 49 00	32 33 00
M35	6 05 42	24 20 00
M41	6 44 54	-20 42 00
M50	7 00 30	-8 16 00
M47	7 34 18	-14 22 00
M46	7 39 36	-14 42 00
M93	7 42 24	-23 45 00
M48	8 11 12	-5 38 00
M44	8 37 30	19 52 00
M67	8 48 18	12 00 00
M81	9 51 30	69 18 00
M82	9 51 54	69 56 00
M95	10 41 18	11 58 00
M96	10 44 12	12 05 00
M105	10 45 12	12 51 00
M108	11 08 42	55 57 00
M97	11 12 00	55 18 00
M65	11 16 18	13 23 00

Name	Right Ascension	Declination
	hrs/min/sec	dec/min/sec
M66	11 17 36	13 17 00
M109	11 55 00	53 39 00
M98	12 11 18	15 11 00
M99	12 16 18	14 42 00
M106	1216 30	47 35 00
M61	12 19 24	4 45 00
M40	12 20 00	58 22 00
M100	12 20 24	16 06 00
M84	12 22 36	13 10 00
M85	12 22 48	18 28 00
M86	12 23 42	13 13 00
M49	12 27 18	8 16 00
M87	12 28 18	12 40 00
M88	12 29 30	14 42 00
M91	12 32 54	14 46 00
M89	12 33 06	12 50 00
M90	12 34 18	13 26 00
M58	12 35 06	12 05 00
M68	12 36 48	-26 29 00
M104	12 37 18	-11 21 00
M59	12 39 30	11 55 00
M60	12 41 06	11 49 00
M94	12 48 36	41 23 00
M64	12 54 18	21 57 00
M53	13 10 30	18 26 00
M63	13 13 30	42 17 00
M51	13 27 48	47 27 00
M83	13 34 18	-29 37 00
M3	13 39 54	28 38 00
M102	14 01 24	54 35 00
M101	14 01 24	54 35 00
M5	15 16 00	2 16 00
M80	16 14 06	-22 52 00
M4	16 20 36	-26 24 00
M107	16 29 42	-12 57 00
M13	16 39 54	36 33 00
M12	16 44 36	-1 52 00
M10	16 54 30	-4 02 00
M62	16 58 06	-30 03 00
M19	16 59 30	-26 11 00
M92	17 15 36	43 12 00
M9	17 16 12	-18 28 00
M14	17 35 00	-3 13 00

Name	Right Ascension	Declination
	hrs/min/sec	dec/min/sec
M6	17 36 48	-32 11 00
M7	17 50 42	-34 48 00
M23	17 54 00	-19 01 00
M20	17 58 54	-23 02 00
M8	18 01 36	-24 20 00
M21	18 01 48	-22 30 00
M24	18 15 30	-18 27 00
M16	18 16 00	-13 48 00
M18	18 17 00	-17 09 00
M17	18 18 00	-16 12 00
M28	18 21 30	-24 54 00
M69	18 28 06	-32 23 00
M25	18 28 48	-19 17 00
M22	18 33 18	-23 58 00
M70	18 40 00	-32 21 00
M26	18 42 30	-9 27 00
M11	18 48 24	-6 20 00
M57	18 51 42	32 58 00
M54	18 52 00	-30 32 00
M56	19 14 36	30 05 00
M55	19 36 54	-31 03 00
M71	19 51 30	18 39 00
M27	19 57 24	22 35 00
M75	20 03 12	-22 04 00
M29	20 22 12	38 21 00
M72	20 50 42	-12 44 00
M73	20 56 24	-12 50 00
M15	21 27 36	11 57 00
M39	21 30 24	48 13 00
M2	21 30 54	-1 03 00
M30	21 37 30	-23 25 00
M52	23 22 00	61 20 00

APPENDIX - E

Star Tables (Level II)

