# SkyMap v1.3 User Guide

## Dedication

*Respectfully dedicated to the memory of:*

*Francis R Scobee*
*Michael J Smith*
*Ellison S Onizuka*
*Judith A Resnick*
*Ronald E McNair*
*Gregory Jarvis*
*S Christa McAuliffe*

*the crew of Challenger flight STS 51-L, 28th January 1986*
*and to all who have lived - and died - for The Dream.*

*"Oh, I have slipped the surly bonds of earth,*
*And danced the skies on laughter-silvered wings;*
*Sunward I've climbed and joined the tumbling mirth*
*Of sun-split clouds -- and done a hundred things*
*You have not dreamed of -- wheeled and soared and swung*
*High in the sunlit silence. Hov'ring there,*
*I've chased the shouting wind along and flung*
*My eager craft through footless halls of air.*
*Up, up the long, delirious, burning blue*
*I've topped the wind-swept heights with easy grace,*
*Where never lark, or even eagle, flew;*
*And, while with silent, lifting mind I've trod*
*The high, untrespassed sanctity of space,*
*Put out my hand, and touched the face of God."*

*"High Flight"     John G Magee Jr, 1943*

## Introduction

## About SkyMap

SkyMap is a "Planetarium" program for Microsoft Windows version 3.1 or later. It will display a map of the sky as seen from any point on Earth for any date between 4000BC and 8000AD. Two different types of map can be drawn - a "Horizon" map showing the observer's local horizon, and a "Sky Area" map showing a detailed view of a small area of the sky. You can get information about any object displayed on the map by simply pointing at the object with the mouse and clicking the button. The display of additional information, such as constellation figures or star labels can be switched on and off with a click of the mouse button, making it easy to see exactly what you want without being overwhelmed by unwanted information. When you have the map exactly as you want it, you can print it on any printer supported by Windows, in either black and white or colour.

SkyMap can also display photographic images, supplied in the form of GIF or Windows bitmap files. Thousands of such images are freely available on bulletin boards and commercial information systems such as CompuServe and BIX. This allows you to build up your own personal library of astronomical photographs which, coupled with the map displays, really helps to bring the sky to life!

There are a number of planetarium programs available today. Unlike some of these, SkyMap makes no claims of blinding calculation speeds. Instead, what SkyMap concentrates on is *accuracy*. When writing SkyMap I've used the most accurate methods available to me for all the calculations. This accuracy makes SkyMap equally suited for both the novice astronomer who just wants to know "what's that bright object up there?" and the serious amateur or professional astronomer who wants a detailed "finder chart" for a faint galaxy. Appendix A of this manual describes the data sources SkyMap uses, and gives an indication of the likely errors in its calculations.

SkyMap carries out its calculations in as efficient as manner as possible, but it *never* compromises accuracy for the sake of speed. An increase in speed can always be achieved by using a faster computer! Having said all that, the speed is still reasonable; on the author's 33MHz 486-based PC for example, the horizon map, with default settings, is computed and drawn in about 5 seconds.

Although I am releasing SkyMap as Shareware, I quite appreciate that you may not consider it worth paying any money for in its current form. I would obviously *like* to be paid the registration fee - I've put a great deal of work into this software - but I would still appreciate receiving your feedback on the program even if you feel it's *not* currently worth registering. If you do feel this way I'd like to know what, if anything, I could do to make you change your mind in the future!

Whilst developing SkyMap I've received the help and encouragement of a number of people. I'd especially like to thank David Webber for many useful suggestions and help with the mathematical problems I encountered, and Steve Moshier for generously consenting to allow me to use many of his coding ideas for various astronomical calculations. Finally, I'd like to thank Jean Meeus for writing the book "Astronomical Algorithms" (Willman-Bell, 1991), without which this program would never have existed.

## What is Shareware?

Shareware distribution gives users a chance to try software before buying it. If you try a shareware program and continue using it, you are expected to register. Individual programs differ on details -- some request registration while others require it, some specify a maximum trial period. With registration, you get anything from the simple right to continue using the software to an updated program with printed manual.

Copyright laws apply to both Shareware and commercial software, and the copyright holder retains all rights, with a few specific exceptions as stated below. Shareware authors are accomplished programmers, just like commercial authors, and the programs are of comparable quality. (In both cases, there are good programs and bad ones!) The main difference is in the method of distribution. The author specifically grants the right to copy and distribute the software, either to all and sundry or to a specific group. For example, some authors require written permission before a commercial disk vendor may copy their Shareware.

Shareware is a distribution method, not a type of software. You should find software that suits your needs and pocketbook, whether it's commercial or Shareware. The Shareware system makes fitting your needs easier, because you can try before you buy. And because the overhead is low, prices are low also. Shareware has the ultimate money-back guarantee -- if you don't use the product, you don't pay for it.

## Disclaimer Agreement

Users of SkyMap must accept this disclaimer of warranty:

"SkyMap is supplied as is. The author disclaims all warranties, expressed or implied, including, without limitation, the warranties of merchantability and of fitness for any purpose. The author assumes no liability for damages, direct or consequential, which may result from the use of SkyMap."

SkyMap is a "shareware program" and is provided at no charge to the user for evaluation. Feel free to share it with your friends, but please do not give it away altered or as part of another system. The essence of "user-supported" software is to provide personal computer users with quality software without high prices, and yet to provide incentive for programmers to continue to develop new products. If you find this program useful and find that you are using SkyMap and continue to use SkyMap after a reasonable trial period, you must make a registration payment to Chris Marriott. The registration fee will license one copy for use on any one computer at any one time. You must treat this software just like a book. An example is that this software may be used by any number of people and may be freely moved from one computer location to another, so long as there is no possibility of it being used at one location while it's being used at another. Just as a book cannot be read by two different persons at the same time.

Commercial users of SkyMap must register and pay for their copies of SkyMap within 30 days of first use or their license is withdrawn. Site-License arrangements may be made by contacting Chris Marriott.

Anyone distributing SkyMap for any kind of remuneration must first contact Chris Marriott at the address below for authorisation. This authorisation will be automatically granted to distributors recognised by the ASP as adhering to its guidelines for shareware distributors, and such distributors may begin offering SkyMap immediately (However Chris Marriott must still be advised so that the distributor can be kept up-to-date with the latest version of SkyMap.).

You are encouraged to pass a copy of SkyMap along to your friends for evaluation. Please encourage them to register their copy if they find that they can use it.

## ASP Ombudsman Statement

This program is produced by a member of the Association of Shareware Professionals (ASP). ASP wants to make sure that the shareware principle works for you. If you are unable to resolve a shareware-related problem with an ASP member by contacting the member directly, ASP may be able to help. The ASP Ombudsman can help you resolve a dispute or problem with an ASP member, but does not provide technical support for members' products. Please write to the ASP Ombudsman at 545 Grover Road, Muskegon, MI 49442 or send a CompuServe message via CompuServe Mail to ASP Ombudsman 70007,3536.

## Contacting the Author

If you have any questions about SkyMap, or you require support, you can contact me in a number of different ways:

1. If you have the capability, e-mail is the best way to contact me. It's quick, and a written request is always easiest to deal with. I can be reached at any of the following addresses, in no particular order of preference:

| | |
|---|---|
| Internet: | chris@chrism.demon.co.uk |
| CompuServe: | 100113,1140 |

2. If you prefer to write me a letter, my postal address is:

Chris Marriott
9, Severn Road
Culcheth
Cheshire WA3 5ED
United Kingdom

I have no intention of moving, so that address should apply for the foreseeable future! Note that this is also the address to which registration fees should be sent.

3. Finally, if you would like to speak to me in person, you can telephone me on the following number:

Within the UK:0925 76 4131
International: +44 925 76 4131

Please call at the weekend, or between 6pm and 10pm GMT during the week. Please also remember that I *am* in the UK, and consider the time difference if you're calling from overseas. I would *not* welcome a call at 3am if you happen to be on the west coast of the USA and you decide to phone me at 7pm local time!

Please feel free to contact me - I'd love to receive any comments you may have on the program, or suggestions as to how it could be improved.

## Registering SkyMap

As described above, SkyMap is not free software. It is shareware and, as such, you must register it if you find it useful after a reasonable trial period. I would suggest that 30 days is reasonable for such a trial. The shareware concept is based on trust, and I trust you to pay for this program if you are using it. There are several different levels of registration available:

Personal: Personal registration allows the program to be used by one person. You may install the software on any number of computers, as long as only one will be in use at any one time.

Club: Club registration allows free use by all members of an astronomy club (or, indeed, any other sort of club!), on *any* number of computers, whilst at club meetings. Any club member who wants to use the program at home is still expected to register the program personally.

Educational: Educational registration allows unrestricted copying and use of SkyMap within a school, college, university, or other educational establishment.

Corporate??: Frankly, I can't imagine any corporate use for SkyMap, but if you *are* a corporate user and you'd like to negotiate a site license for use of SkyMap, please contact me to discuss it!

For full information about registration, including details of current prices and methods of payment, please refer to the separate registration form "REGISTER.TXT".

If you have access to CompuServe you may wish to take advantage of the on-line shareware registration forum to quickly and easily obtain a personal registration for SkyMap. To do so, enter the command "GO SWREG" at any "!" prompt, and select program ID 876. The registration fee will be charged directly to your CompuServe account and, especially if you live in a country other than the UK, you will avoid the inconveniences caused by having to deal with foreign currency.

If you register SkyMap you will receive:

1. A registered copy of the latest version of SkyMap, with the registration reminder removed from the "About SkyMap" box.

2. A bound, illustrated manual.

3. A much larger star database.

4. Unlimited lifetime support, using any of the methods described in the "Contacting the Author" section of this manual.

5. The right to purchase, for a small fee, additional materials which enhance the use of SkyMap.

6. The right to upgrade to a registered copy of the latest version of SkyMap, at any time, for a nominal fee. You may do this as often as you wish.

7. A lifetime money-back guarantee. If you *ever* find a serious bug in SkyMap which makes it unusable, your registration fee will be immediately refunded, with no questions asked.

## System Requirements

SkyMap requires Microsoft Windows version 3.1 or above to run.   It will *not* work with Windows 3.0 or earlier.   Windows 3.0 had a number of major flaws, and early on in the development of SkyMap I made the decision not to support it.   I apologise if this inconveniences you, but supporting Windows 3.0 would have quite severely restricted certain aspects of SkyMap's operation.

You do not actually *need* a maths coprocessor to run SkyMap, but it will run *very* slowly without one.   SkyMap does a great deal a great deal of trigonometry while creating maps, and use of a coprocessor can speed up this process by a factor of ten or more!

SkyMap will work with any type of video card supported by Windows.   For best results, VGA or better is recommended.   If you want to display photographic images you really need a card and monitor capable of displaying 256 (or more) colours at the same time, such as a "SuperVGA", "High Colour" or "True Colour" video card..

Maps can be printed, in either black and white or colour, on any type of printer supported by Windows.   The best results will be obtained from a laser or high-quality ink-jet printer, but perfectly acceptable results will be obtained from a 9-pin or 24-pin dot-matrix printer, too.

The files distributed with   SkyMap require a total of about 1.4MB of disk space.

## Setting Up SkyMap

Before SkyMap can be used, it must be installed on your computer, then configured to know about your location and time zone.

## Installing SkyMap on your Computer

SkyMap is distributed as three ZIP archive files - one containing the program and documentation; one containing the support files essential to the program's operation, and the third containing optional files which enhance the program but are not essential.

The program archive, which will probably be called "SKYMP13A.ZIP" should contain the following files:

| | |
|---|---|
| README.1ST | Read this file! |
| REGISTER.TXT | SkyMap registration form |
| HISTORY.TXT | SkyMap release history |
| SKYMAP.EXE | The SkyMap program |
| SKYMAP.HLP | On-line help file |
| SKYMAP.TXT | This manual. |
| CTL3D.DLL | 3D control library. |
| MWSPIN.DLL | Spin button control library. |
| MSDNTB.DLL | ToolBar library. |

The data and support archive, which will probably be called "SKYMP13B.ZIP", should contain the following files:

| | |
|---|---|
| README.2ND | Read this file! |
| STAR.SKY | Main star database. |
| STARNAME.SKY | Star name database. |
| STARPROP.SKY | Star proper name database. |
| CONFIGUR.SKY | Constellation figures database. |
| CONNAME.SKY | Constellation name database. |
| MOON.SKY | Moon position database. |
| PLANETS.SKY | Planet position database. |

The optional files archive, which will probably be called "SKYMAP13C.ZIP", should contain the following files:

| | |
|---|---|
| README.3RD | Read this file! |
| CONOUTLN.SKY | Constellation boundaries database |
| RNGC.SKY | RNGC non-stellar object database |
| RNGCPOP.SKY | RNGC object popular name database |

You may also have one or more picture file archives. Please refer to the "Displaying Pictures" section of the manual for information about how to use these.

To install SkyMap, carry out the following steps:

1. Create a directory on your hard disk. For the purposes of this discussion we'll assume you want to install the program in directory SKYMAP on your C: drive. Enter the commands:

C:
MD \SKYMAP

2. Unpack both the archive files into the directory. Assuming that the archives are on a floppy disk in the A: drive you would do this with the commands:

CD \SKYMAP
PKUNZIP A:\SKYMP13A
PKUNZIP A:\SKYMP13B
PKUNZIP A:\SKYMP13C

3. Read the "Readme" text files. They may contain important additions to the information in this manual!

4. Select the Program Manager group you'd like to add the SkyMap icon into.

5. From the Program Manager's "File" menu, select "New...". A dialog box will appear. Select "Program Item" (this should be the default, anyway) and press the OK button.

6. The "Program Item Properties" dialog will appear. Fill it in as shown below, then press the <OK> button.

| | |
|---|---|
| Description: | SkyMap |
| Command Line: | SKYMAP.EXE |
| Working Directory: | C:\SKYMAP |

The SkyMap icon (a picture of a telescope) should appear in the Program Manager group window. SkyMap is now installed and ready to run.

## Configuring SkyMap for your Location

When SkyMap is run for the first time, you must configure it for the your location. Before SkyMap can correctly draw a map of the sky for you, you have to tell it where you are, and what time zone you are in. To configure the program, carry out the following steps:

1. Run SkyMap by double clicking on its icon in the Program Manager. The empty SkyMap main window should appear. Note the grey "status bar" at the bottom of the window. This is used to display important information to the user, so keep an eye on it!

2. From the File menu, choose "New...". The "Create New Window" dialog box will appear, which lists the different types of window you can create. Press <Enter> to create a Horizon Map window, which will be the default. A blank Horizon Map window will appear, and additional items will be added to the menu bar. Note that the message "Press F5 to draw the map" has appeared on the status bar. Ignore this message for the time being!

3. From the "Options" menu, choose "Observer...". The "Observer" dialog box will be displayed. This is where you set up all the information about the location you will be observing from.

Fill in your longitude and latitude, each in degrees, minutes, and seconds. You need not be exact - a position correct to the nearest degree is fine unless extreme accuracy is required.

In the "Local Time" box enter your time zone, expressed in minutes ahead or behind Universal Time (UT), commonly called Greenwich Mean Time (GMT). Eg, if your time zone is Eastern Standard Time, you are 5 hours behind UT, so you would enter "300" (5x60) into the text box, and click the button to change the display to read "minutes behind UT".

If Daylight Saving Time (called "Summer Time" in the UK) is currently in operation, check the appropriate box. If it is not currently in force, leave the box blank. If the box is checked, your local time is taken to be an extra hour ahead of UT.

4. Finally, you should save the information you've entered. From the "File" menu, choose "Save Defaults...". A box will appear asking you if you really want to save the information. Press the "Yes" button, or just press <Enter> to save the information. All the current map settings will be saved in a configuration file called `SKYMAP.INI` and will be used as the default values for all horizon maps subsequently drawn.

5. Press the <F5> key. A "Please wait" box will be displayed for a few seconds (depending on the speed of your computer), after which a map of the southern part of the sky as it currently looks from your location will appear in the map window. Congratulations - you have successfully drawn your first map!

Note the following features of the map:

1. The "status bar" at the bottom of the window displays information about the map, such

as the time and date, and the coordinates of the map centre.

2. The "Toolbar" at the top of the window provides a shortcut method of accessing many of the most frequently used commands, as well as giving an instant view of which map features are currently enabled.

3. Along the bottom of the map is the horizon, with the compass points displayed along it. By default, the program displays a view of roughly one third of the sky, centred on the southern horizon. The zenith (the point directly overhead) is at the top of the map.

4. Stars are displayed as dots of differing sizes. The brighter the star, the larger the dot. By default, stars down to magnitude 5.0 are displayed, although the star database supplied with the program contains stars down to magnitude 7.0. (The complete SAO catalog is reasonably complete down to about magnitude 9.5.)