Southern Hemisphere

1950 Epoch

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Alpheratz	0 05 48	28 48 52	2.1
Phoenix Epsilon	0 06 53	-46 01 24	3.9
Algenib	0 10 39	14 54 20	2.9
Hydrus Beta	0 23 09	-77 32 09	2.9
Ankaa	0 23 49	-42 34 39	2.4
Phoenix Zeta	0 39 30	-56 46 35	5.0
Dipda	0 41 05	-18 15 39	2.2
Phoenix Beta	1 03 51	-46 59 10	3.4
Phoenix Gamma	1 26 12	-43 34 26	3.4
Phoenix Delta	1 29 10	-49 15 55	4.0
Achernar	1 35 51	-57 29 25	-1.3
Mesarthim	1 50 47	19 03 06	4.8
Sheraton	1 51 52	20 33 52	2.7
Hydrus Alpha	1 57 12	-61 48 45	3.0
Hamal	2 04 21	23 13 37	2.2
Mira	2 16 49	-3 12 13	9.9
Aries 35	2 40 31	27 29 44	4.6
Aries 39	2 44 56	29 02 27	4.6
Aries 41	2 47 02	27 03 20	3.7
Hydrus Nu	2 50 46	-75 16 17	4.7
Menkar	2 59 40	3 53 41	2.8
Algol	3 04 54	40 45 52	2.5
Mirfak	3 20 44	49 41 06	1.9
Taurus XI	3 24 27	9 33 35	3.7
Hydrus Gamma	3 48 00	-74 23 34	3.2
Taurus Lambda	3 57 54	12 21 02	3.9
Taurus Gamma	4 16 57	15 30 31	3.9
Alin	4 25 42	19 04 16	3.6
Aldebaran	4 33 03	16 24 37	1.1
Taurus Tau	4 39 14	22 51 46	4.3
Rigel	5 12 08	-8 15 29	0.3
Capella	5 13 00	45 56 58	0.2
Bellatrix	5 22 27	6 18 22	1.7
Elnath	5 23 08	28 34 02	-1.5
Mintaka	5 29 27	0 20 04	2.5
Arneb	5 30 31	-17 51 24	2.7

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Alnilam	5 33 41	-1 13 56	1.8
Taurus Zeta	5 34 39	21 06 50	3.0
Phadt	5 37 50	-34 05 59	2.8
Alnitak	5 38 14	-1 58 03	2.1
Saiph	5 45 23	-9 41 09	2.2
Betelgeuse	5 52 28	7 23 58	0.0
Gemini 1	6 01 05	23 16 04	4.3
Tejat Prior	6 11 52	22 31 23	3.5
Tejat Posterior	6 19 56	22 32 28	3.2
Mirzam	6 20 30	-17 55 47	2.0
Canopus	6 22 51	-52 40 04	-.9
Alhena	6 34 49	16 26 37	1.9
Mebsuta	6 40 51	25 10 57	3.2
Gemini XI	6 42 29	12 57 04	3.4
Sirius	6 42 57	-16 38 46	-1.4
Gemini E	6 51 50	13 14 35	4.7
Canis Major Pi	6 53 27	-20 04 17	4.6
Adhara	6 56 40	-28 54 10	1.6
Canis Major Omieron	7 00 56	-23 45 33	3.1
Mekbuda	7 01 09	20 38 43	3.9
Canis Major Gamma	7 01 30	-15 33 29	4.1
Wesen	7 06 22	-26 18 45	2.0
Canis Major Omega	7 11 47	-26 41 05	3.8
Wasat	7 17 08	22 04 34	3.5
Castor	7 21 35	31 59 58	1.6
Aludra	7 22 07	-29 12 16	2.4
Procyon	7 36 41	5 21 16	0.5
Gemini Kappa	7 41 26	24 31 11	3.7
Pollux	7 42 16	28 08 55	1.2
Suhail	8 06 09	-43 13 48	2.2
Regor	8 08 00	-47 11 18	2.2
Cancer Beta	8 13 48	9 20 28	3.8
Chamaeleon Alpha	8 19 51	-76 45 44	4.1
Avior	8 21 29	-59 20 53	1.7
Chamaeleon Theta	8 22 11	-77 19 26	4.2
Ascellus Bor.	8 40 24	21 38 59	4.7
Ascellus Aust.	8 41 51	18 20 22	4.2
Cancer Iota	8 43 41	28 56 39	4.2
Sertan	8 55 45	12 03 09	4.3
Leo Eta	9 04 37	17 00 26	3.6
Regulus	9 05 43	12 12 44	1.3