5. By default, constellation names and figures are displayed. These can both be switched off using the items on the "View" menu, or by clicking on the appropriate buttons on the Toolbar.

6. Planets are shown as dots, with the standard astronomical symbol alongside. The Moon is displayed with its correct phase and orientation. The Sun is displayed as a hollow circle.

## Horizon Maps

A horizon map shows the sky as seen from the observer's location for a particular time and date.   It will probably be the starting point for most runs of SkyMap.

Drawing a Horizon Map
Using a Horizon Map

## Drawing a Horizon Map

To draw a horizon map, the following steps should be followed:

1. From the "File" menu, choose "New...". The "Create New Window" dialog box will be displayed, showing the different types of window that can be created. "Horizon Map" should be the default selection in the list, so simply press <Enter> to create a new Horizon Map window.

2. Use the items on the "Options" menu to set all the options required for the map. These options are described below. Once the options have been set, you can save them to be used as the defaults for all future Horizon maps by selecting the "Save Defaults..." option from the "File" menu.

3. Use the items on the "View" menu to select which features you would like plotted on the map. Most of these can also be selected from the Toolbar, too.

4. Press the <F5> key to draw the map. This process will take anything from a few seconds to (in extreme cases!) several minutes, depending on the speed of your computer, and the complexity of the map.

5. When the map appears, you can zoom in or out on it, identify objects on it, or print it. These options are described later.

## Viewpoint

This option allows you to determine which part of the sky appear on the map.   When this option is selected, the "Horizon View" dialog is displayed.

The "Azimuth" and "Altitude" fields specify the coordinates of the centre of the map.   The azimuth corresponds to the compass direction you are looking in and has the value 0° for due North, 90° for East, 180° for South, and 270° for West.   The altitude indicates how far up you are looking, and is 0° on the horizon, and 90° directly overhead.

The "Radius" field specifies the vertical size of the map.   The minimum altitude displayed on the map will be "Radius" degrees below the centre; the maximum altitude will be "Radius" degrees above the centre (ie, the range of altitude displayed on the map will be double the value entered).   The azimuth range of the map is scaled automatically.

Notes:

1.   Even if the radius is greater than the centre azimuth (ie, Centre-Radius<0), objects below the horizon will not be displayed - the horizon line will simply appear higher up the map.

2.   To display a circular map of the whole sky, enter a centre altitude of 90°, and a radius of 90°.   In this case the azimuth setting simply determines the orientation of the map - the specified azimuth will be appear at the bottom of the map.

## Time

The time and date for which the map is drawn are initially set from the computer's clock for the instant that the Horizon Map window is created. The Time option allows the user to display a map for any other time and date. When this option is selected, the "Observation Time" dialog is displayed.

Fill in the dialog fields for the time and date required. Pressing the "Now" button will read the time and date from the computer's clock.

Notes:

1. Dates before 1AD should be entered as negative numbers in the normal astronomical manner. Enter the year 1BC as "0", 1000BC as "-999", and so on.

2. Dates must be between 4000BC (-3999) and 8000AD, this being the range over which the program's calculations are valid.

3. Dates on or after 0h on 15th October 1582 are assumed to be in the Gregorian calendar; dates before then in the Julian calendar.

4. The observation time is assumed to be a local time - ie, the time as shown on an observer's clock. The time zone information specified on the Observation Location dialog (see below) is used to convert the time to UT.

## Observer

The Observer option allows the user to enter information about the location from which the observation is taking place. When this option is selected, the "Observer" dialog is displayed.

The "Latitude" and "Longitude" fields specify the location of the observer. Both are entered in degrees, minutes, and seconds although, unless extreme accuracy is required, a position correct to the nearest degree will normally suffice.

The "Conditions" information describes the atmospheric temperature and pressure at the time of observation. This information is used when calculating the effects of refraction. Changing these values only has a very small effect and, unless extreme accuracy is desired, they may safely be left at their default values.

The "Local Time" data specifies the observer's time zone. It is used to convert the time of observation (which is always assumed to be local time) into UT or GMT. The time difference is entered in *minutes* (not hours!) difference between local time and UT. For example, an observer on the east coast of the USA, whose clocks are set 5 hours earlier than GMT, should enter "300" (5 x 60) in this box, and click the arrow to change the text to "before UT".

The "Daylight saving time" box should be checked if DST (called "Summer Time" in the UK, and perhaps other countries too) is currently in operation. If the box is checked, the local time is assumed to be one additional hour ahead of UT.

Notes:

1. The reason that the time difference is entered in minutes, rather than hours, is that not all countries are exact hours ahead of or behind GMT. India, for example, is 5.5 hours (330 minutes) ahead of GMT.

## Stars

The Stars option controls both which stars are plotted on the map, and the way that plotted stars are displayed.   When this option is selected, the "Star Display" dialog is displayed.

The "Limiting magnitude of map" field determines the magnitude of the faintest star whose position will be calculated.   The higher the number, the fainter the stars which will be displayed (and the longer the map will take to compute).   The star database supplied with the program contains stars down to magnitude 7.0; the full SAO star catalog has stars down to magnitude 9.5 or so.

The "Limiting magnitude displayed" field determines the magnitude of the faintest star that will actually be displayed on the map.   Once a map has been drawn, you can change the value in this field to temporarily suppress the display of the fainter stars on a map, to remove "clutter".   The value entered in this field should be less than or equal to the value entered in the "Limiting magnitude" field above..

The lower half of the dialog box controls the way that the size of the star images varies with their magnitude.   All stars *brighter* than the first "Display mag" field will be displayed using the size of star circle shown to its right.   All stars *fainter* than the second "Display mag" field will be displayed using the size of star circle shown to *its* right.   All stars with magnitudes between these two limits will be drawn with an image size inversely proportional to the magnitude (ie, the brighter the star, the larger the image).

Notes:

1.   The number of stars rises *very* quickly with magnitude.   Generally, increasing the limiting magnitude by one magnitude will more than double the number of stars visible on the map, and consequently the time taken to compute their positions.

## Star Labels

This option controls the way in which stars are labelled on the map.   When selected, the "Star Labels" dialog box is displayed.

The way in which stars are named has evolved over hundreds of years.   As a result, a lot of the brighter stars have many different names.   The "Label Preferences" box allows the user to determine which, if any, of those names is displayed on the map.

"Proper Names" refers to the "popular" name of a star, such as "Polaris" or "Rigel".

"Bayer Letters" refers to the convention of labelling the brightest stars in each constellation with Greek letters, such as "Alpha Centauri" or "Beta Cygni".

"Flamsteed Numbers" refers to the convention of labelling stars in each constellation with numbers, such as "61 Cygni".

The "Label Options" box at the bottom of the dialog box determines which stars are labelled.   If "All stars" is selected, then all stars which have the appropriate name will be labelled.   If "Brighter than magnitude" is selected, then only those stars brighter than the number in the edit box will be labelled.

Notes:

1.   This dialog only determines the way in which stars are labelled.   If order to actually display star labels, the "Star Labels" option must be enabled on the "View" menu or the Toolbar.

2.   If a star has multiple names, and more than one of the naming options is selected in the "Preferences" box, the name highest up the box will be displayed.   Eg, if both the "Proper Names" and "Bayer Letters" options are selected, the map would display the name "Polaris" in preference to "Alpha Ursae Minoris" when labelling the pole star.

## Constellation Font

This option allows the user to choose the font used for constellation names. Selecting this option displays a standard font selection dialog.

## Labels

Selecting this option displays a submenu of labelling options. If the "Altitude" option is selected, the "Altitude Label Options" dialog box is displayed.

The "Label type" radio buttons allow the type of altitude labelling to be selected. The options are:

| | |
|---|---|
| Automatic | The label interval is selected automatically. |
| Every ... | The label interval is specified in the text box. |
| Nothing | No altitude labels are displayed. |

If the "Draw Altitude Lines" box is checked, altitude lines are drawn across the map at the appropriate (manual or automatic) intervals, and the lines are labelled at the left-hand side of the map.

If the box is blank, altitude tick marks are drawn in the centre of the map.

Notes:

1. If the "Nothing" box is selected, neither altitude lines nor labels are drawn, regardless of the state of the "Draw Altitude Lines" check box.

Selecting the "Azimuth" option from the "Labels" submenu displays the "Azimuth Label Options" dialog box.

The radio buttons in the "Label with" box control the type of azimuth labelling, and determine which (if any) of the other values in the dialog are used.

If the "Compass Points" button is selected, the horizon is labelled with the names of compass points, and the options in the "Compass Interval" section of the dialog are used.

If the "Azimuth" button is selected, the horizon is labelled with azimuth numbers (in degrees), and the options in the "Azimuth Interval" section of the dialog are used.

If the "Nothing" button is selected, the azimuth axis is not labelled, and the rest of the dialog is ignored.

The "Compass Interval" section of the dialog determines the labelling method used when "Compass Point" labelling is selected. The radio buttons allow the labelling interval to either be determined automatically, or one of three manual intervals selected.

The "Azimuth Interval" section of the dialog determines the labelling method used when

"Azimuth" labelling is selected.   The options allow the labelling interval to be either determined automatically, or specified manually by the value in the text field.

If the "Draw Azimuth Lines" box is checked, lines are drawn up from the labelled points on the horizon to the top of the map.

## RNGC Objects

Selecting this option displays the "RNGC Options" dialog box, allowing you to determine which deep sky objects are displayed on the map.

The "Object Selection" box determines which catalogue will be searched to find objects to display; the entire RNGC catalogue or only Messier objects.

The "Object Types" box controls which objects will be displayed on the map, based on their type. If the "All objects" box is checked, then the other boxes in the group are ignored, and all objects which match the other selection criteria will be displayed. If the "All objects" box is not checked, individual types of object can be selected using the other boxes in this group.

The "Magnitude Limit" box allows you to control which objects are displayed, based on a magnitude selection. If "All Objects" is selected, then all objects matching the other selection parameters will be displayed; if "Brighter than mag" is selected, then only those objects brighter than the specified magnitude will be displayed.

Finally, the "Label Objects" box, determines whether displayed objects will be labelled. If the box is checked, objects will be labelled. Messier objects will be labelled "M" followed by a number (eg "M32"); other objects will simply have their RNGC catalogue number displayed (eg "1985" refers to the planetary nebula "RNGC 1985" ).

Notes:

1. This is a complex dialog box - the most complex in the program! - but it gives you the ability to exercise very fine control over the non-stellar objects which are displayed. For example, you can make selections such as "only display globular clusters in the Messier catalogue brighter than magnitude 11".

2. The program will only display those Messier objects that are in the RNGC. Four objects in the Messier catalogue are not in the RNGC, so will not be drawn. These are: M24 (a local brightening of the Milky Way), M25 (the open cluster IC 4725), M40 (the wide double star Winneke 4), and M45 (the Pleiades).

3. The RNGC is based on the NGC, compiled towards the end of the 19th century. As such, it contains many incorrect classifications, based on the information available at the time. For example, the Crab Nebula in Taurus, M1, we now know to be a supernova remnant, but the RNGC classifies it as a planetary nebula. The RNGC is, however, a catalogue of great historical significance, and no attempt has been made by the author to "correct" it.

4. The symbols used to draw non-stellar objects on the map have been based on those used in the authoritative "Uranometria 2000" star atlas.

## Colours

This option displays a sub-menu allowing the user to select the colours used for every item drawn on the map for either the screen or the printer.   When either "Screen" or "Printer" is selected, the "Horizon Map Colours" dialog box is displayed.

To view or edit the colour of any map component, either double click on the name in the listbox, or move the listbox highlight to the name and press the "Edit..." button.   Either way, a standard colour selector box will be displayed, letting you choose the colour for the item.

Notes:

1.   Pressing the "Cancel" button will restore all the colours to their previous settings, not only the colour just edited.

2.   The "Printer" colour settings only relate to the printing of colour maps.   Refer to the printing topic for further information.

## Reduce Positions

## Draw

Selecting this option will draw the map, using the current option settings. You may press the <F5> function key as a "shortcut" for this option.

## Using a Horizon Map

Once the horizon map has been created using the methods described in the previous section of the manual, it can be manipulated in various way.   This section describes the available options:

## Setting the Visibility of Objects

The first section of the "View" menu contains a list of item names, each of which has a tick alongside if that type of item is currently visible. The items are:

- Stars
- Star Labels
- Planets
- Constellation Figures
- Constellation Boundaries
- Constellation Names
- Alt/Az Grid
- RNGC Objects

Each of these items has a corresponding button on the ToolBar. To change an item from visible to invisible, or vice versa, either select the item from the menu, or press the button on the ToolBar.

## Changing the Map Scale

The "Zoom In" and "Zoom Out" items on the "View" menu may be used to change the magnification of the map. The <F2> and <F3> function keys are shortcuts for these operations, as are the first two buttons on the ToolBar. When the map is first drawn, it is scaled so that the map exactly fills a maximised map window. Every time "Zoom In" is selected, the size of the map increases by 50%, and the map is redrawn. Every time "Zoom Out" is selected, the size is correspondingly reduced.

When the map is zoomed, the centre of the current window will remain stationary. You can therefore zoom in a particular feature by first scrolling it to the centre of the window, then repeatedly pressing the <F2> key. To aid this process, a shortcut method has been provided to bring a point to the centre:

1. Position the mouse pointer over the point on the map you would like to bring to the centre.
2. Press the *right* mouse button. A pop-up menu will appear under the mouse pointer.
3. Select the "Centre" item with the left mouse button. The window will scroll to bring the chosen point to the centre of the map.

Note that the map will not scroll past its edges (the boundaries of the full-screen normal size map). In order to bring a point to the centre of the map it may, therefore, be necessary to zoom in one or more times first.

## Identifying Objects on the Map

To display a dialog box showing information about any object visible on the map, move the mouse pointer over the object, and press the right mouse button. A pop-up menu will appear. Select the item you wish to identify.

Star Identification
Planet Identification
RNGC Object Identification

## Star Identification

If you ask for information about a star, a "Star Information" dialog box is displayed. The amount of information displayed will depend on the star, but will include the following:

1. The star's SAO catalogue number is displayed in the dialog box title. The SAO number is the way that SkyMap identifies the star internally - all other information is derived from this.

2. The top section of the dialog displays the identify of the star. The same star can be identified in a truly bewildering variety of different ways. SkyMap attempts to show a few of the more popular names for the star:

The first line of the dialog always displays the name of the constellation that the star is in. In the case of a star which has either a Bayer letter or Flamsteed number, the star's constellation is actually stored in the database. In cases where this information is not present, the constellation is computed from the star's position, using the official IAU constellation boundaries.

The next line, if present, displays the "proper name" of the star - "Rigel", for example. Note that many star names are derived from Arabic and, as such, have a number of alternate English spellings. In the case of such stars, the name that SkyMap displays may well be slightly different from the name your reference sources show. All that means is that I used a different reference book!

Next are shown the star's Bayer letter (eg beta Orionis) and Flamsteed number (19 Orionis), if present.

Finally in the initial section of the dialog, the star's visual magnitude is shown.

3. The lower section of the dialog shows the position of the star in several different coordinate systems.

First, the star's apparent geocentric right ascension and declination are displayed. These coordinates are referred to the true equinox and ecliptic of date, and are corrected for:

- Proper Motion
- Annual Aberration
- Precession
- Nutation

The star's position is also corrected for refraction before being displayed on the map, but the apparent position displayed in the dialog box does *not* include this correction.

Next, the star's catalogue position is displayed - the right ascension (RA) and declination for the mean equinox and ecliptic of epoch J2000.0. This information is taken straight from the SAO star catalogue and contains no position corrections.

Finally, the current altitude and azimuth as seen from the observer's location are displayed. The altitude displayed here includes the effects of refraction.

## Planet Identification

If information about a planet is requested, a dialog with multiple screens of information is displayed. The dialog has buttons down the right hand side for switching between the different screens of information. The names on the buttons refer to the position of the *viewer* - eg, the "Sun" button displays a screen of heliocentric information.

The information displayed is as follows:

The "Local" screen displays information about the planet as seen from the observer's location at the time and date for which the map is displayed. The following information is displayed:

1. The altitude and azimuth of the planet as seen from the observer's location at the current time. This is derived from the apparent geocentric position, with additional corrections being applied for diurnal parallax (the difference between the position of the planet as seen from the centre of the Earth and the position as seen from the observer's actual position) and refraction.

The "Earth" screen (initially displayed) displays information about the planet as seen from the centre of the earth - ie, geocentric information. The following information is displayed:

1. The apparent geocentric right ascension and declination, referred to the true equinox and ecliptic of date. This position is corrected for the effects of:

    Light Time
    Light Deflection (due to the Sun's gravity)
    Annual Aberration
    Nutation

The position of the planet as displayed on the map has additional corrections for diurnal parallax and refraction, but these corrections are not reflected in the position displayed here.