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Alphard	9 25 08	-8 26 27	2.2
Ras Elased Austr.	9 43 01	24 00 19	3.1
Ras Elased Bor	9 49 55	26 14 36	4.1
Adhafera	10 13 55	23 40 02	3.6
Algieba	10 17 13	20 05 43	2.6
Chamaeleon Gamma	10 34 54	-78 20 54	4.1
Chamaeleon Delta	10 45 20	-80 16 35	4.6
Zosma	11 11 27	20 47 52	2.6
Coxa	11 11 37	15 42 11	3.4
Denebola	11 46 31	14 51 06	2.2
Crux Delta	12 12 29	-58 28 15	3.1
Giena	12 13 14	-17 15 52	2.8
Chamaeleon Beta	12 15 22	-79 02 05	4.4
Acrux	12 23 48	-62 49 20	1.6
Gacrux	12 28 23	-56 50 01	1.6
Musca Gamma	12 29 27	-71 51 25	4.0
Musca Alpha	12 34 11	-68 51 37	2.9
Nuhlifain	12 38 45	-48 41 08	2.4
Musca Beta	12 43 12	-67 50 05	3.3
Mimosa	12 44 47	-59 24 57	1.5
Musca Delta	12 58 48	-71 16 47	3.6
Spica	13 22 33	-10 54 04	1.2
Hadar	14 00 17	-60 07 58	0.9
Libra Sigma	14 01 08	-25 05 13	3.4
Menkent	14 03 44	-36 07 30	2.3
Arcturus	14 13 23	19 26 31	0.2
Octans Delta	14 18 39	-83 26 30	4.1
Rigel Kent	14 36 11	-60 37 49	0·.1
Zubenelgenubi	14 48 07	-15 50 07	2.9
Tri Australae Gamma	15 14 13	-68 29 49	3.1
Zubenschamali	15 14 19	-9 11 59	2.7
Tri Australae Epsilon	15 32 07	-66 09 05	4.1
Zubenelakrab	15 32 44	-14 37 28	4.0
Tri Australae Beta	15 50 43	-63 16 43	3.0
Scorpius Rho	15 53 48	-29 04 11	4.0
Scorpius Pi	15 55 49	-25 58 18	3.0
Dschubba	15 57 22	-22 28 52	2.5
Acrab	16 02 32	-19 40 13	2.9
Lesath	16 09 05	-19 19 57	4.3
Scorpius Sigma	16 18 09	-25 28 29	3.0
Antares	16 26 20	-26 19 22	1.2
Rutilicus	16 28 04	21 35 50	2.8

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Scorpius Tau	16 32 46	-28 06 51	2.9
Hercules Zeta	16 39 24	31 41 32	3.0
Hercules Eta	16 41 11	39 00 58	3.6
Atria	16 43 21	-68 56 20	1.9
Scorpius Epsilon	16 46 55	-34 12 16	2.4
Scorpius Mu	16 48 29	-37 57 49	3.0
Graphias	16 51 04	-42 16 40	3.7
Hercules Epsilon	16 58 23	30 59 55	3.9
Sabik	17 07 31	-15 39 53	2.6
Scorpius Eta	17 08 34	-43 10 31	3.4
Sarin	17 12 59	24 53 48	3.2
Hercules Pi	17 13 18	36 51 51	3.4
Shaula	17 30 13	-37 04 16	1.7
Scorpius Theta	17 33 43	-42 58 05	2.0
Scorpius lota	17 44 01	-40 06 35	3.1
Nushaba	18 02 36	-30 25 36	3.1
Kaus Medius	18 17 48	-29 51 05	2.8
Kaus Australis	18 20 51	-34 24 37	1.9
Kaus Borealis	18 24 53	-25 27 04	2.9
Corona Australis Theta	18 29 56	-42 21 02	4.7
Vega	18 35 15	38 44 09	0.1
Sagittarius Phi	18 42 32	-27 02 39	3.3
Corona Australis Eta	18 45 14	-43 44 12	5.0
Nunki	18 52 10	-26 21 39	2.1
Ascella	18 59 26	-29 57 13	2.7
Corona Australis Zeta	18 59 35	-42 10 06	4.9
Corona Australis Gamma	19 03 02	-37 08 14	0.0
Sagittarius Tau	19 03 49	-27 44 43	3.4
Corona Australis Delta	19 04 52	-40 34 34	4.7
Corona Australis Alpha	19 06 04	-37 59 04	4.1
Corona Australis Beta	19 06 36	-39 25 20	4.2
Altair	19 48 21	8 44 05	0.9
Octans Sigma	20 15 03	-89 08 19	5.0
South Star	20 15 03	-89 08 19	5.0
Gredi	20 15 17	-12 42 05	3.7
Dabih	20 18 12	-14 56 27	3.2
Indus Alpha	20 34 04	-47 28 03	3.2
Deneb	20 39 44	45 06 03	1.3
Capricornus Psi	20 43 08	-25 27 07	4.2
Capricornus Omega	20 48 51	-27 06 28	4.2
Indus Beta	20 50 55	-58 38 40	3.7
Capricornus Theta	21 03 08	-17 25 58	4.2