2. The constellation the planet is in.

3. The true (geometric) distance of the planet in both astronomical units (exactly) and millions of km (approximately). In the case of the Moon, the exact distance is displayed in km.

The "Sun" screen displays information about the planet as seen from the centre of the Sun - ie, heliocentric data. The following information is displayed:

1. The apparent ecliptic longitude and latitude of the planet, referred to the true ecliptic of date.

2. The geometric radius vector of the planet (ie, the distance between the planet and the Sun) in both astronomical units (exactly) and millions of km (approximately).

The "Physical" screen displays physical information about the planet. The following information is displayed:

1. The visual magnitude.

2. The phase, as a fraction between 0 and 1. A phase of 0 indicates that the object is "new"; a phase of 1 is "full". The phase is equal to the fraction of the planet's disk that is illuminated, as seen from the Earth.

3. The apparent diameter, in seconds of arc. For some planets, separate equatorial and polar diameters are shown.

4. The phase angle, in degrees. This is the angle between the Earth and Sun, as seen from the centre of the planet, and determines the phase of the planet as seen from the Earth.

5. The elongation, in degrees. This is the angle between the planet and the Sun, as seen from the centre of the Earth.

6. The light time in hours, minutes, and seconds. This is the time taken for light to travel from the planet to the observer, and is an indication of the "age" of the view we see of the planet. Eg, if the light travel time for Mars is shown as 5 minutes, this means that we are seeing Mars as it actually was 5 minutes ago.

## RNGC Object Identification

If you ask for information about an RNGC object, a dialog box is displayed. The amount of information displayed will depend on the object, but will include the following:

1. The dialog box title will contain the catalogue number of the object. This will be shown as a Messier number for objects in the Messier catalogue, and an RNGC catalogue number otherwise.

2. The upper section of the dialog identifies and describes the object. The following information could be displayed:

RNGC Number: For Messier objects, the corresponding number in the RNGC catalogue. For example, in the case of "M44", this line will display "NGC 2632".

Popular name: Some objects have a "popular name" by which they are commonly known, in addition to their various catalogue numbers. For example, in the case of M44, this line will display the name "Praesepe".

Type of object: A brief description of the object type, such as "Galaxy", "Globular Cluster", "Diffuse Nebula", etc. As has already been stated, these classifications are not always correct, and should not be taken as an authoritative guide to what an object really is! That having been said, the classification is correct for the vast majority of objects.

Magnitude: The visual magnitude of the object. It should be noted that this is normally an "integrated magnitude" - the total amount of light received from the whole of the object. Normally, a 10th magnitude galaxy is visually a *lot* fainter than a 10th magnitude star, because in the case of the galaxy the light is coming from an area of sky, rather than from a point source.

Description: The "Dreyer Description" of the object. When Dreyer compiled the NGC in 1888, he gave a brief *visual* description of the object in a highly compressed format. These descriptions are, in the author's opinion, the real value of the NGC, since they indicate what you are likely to actually see in a typical modern amateur telescope. The "encoded" format of the descriptions may seem cryptic and hard to understand at first but, with practice, soon becomes a useful source of information. Refer to Appendix B of the manual for a description of Dreyer descriptions.

3. The lower section of the dialog shows the position of the object in several different coordinate systems.

The first line displays the name of the constellation the object is in.

The second line shows the object's apparent geocentric right ascension and declination, referred to the true equinox and ecliptic of date. The position is corrected for:

Annual Aberration
Precession
Nutation

The object's position is also corrected for refraction before being displayed on the map, but the apparent position displayed in the dialog box does *not* include this correction. Note that rigorous position corrections are applied, regardless of the current setting of the "Reduce Positions" switch on the "Options" menu.

Next, the object's catalogue position is displayed - the right ascension (RA) and declination for the mean equinox and ecliptic of epoch J2000.0. This information is taken straight from the RNGC catalogue and contains no position corrections.

Finally, the current altitude and azimuth as seen from the observer's location are displayed. The altitude displayed here includes the effects of refraction.

## Zooming to an Area Map

If you wish to display a detailed "Area Map" of a particular region of the sky, position the mouse pointer over the point on the horizon map that you wish to be the centre of the area map. Press the right mouse button and select "Area Map..." from the pop-up menu. The "Sky Area View" dialog box will appear, with the coordinates of the map centre already filled in. Enter the radius of the map you would like, in degrees, then press <Enter>. A blank area map window will appear. The next chapter of the manual describes how to draw and use the Sky Area map.

## Printing the Map

To print the map, choose the "Print" option from the "File" menu. This will display the "Print Options" dialog box.

The "View Options" box selects what type of map is drawn. If "Whole Map" is selected, the entire map will be drawn, scaled to fit onto the printer page. If "Current View" is selected, the current map view will be printed, at the current zoom factor.

The "Colour Options" box is used to select whether the map is printed in black and white or colour. If "black and white" is selected, all objects on the map are printed black, and the map background is left white. If "Colour" is selected, the map background is again left white, but the colour of all other objects is taken from the settings in the "Options/Colour/Printer" dialog.

When the <OK> button is pressed, a standard "Print" dialog is displayed. This allows you to select the printer, resolution, paper orientation etc in the normal way. Press <OK> from this dialog to print the map.

Notes:

1. By default, the map is printed in landscape orientation. If you wish to change this, use the "Print Setup" option.

2. The default "Print Options" settings of "Whole Map" and "Black and White" correspond to the way that maps were printed in previous versions of SkyMap.

3. The "Current View" printout is intended as a "quick and dirty" method of getting a printed map of a zoomed-in area of the sky, without having to draw a separate Sky Area map and print that. No attempt is made to properly scale the map to fit the paper size, draw borders, or anything else. If you have a very high zoom factor set, and try to print to a high-resolution device using this settings, problems may occur.

4. The "Colour" setting in the "Colour Options" box can be used to print a grey-scale map even on a black and white printer. The exact correspondence between colours and shades of grey will depend on the capabilities of the printer driver. This works beautifully on a PostScript laser printer; not so well on an Epson 9-pin dot matrix printer!

## Sky Area Maps

A Sky Area map shows a detailed view of a (normally) small area of the sky, centred on a particular point of right ascension and declination. It is a circular map, displaying all objects within a specified radius of the centre.

## Drawing a Sky Area Map

There are two ways to draw a Sky Area map:

1. Draw a horizon map, then click the right mouse button over the location you want to be the centre of the Sky Area map. Select "Area Map..." from the pop-up menu which appears.

2. From the "File" menu, select "New...". The "Create New Window" dialog box will appear. Select "Sky Area Map" from the listbox and press <OK>.

Whichever of these two methods is used, the "Sky Area View" dialog box will be displayed.

The "Vertical Radius" field specifies the radius of the map, in degrees. This must be between 1° and 90°. The "Right Ascension" and "Declination" fields specify the coordinates of the map centre. If you are drawing the Area map from a Horizon map, these will already contain the correct values.

When the dialog is correctly filled in, press <OK> to create a new map. A blank Sky Area Map window will be displayed, and the menu will change to the Sky Area menu.

Use the items on the "Options" menu to set all the options required for the map. These options are described below. Once the options have been set, you can save them to be used as the defaults for all future Sky Area maps by selecting the "Save Defaults..." option from the "File" menu.

Finally, press the <F5> key to draw the map. This process will take anything from a few seconds to (in extreme cases!) several minutes, depending on the speed of your computer, and the complexity of the map.

The items on the "Options" menu are:

- Viewpoint
- Time
- Observer
- Stars
- Star Labels
- Constellation Names
- RNGC Objects
- Colours
- Draw

## Viewpoint

This option allows the user to specify which part of the sky is visible on the map.   When this option is selected, the "Sky Area View" dialog is displayed.

The "Vertical Radius" field controls the radius of the map.   It can take values ranging from 1° to 90º.   The total field of view of the map will be double the value entered here.

The "Right Ascension" and "Declination fields specify the coordinates of the centre of the map.   Right Ascension is entered in hours and minutes of time; declination in degrees and minutes of arc.

## Time

The time and date for which the map is drawn are initially set from the computer's clock for the instant that the Sky Area Map window is created. The Time option allows the user to display a map for any other time and date. When this option is selected, the "Observation Time" dialog is displayed.

Fill in the dialog fields for the time and date required. Pressing the "Now" button will read the time and date from the computer's clock.

Notes:

1. Although the map is drawn centred on a fixed point on the RA/Dec coordinate grid, the date and time are still used to calculate such things as planetary positions, and also, over long periods of time, affect which stars are visible on the map, due to the effects of proper motion and precession.

2. Dates before 1AD should be entered as negative numbers in the normal astronomical manner. Enter the year 1BC as "0", 1000BC as "-999", and so on.

3. Dates must be between 4000BC (-3999) and 8000AD, this being the range over which the program's calculations are valid.

4. Dates on or after 0h on 15th October 1582 are assumed to be in the Gregorian calendar; dates before then in the Julian calendar.

5. The observation time is assumed to be a local time - ie, the time as shown on an observer's clock. The time zone information specified on the Observation Location dialog (see below) is used to convert the time to UT.

## Observer

The Observer option allows the user to enter information about the location from which the observation is taking place.   When this option is selected, the "Observer" dialog is displayed.

The "Latitude" and "Longitude" fields specify the location of the observer.   Both are entered in degrees, minutes, and seconds although, unless extreme accuracy is required, a position correct to the nearest degree will normally suffice.

The "Conditions" information describes the atmospheric temperature and pressure at the time of observation.   This information is used to calculate the effects of refraction, so has no influence on the Sky Area map.

The "Local Time" data specifies the observer's time zone.   It is used to convert the time of observation (which is always assumed to be local time) into UT or GMT.   The time difference is entered in *minutes* (not hours!) difference between local time and UT.   For example, an observer on the east coast of the USA, whose clocks are set 5 hours earlier than GMT, should enter "300" (5 x 60) in this box, and click the arrow to change the text to "before UT".

The "Daylight saving time" box should be checked if DST (called "Summer Time" in the UK, and perhaps other countries too) is currently in operation.   If the box is checked, the local time is assumed to be one additional hour ahead of UT.

Notes:

1.   The reason that the time difference is entered in minutes, rather than hours, is that not all countries are exact hours ahead of or behind GMT.   India, for example, is 5.5 hours (330 minutes) ahead of GMT.

2.   The location of the observer is used by the Sky Area map when calculating the effects of "diurnal parallax" for nearby objects such as the Sun, Moon, and planets.   This is the difference in the apparent position of a nearby body against the star background as seen from different places on Earth.   In the case of the Moon in particular, the correction for diurnal parallax is important, and can alter the Moon's apparent place by up to 2 degrees - 4 times the Moon's apparent diameter!

## Stars

The Stars option controls which stars are plotted on the map, and also the way that plotted stars are displayed.   When this option is selected, the "Star Display" dialog is displayed.

The "Limiting magnitude of map" field determines the magnitude of the faintest star whose position will be calculated.   The higher the number, the fainter the stars which will be displayed (and the longer the map will take to compute).   The star database supplied with the program contains stars down to magnitude 7.0; the full SAO star catalog has stars down to magnitude 9.5 or so.

The "Limiting magnitude displayed" field determines the magnitude of the faintest star that will actually be displayed on the map.   Once a map has been drawn, you can change the value in this field to temporarily suppress the display of the fainter stars on a map, to remove "clutter".   The value entered in this field should be less than or equal to the value entered in the "Limiting magnitude" field above..

The lower half of the dialog box controls the way that the size of the star images varies with their magnitude.   All stars *brighter* than the first "Display mag" field will be displayed using the size of star circle shown to its right.   All stars *fainter* than the second "Display mag" field will be displayed using the size of star circle shown to *its* right.   All stars with magnitudes between these two limits will be drawn with an image size inversely proportional to the magnitude (ie, the brighter the star, the larger the image).

Notes:

1.   The number of stars rises *very* quickly with magnitude.   Generally, increasing the limiting magnitude by one magnitude will more than double the number of stars visible on the map, and consequently the time taken to compute their positions.

## Stars Labels

This option controls the way in which stars are labelled on the map. When selected, the "Star Labels" dialog box is displayed.

The way in which stars are named has evolved over hundreds of years. As a result, a lot of the brighter stars have many different names. The "Label Preferences" box allows the user to determine which, if any, of those names is displayed on the map.

"Proper Names" refers to the "popular" name of a star, such as "Polaris" or "Rigel".

"Bayer Letters" refers to the convention of labelling the brightest stars in each constellation with Greek letters, such as "Alpha Centauri" or "Beta Cygni".

"Flamsteed Numbers" refers to the convention of labelling stars in each constellation with numbers, such as "61 Cygni".

The "Label Options" box at the bottom of the dialog box determines which stars are labelled. If "All stars" is selected, then all stars which have the appropriate name will be labelled. If "Brighter than magnitude" is selected, then only those stars brighter than the number in the edit box will be labelled.

Notes:

1. This dialog only determines the way in which stars are labelled. If order to actually display star labels, the "Star Labels" option must be enabled on the "View" menu or the ToolBar.

2. If a star has multiple names, and more than one of the naming options is selected in the "Preferences" box, the name highest up the box will be displayed. Eg, if both the "Proper Names" and "Bayer Letters" options are selected, the map would display the name "Polaris" in preference to "Alpha Ursae Minoris" when labelling the pole star.

## Constellation Names

This option displays a standard font selector allowing the user to select the font used to write constellation names on the map.

## RNGC Objects

Selecting this option displays the "RNGC Options" dialog box, allowing you to determine which deep sky objects are displayed on the map.

The "Object Selection" box determines which catalogue will be searched to find objects to display; the entire RNGC catalogue or only Messier objects.

The "Object Types" box controls which objects will be displayed on the map, based on their type. If the "All objects" box is checked, then the other boxes in the group are ignored, and all objects which match the other selection criteria will be displayed. If the "All objects" box is not checked, individual types of object can be selected using the other boxes in this group.

The "Magnitude Limit" box allows you to control which objects are displayed, based on a magnitude selection. If "All Objects" is selected, then all objects matching the other selection parameters will be displayed; if "Brighter than mag" is selected, then only those objects brighter than the specified magnitude will be displayed.

Finally, the "Label Objects" box, determines whether displayed objects will be labelled. If the box is checked, objects will be labelled. Messier objects will be labelled "M" followed by a number (eg "M32"); other objects will simply have their RNGC catalogue number displayed (eg "1985" refers to the planetary nebula "RNGC 1985" ).

Notes:

1. This is a complex dialog box - the most complex in the program! - but it gives you the ability to exercise very fine control over the non-stellar objects which are displayed. For example, you can make selections such as "only display globular clusters in the Messier catalogue brighter than magnitude 11".

2. The program will only display those Messier objects that are in the RNGC. Four objects in the Messier catalogue are not in the RNGC, so will not be drawn. These are: M24 (a local brightening of the Milky Way), M25 (the open cluster IC 4725), M40 (the wide double star Winneke 4), and M45 (the Pleiades).

3. The RNGC is based on the NGC, compiled towards the end of the 19th century. As such, it contains many incorrect classifications, based on the information available at the time. For example, the Crab Nebula in Taurus, M1, we now know to be a supernova remnant, but the RNGC classifies it as a planetary nebula. The RNGC is, however, a catalogue of great historical significance, and no attempt has been made by the author to "correct" it.

4. The symbols used to draw non-stellar objects on the map have been based on those used in the authoritative "Uranometria 2000" star atlas.

## Colours

This option displays a sub-menu allowing the user to select the colours used for every item drawn on the map for either the screen or the printer.   When either "Screen" or "Printer" is selected, the "Horizon Map Colours" dialog box is displayed.

To view or edit the colour of any map component, either double click on the name in the listbox, or move the listbox highlight to the name and press the "Edit..." button.   Either way, a standard colour selector box will be displayed, letting you choose the colour for the item.

Notes:

1.   Pressing the "Cancel" button will restore all the colours to their previous settings, not only the colour just edited.

2.   The "Printer" colour settings only relate to the printing of colour maps.   Refer to the "Printing" topic for further information.

## Draw

Selecting this option will draw the map, using the current option settings.   You may press the <F5> function key as a "shortcut" for this option.

## Using the Sky Area Map

Once the Sky Area map has been drawn, it can be manipulated in various ways. Most of the options are the same as for the Horizon Map, so they are just summarised here for ease of reference.