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Indus Theta	21 16 19	-53 39 38	4.6
Capricornus Iota	21 19 28	-17 02 55	4.3
Capricornus Zeta	21 23 49	-22 37 45	3.9
Octans Nu	21 36 00	-76 36 50	3.7
Nashira	21 37 19	-16 53 21	3.8
Capricornus Kappa	21 39 52	-19 05 43	4.8
Piscis Austrinus Iota	21 41 58	-33 15 18	4.3
Scheddi	21 44 17	-16 21 19	3.0
Al Dhanab	21 50 54	-37 36 04	3.2
Indus Delta	21 54 32	-55 13 53	4.6
Grus Lambda	22 03 07	-39 47 08	4.6
Al Nair	22 05 05	-47 12 15	2.2
Grus Alpha	22 05 05	-47 12 15	2.2
Piscis Austrinus Mu	22 05 28	-33 14 01	4.6
Grus Delta	22 26 17	-43 45 06	4.0
Piscis Austrinus Beta	22 28 40	-32 36 11	4.4
Piscis Autrinus Epsilon	22 37 54	-27 18 18	4.2
Grus Beta	22 39 41	-47 08 48	2.2
Octans Beta	22 41 05	-81 38 41	4.3
Grus Epsilon	22 45 33	-51 34 49	3.7
Piscis Austrinus Delta	22 53 11	-32 48 26	4.3
Fomalhaut	22 54 54	-29 53 16	1.3
Scheat	23 01 21	27 48 40	2.6
Markab	23 02 16	14 56 09	2.6
Grus Iota	23 07 32	-45 31 05	4.1
	CONSTELLATIONS		
Phoenix	0 54 00	-49 00 00	
Hydrus	2 17 30	-70 06 00	
Aries	2 35 30	20 33 00	
Taurus	4 39 00	15 30 00	
Orion	5 32 00	6 00 00	
Canis Major	6 48 30	-22 06 00	
Gemini	7 01 30	21 39 00	
Canis Minor	7 36 30	6 39 00	
Cancer	8 36 00	20 03 00	
Leo	10 37 00	13 27 00	
Chamaeleon	10 40 00	-79 00 00	
Octans	12 00 00	-82 12 00	
Crux	12 24 00	-60 00 00	
Musca	12 31 30	-69 51 00	
Libra	15 08 30	-15 06 00	

Name	Right Ascension	Declination	Magnitude
	hrs/min/sec	deg/min/sec	
Tri Australae	15 59 30	-65 18 00	
Scorpius	16 49 30	-26 51 00	
Hercules	17 21 30	27 36 00	
Corona Australis	18 35 00	-41 18 00	
Sagittarius	19 03 00	-28 36 00	
Capricornus	21 00 30	-18 15 00	
Indus	21 55 00	-60 03 00	
Piscis Austrinus	22 14 30	-30 57 00	
Grus	22 25 00	-46 24 00	
Pegasus	22 39 30	19 15 00	
	MESSIER OBJECTS		
M31	0 40 00	41 00 00	
M45	3 43 54	23 58 00	
M42	5 32 54	-5 25 00	
M41	6 44 54	-20 42 00	
M44	8 37 30	19 52 00	
M104	12 3718	-11 21 00	
M94	12 48 36	41 23 00	
M64	12 54 18	21 57 00	
M10	16 54 30	-4 02 00	
M16	18 16 00	-13 48 00	
M57	18 51 42	32 58 00	
M55	19 36 54	-31 03 00	
M15	21 27 36	11 57 00	

IUS SERVICE INFORMATION

One of the first things IUS wants you to know is that we are interested in all possible improvements for our products. With this in mind we would like you to send us your comments and recommendations. This system is the first in our educational series of products so we really need your feedback. We have supplied a feedback card with this system for you to fill out and return to us after you've used your TellStar system for a month or so. Your diskette is guaranteed against defects for a period of five days from the date of purchase. IUS offers an updating service for any future changes made to a product. A minimal fee of $15.00 will include the new software copied over your original diskette. the additional documentation, and first class return postage. Registered owners may return damaged diskettes and order replacements for $10.00. A registration card has been included that will qualify you for this update service, and disk warranty. Please return this card as soon as possible.