Setting the Visibility of Objects
Changing the Map Scale
Identifying Objects on the Map
Zooming to an Area Map
Printing the Map

## Setting the Visibility of Objects

The top section of the "View" menu consists of a list of "toggles" controlling the visibility of various items on the Area map. Each item has a corresponding button on the ToolBar. If an item has a tick mark alongside it on the menu, or its button is in a "pressed" state on the ToolBar, it is currently visible on the map. If it does not have a tick mark, or its button is not pressed, it is not visible. The items are:

- Stars
- Star Labels
- Planets
- Constellation Figures
- Constellation Boundaries
- Constellation Names
- Right ascension/Declination Grid
- RNGC Objects

## Changing the Map Scale

The "Zoom In" and "Zoom Out" items on the "View" menu may be used to change the magnification of the map. The <F2> and <F3> function keys are shortcuts for these operations, as are the first two buttons on the ToolBar. When the map is first drawn, it is scaled so that the map exactly fills a maximised map window. Every time "Zoom In" is selected, the size of the map increases by 50%, and the map is redrawn. Every time "Zoom Out" is selected, the size is correspondingly reduced.

When the map is zoomed, the centre of the current window will remain stationary. You can therefore zoom in a particular feature by first scrolling it to the centre of the window, then repeatedly pressing the <F2> key. To aid this process, a shortcut method has been provided to bring a point to the centre:

1. Position the mouse pointer over the point on the map you would like to bring to the centre.

2. Press the *right* mouse button. A pop-up menu will appear at the mouse position.

3. Select the "Centre" item with the left mouse button. The window will scroll to bring the chosen point to the centre of the map.

Note that the map will not scroll past its edges (the boundaries of the full-screen normal size map). In order to bring a point to the centre of the map it may, therefore, be necessary to zoom in one or more times first.

## Identifying Objects on the Map

To display a dialog box showing information about any object visible on the map, move the mouse pointer over the object, and press the right mouse button.   A pop-up menu will appear.   Select the item you wish to identify.

Star Identification
Planet Identification
RNGC Object Identification

## Zooming to an Area Map

To display a new Area map centred on a particular point on the current map, position the mouse pointer over the required point and press the right mouse button.   Select "Area Map..." from the pop-up menu.

## Printing the Map

To print the map, choose the "Print" option from the "File" menu. This will display the "Print Options" dialog box.

The "View Options" box selects what type of map is drawn. If "Whole Map" is selected, the entire map will be drawn, scaled to fit onto the printer page. If "Current View" is selected, the current map view will be printed, at the current zoom factor.

The "Colour Options" box is used to select whether the map is printed in black and white or colour. If "black and white" is selected, all objects on the map are printed black, and the map background is left white. If "Colour" is selected, the map background is again left white, but the colour of all other objects is taken from the settings in the "Options/Colour/Printer" dialog.

When the <OK> button is pressed, a standard "Print" dialog is displayed. This allows you to select the printer, resolution, paper orientation etc in the normal way. Press <OK> from this dialog to print the map.

Notes:

1. By default, the map is printed in landscape orientation. If you wish to change this, use the "Print Setup" option.

2. The default "Print Options" settings of "Whole Map" and "Black and White" correspond to the way that maps were printed in previous versions of SkyMap.

3. The "Current View" printout is intended as a "quick and dirty" method of getting a printed map of a zoomed-in area of the sky, without having to draw a separate Sky Area map and print that. No attempt is made to properly scale the map to fit the paper size, draw borders, or anything else. If you have a very high zoom factor set, and try to print to a high-resolution device using this settings, problems may occur.

4. The "Colour" setting in the "Colour Options" box can be used to print a grey-scale map even on a black and white printer. The exact correspondence between colours and shades of grey will depend on the capabilities of the printer driver. This works beautifully on a PostScript laser printer; not so well on an Epson 9-pin dot matrix printer!

## Displaying Pictures

One of the most exciting features of SkyMap is its ability to display photographic images of astronomical objects.   You can build up your own collection of pictures which, together with the maps, can really bring the sky to "life", and which are a superb way to show astronomical objects to a novice on a cloudy night! (Here in England we get a *lot* of cloudy nights!)

In order to display pictures, you really need a "SuperVGA" display capable of displaying 256 or more colours at once.   You *can* display pictures on a standard 16-colour VGA display, but the results will probably be pretty horrible!

Picture Formats
Displaying Pictures Manually
Displaying Pictures Automatically
Obtaining Picture Files

## Picture Formats

SkyMap can currently display picture files in the following formats:

1. GIF files. GIF is probably the most popular of all image formats currently in use. The format was specifically devised to enable pictures to be easily transferred between different types of computer, and there are literally tens of thousands on pictures in GIF format available. SkyMap will display files in either GIF87a or GIF89a format, and can handle both interlaced and non-interlaced images. The only restriction is that only the first image in a file can currently be displayed. GIF files for the PC normally have an extension of "`.GIF`".

2. Windows "Bitmap" files. These are "device independent bitmap" files created for use with Microsoft Windows. They normally have an extension of "`.BMP`" (for uncompressed images) or "`.RLE`" (for compressed images). An increasing number of these files can be found on bulletin board systems, normally made available for use as Windows "wallpaper".

## Displaying Pictures Manually

From the "File" menu, choose the "Open Image..." item.   A standard file selector will be displayed, letting you select a file from any available drive or directory.   Pressing the <OK> button will create a new window in which the image will be displayed.

## Displaying Pictures Automatically

SkyMap has the ability to load and display pictures of certain object automatically. This can be done for all RNGC objects, as well as the planets, Moon, and Sun. In order to use this feature of the program, carry out the following steps:

1. Find a nice picture of an RNGC object or planet in any supported image format. You can use the "manual" method described above to look through pictures until you find one you would like to have as a "standard" picture for a particular object.

2. Copy the picture to the directory containing the SkyMap program, and rename the file to "`OBJECT.EXT`", where "`OBJECT`" is the name of the object, and "`.EXT`" is the "standard" extension for the image format - "`.GIF`" for GIF files and "`.BMP`" for bitmap files.

For planets, the name used should be one of the following:

```
SUN
MOON
MERCURY
VENUS
MARS
JUPITER
SATURN
URANUS
NEPTUNE
```

For Messier objects, the name should be "M" followed by the Messier number; "`M32`", for example.

For other RNGC objects, the name should be "NGC" followed by the RNGC catalogue number; "`NGC1530A`", for example.

3. Now, if you draw a map and click the right mouse button over an object for which a picture has been stored, you should find that a "Picture of <object>" item appears on the resulting pop-up menu. Selecting this item will display the picture in a new window.

Notes:

1. When you click on a object, SkyMap will first of all look for a file with a "`.GIF`" extension, and then for a file with a "`.BMP`" extension. If files with both extensions are present, the GIF file will be displayed.

## Obtaining Picture Files

There are many sources from which picture files (particularly GIF images) suitable for use with SkyMap can be obtained. Some of these are:

1. Commercial information services such as CompuServe or BIX. An especially good source is the CompuServe "Astronomy" forum (type "GO ASTROFORUM" from any prompt), which currently has more than 1000 astronomy and space-related GIF files available.

2. Bulletin board systems, of which there are a vast and ever-changing number. Some of these specialise in astronomy and carry a large number of GIF images.

3. Public domain and shareware software libraries.

4. If you have access to it, perhaps the best source of all are the <u>vast</u> resources of the Internet - a world-wide computer network. Take a look, for example at the machine "ames.arc.nasa.gov", in directory "pub/SPACE/GIFS".

5. Finally, if you get really stuck, I can supply you with GIF images for the cost of the disks plus a small handling fee. Refer to the separate registration form for details.

## Data Sources and Precision

The sources of the data used by SkyMap are as follows:

Stars
Planets and Sun
Moon
RNGC Objects
Time Corrections

## Stars

Smithsonian Astrophysical Observatory (SAO) star catalog, (SAO Staff, 1966), 1990 machine readable version, as supplied on NASA's National Space Science Data Center's "Selected Astronomical Catalogs, Volume 1" CD-ROM.

The SAO star catalog is a catalog of 258,997 stars to epoch J2000.0, and is reasonably complete down to magnitude 9.5 or so. The star database supplied with the shareware version of SkyMap contains all the stars from the SAO catalog down to magnitude 7.0 - a total of 15,931 stars. Larger databases, up to and including the full SAO catalog, can be supplied to registered users of SkyMap for a small fee - refer to the separate registration form for details.

SkyMap rigorously reduces star positions from mean to apparent place. The following corrections are applied:

Precession
Proper Motion
Nutation
Aberration

In the case of the Horizon Map, the apparent place is used to compute the local altitude and azimuth of the star, and the altitude is then corrected for the effects of refraction.