If you wish to upgrade from the TellStar level-I series to the level-II series you simply send us your original disk and a check for $40.00. We will return to you the level-II disk, additional documentation, and star charts.

California Residents must include $2.60 sales tax (6.5%).

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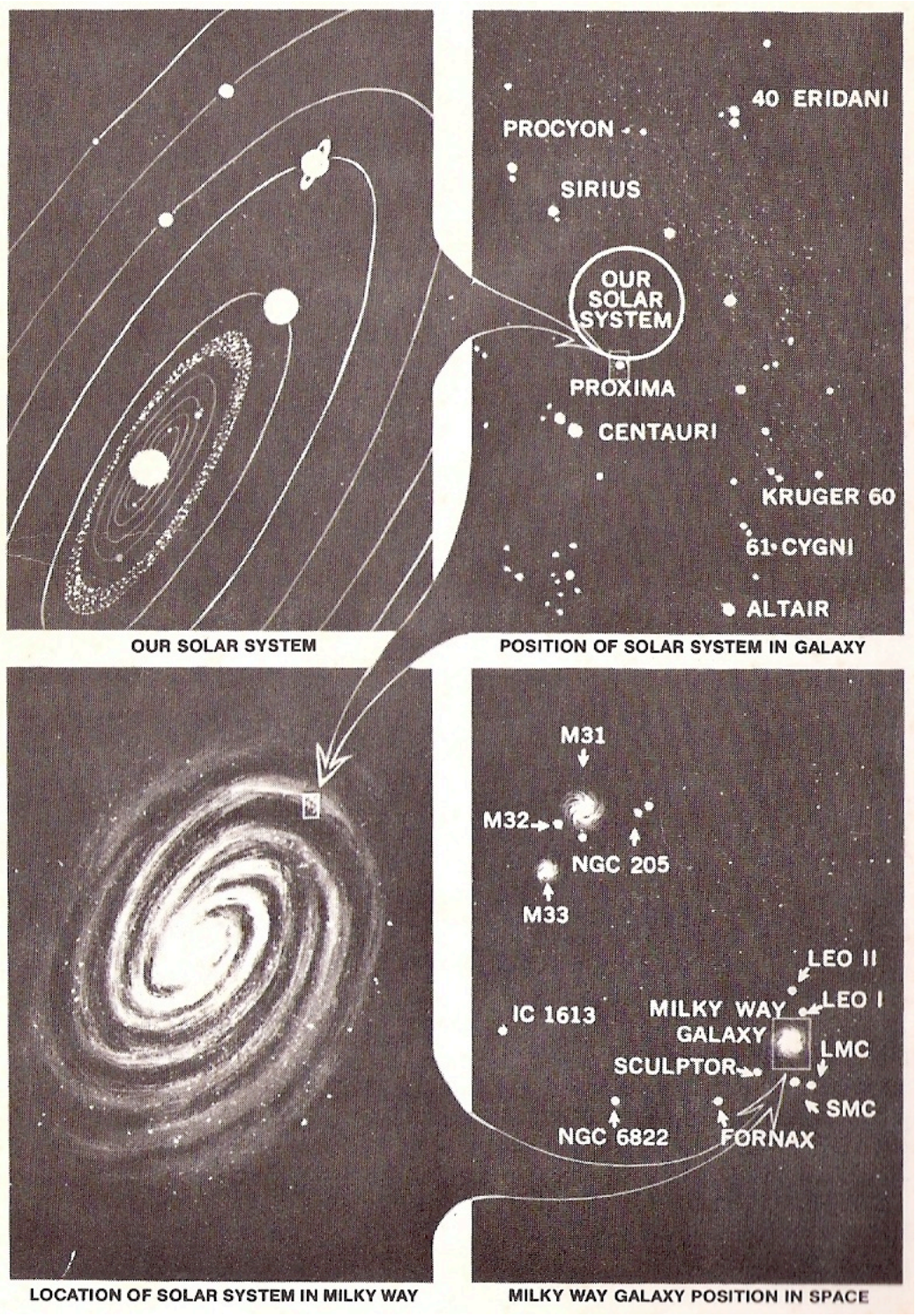
JUST A SPECK IN THE UNIVERSE



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