## Planets and Sun

The positions of the Sun, and the planets Mercury to Neptune are computed using a subset of Bretagnon and Francou's VSOP87 planetary theory, as described in the book "Astronomical Algorithms", by Jean Meeus (Willman-Bell, 1991).

Spot checks against recent editions of the "Astronomical Almanac" indicate that the mean error in the computed positions of the planets is under half a second of arc, with peak errors of about one arc second. For comparison, the apparent diameter of the planet Neptune is about 2", whilst that of Jupiter is typically 35".

## Moon

The position of the moon is computed from the ELP 2000-85 lunar theory (Chapront-Touzé and Chapront, 1988), which in turn is fitted to the DE200/LE200 numerical integration of the Jet Propulsion Laboratory (Standish, 1981).

Spot checks against the "Astronomical Almanac" again indicate that the mean error in the computed position of the Moon is about half an arc second, with peak errors around one arc second.

## RNGC Objects

For non-stellar objects, SkyMap uses the machine-readable version of the "Revised New General Catalog of Non-stellar Astronomical Objects" (Sulentic and Tifft, 1973), or RNGC. This is a modern, revised and expanded version of the "New General Catalogue of Nebulae and Clusters of Stars" (Dreyer 1888).

## Time Corrections

Because of the irregularities in the Earth's rotation, the theories of motion of astronomical bodies do not use Universal Time (GMT), but a uniform timescale called Terrestrial Dynamical Time (TDT). SkyMap uses TDT internally for all its calculation of planetary positions, etc, but obviously the user specifies the time for which a map is required in UT (or rather, in local time, which is converted to UT).

The difference between TDT and UT is called "delta T", and currently has a value of approximately 1 minute. It is currently increasing at a rate of somewhat less than 1 second per year. The problem is that the value of delta T can only be determined historically (typically by analyzing the motion of the Moon), and current and future values can only be estimated, whilst values for the distant past (before the advent of modern astronomy) are uncertain to the order of many minutes.

What this means in practice is that although the time of a total solar eclipse in the year 1500BC could be computed to a precision of a fraction of a second in TDT, the actual time in UT that the eclipse occurs (hence the places on Earth from which it is visible) will be uncertain to within several minutes.

The "Astronomical Almanac" lists the values of delta T for every year from 1620 onwards (currently up to 1992), and provides estimates of its value for the current time. SkyMap has all this data stored, and interpolates or extrapolates in this table to find values of delta T for dates between 1620 and 2000.

For dates beyond the year 2000, an estimate of delta T is made using the method of L V Morrison and F R Stephenson, "Sun and Planetary System" vol 96,73 eds. W Fricke, G Teleki, Reidel, Dordrecht (1982).

For dates prior to 1620, an estimate is made using the method of F R Stephenson and M A Houlden, "Atlas of Historical Eclipse Maps", Cambridge University Press (1986). They estimate the uncertainty to be 15 minutes at 1500BC.

## Dreyer Descriptions

The RNGC catalogue of non-stellar objects includes the visual descriptions used by Johann Dreyer in his "New General Catalogue", published in 1888. These descriptions are remarkable for their information content, but can be somewhat daunting at first. For example, the Dreyer description of the globular cluster M3 in Canes Venatici is as follows:

GCL,EB,VL,VSMBM,*11

This can be translated as "Globular cluster, extremely bright, very large, very suddenly much brighter towards the middle, composed of 11th magnitude stars" - a pretty good description in only 19 characters!

Similarly the galaxy NGC 2863 in Hydra is described as:

CF,S,E,BET2*12,16

which means "considerably faint, small, elongated, between two stars of magnitude 12 and 16".

The description normally starts with a description of the object's brightness and size. Dreyer adopted the scale used for this from Sir John Herschel, and the order used may be confusing to modern observers; for example, is "considerably faint" brighter or fainter than merely "faint"? The other possible source of confusion is that 19th century astronomers often called a faint star "small" and a bright star "large", so one always has to be careful to judge whether a description such as "pretty small" refers to size or brightness!

The scale used is as follows:

| Brightness | | Size | |
|---|---|---|---|
| EF | Excessively faint | ES | Excessively small |
| VF | Very faint | VS | Very small |
| F | Faint | S | Small |
| CF | Considerably faint | CS | Considerably small |
| PF | Pretty faint | PS | Pretty small |
| PB | Pretty bright | PL | Pretty large |
| CB | Considerably bright | CL | Considerably large |
| B | Bright | L | Large |
| VB | Very bright | VL | Very large |
| EB | Extremely bright | EL | Excessively large |

Next normally comes a description of object's general shape. This lies on a scale ranging from "round" to "extremely extended", as follows:

Code Shape

| | |
|---|---|
| R | Round |
| VLE | Very little extended |
| E | Elliptic or oval |
| CE | Considerably extended |
| PME | Pretty much extended |
| ME | Much extended |
| VME | Very much extended |
| EE | Extremely extended |

By far the most cryptic part of the description, at first glance, is the group of letters giving what Sir John Herschel described as "the degree and rate of condensation". A simple example is "GBM", meaning "gradually brighter towards the middle". Looking, though, at NGC 4725, a galaxy in Coma Berenices, we find the dreadful looking "VSVMBMEBN"! Even this mouthful, though, is fairly easily translated as "very suddenly very much brighter in the middle, with an extremely bright nucleus".

When the descriptions give directions on the sky, the terms "preceding" and "following" are used for west and easy respectively. To see what is meant by this, picture the way an object drifts across the field of view of a telescope if the drive is switched off. Use of these terms is much more natural at the telescope eyepiece than the very confusing west and east, given the way that optical systems invert and/or reflect the field of view.

Quite often the notes speak of groups. The "1st of 4" is the first member of a group of four nebulae to drift across the field of view ie, the most western one, preceding all the others. All members of a group will have very nearly the same declination.

The complete list of abbreviations used in the Dreyer description of an object appears below:

| Code | Meaning |
|---|---|
| AB | about |
| ALM | almost |
| AM | among |
| APP | appended |
| ATT | attached |
| B | bright |
| B | brighter (always coupled with another letter) |
| BET | between |
| BF | brighter toward following side |
| BIN | binuclear |
| BN | bright toward north side |
| BP | brighter toward preceding side |
| BS | brighter toward south side |
| C | compressed |
| C | considerably |
| CH | chevelure |
| CL | cluster |
| CO | coarse, coarsely |

| | |
|---|---|
| COM | cometic |
| CONT | in contact |
| D | double |
| D | diameter |
| DEF | defined |
| DIF | diffused |
| DIFFIC | difficult |
| DIST | distance |
| E | extended |
| E | extremely, excessively |
| EE | most extremely |
| ER | easily resolvable |
| EXC | excentric |
| F | faint |
| F | following |
| G | gradually |
| GCL | globular cluster of stars |
| GR | group |
| I | irregular |
| IF | irregular figure |
| INV | involved, involving |
| L | large |
| L | little (adv.), long (adj.) |
| M | middle or in the middle |
| M | much |
| MM | mixed magnitudes |
| MN | milky nebulosity |
| N | nucleus or to a nucleus |
| N | north |
| NEB | nebula |
| NF | north following |
| NP | north preceding |
| NR | near |
| P | poor |
| P | preceding |
| P | pretty (before F, B, L, S) (size and brightness blocks) |
| PG | pretty gradually |
| PLN | planetary nebula |
| PM | pretty much |
| PS | pretty suddenly |
| QUAD | quadrilateral |
| QUAR | quartile |
| R | round |
| R | resolvable |
| RI | rich |

| | |
|---|---|
| RR | exactly round |
| RR | partially resolved, some stars seen |
| RRR | well, resolved, clearly consisting of stars |
| | |
| S | small |
| S | suddenly |
| S | south |
| SC | scattered |
| SEV | several |
| SF | south following |
| SH | shaped |
| SM | smaller |
| SP | south preceding |
| ST | stars |
| ST9 | stars from the 9th magnitude downward |
| ST9...13 | stars from 9th to 13th magnitude |
| STELLstellar | |
| SUSP | suspected |
| | |
| TRAP | trapezium |
| TRI | triangle, forms a triangle with |
| TRIN | trinuclear |
| | |
| V | very |
| VAR | variable |
| VV | very very, an intensive of V |
| | |
| * | a star (or stars) |
| *10 | a star of 10th magnitude |
| ** | double star |
| *** | triple star |
| () | items questioned by Dreyer enclosed in parentheses |
| " | arc seconds (two "not-equals" in published catalogue) |
| ' | arc minutes (one "not-equals" in published catalogue) |