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Introduction

The accuracy of the astronomical data in AstroNav is similar to that used in compiling printed tables but the results will be noticeably better because simplification and interpolations are avoided.

A voyage plan allows sights to be combined while allowing for interim course alterations. Potential bodies can be considered up to the limit of the naked eye while the alternatives offered are sifted using altitude/ azimuth limits. Manual sight calculations can also be checked/ compared using the values expected from printed tables and manual methods.

The comprehensive list of stars used extends to the limit of ordinary binoculars. These can be plotted and magnified to provide a field of view of about 1°~1°.5 on the screen or double the magnification of 8x40 binoculars.

The "Fixed" screens use the same window but floating screens open in separate windows for use at the same time. For instance, AltAz might be open with a list of suitable bodies for a series of sights, the Star Atlas available to help identify them and the Sights screen open to receive details of each sight as it is taken.

Getting Started

The following sections will provide enough information for normal celestial navigation.

Basic Setup
AltAz
Star Atlas
Sights
Voyage Plan

Other screens can be explored when of specific interest.

Basic Setup

Entering Data

Degrees and Minutes

The Space and D keys are recognised as the separator between degrees and minutes. The +/ - keys, N/ S or E/ W keys can be used to change hemisphere.

Text

Ctrl & D will insert the degree character e.g. 123°

Ship's Time

This is entered as hours and up to two decimal places. 1.3 is interpreted as 1h 18m and 1.33 will give 1h 20m.

Dates

Date fields can be changed using +/ - keys

The month can be entered as a number e.g. 1 for January or by typing in the first three letters of the month. e.g. "jan"

The year can be entered as a one or two figure number, e.g. 06 for 2006 while the current year is between 1950 and 2049. For years between 1AD and 99AD, the year must be moved outside that range. Entering 100, and then 33 year will access 33AD.

To change between AD and BC or from the Gregorian to Julian calendars, click between the year and hour or on the time zone label.

Display of Information

The column order of most screens can be changed from the Options screen by holding the right mouse button down on an item and dragging it to a new position.

The Auto-Size option will resize all columns to fit the screen area if the selection is changed. This is useful when quickly switching columns but should usually be disabled when preparing to print.

Column widths can be changed within the screens by clicking and dragging borders.

Right-clicking a column heading offers quick access to some layout options.

Printing

Print output is determined by the current screen layout. Relative column widths are preserved for most screens and then sized to fit the paper's width.

The Almanac screen will be printed on a single page using Landscape or on two pages if the printer is set to Portrait.

Initial Settings

The date/ time and time zone are initially taken from the computer's settings but other inputs such as position need to be defined. These are set from the Options screen.
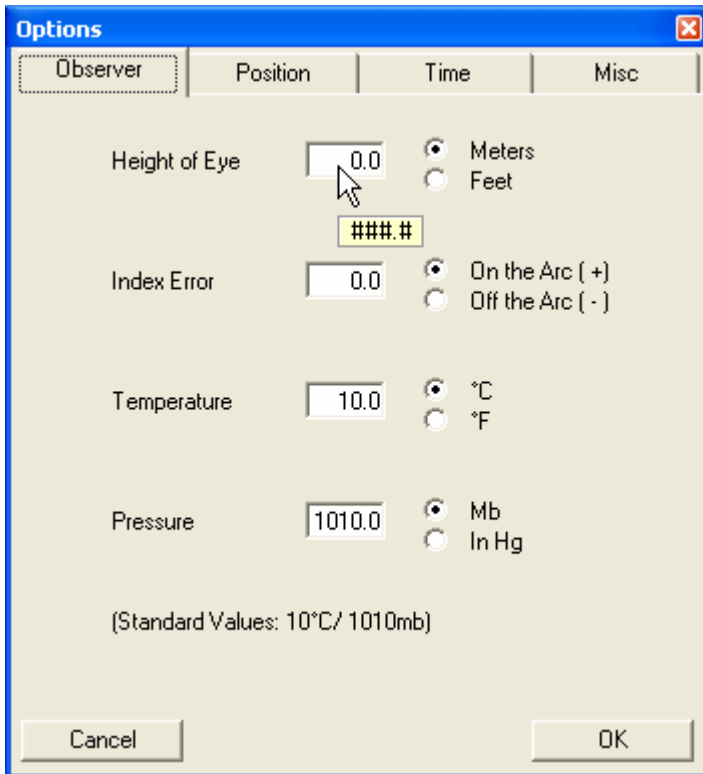
Moving the mouse over data entry areas will give a description of the format required and any delimiters necessary. In the screen shot above, the popup below the Height of Eye box shows the format with # used to indicate a numeral thus ###.# might be 123.4.

The tabs shown by calling Options from the Main screen (as above,) are common to most other screens, and any changes will affect them as well. The other screens have additional tabs relevant to them.

Positions

Most information in the program is based on a position which is determined by the method selected from the Position tab. The same method is used by all screens.

⚠ next to a date in the main screens shows that the position generated may be invalid. This happens when a single track is in use for more than one year or the track reached a latitude of 90°. It also occurs when a voyage plan is in use but the date is outside the voyage. In this case either the first or last position will be used as appropriate.

AltAz (Altitudes & Azimuths)

AltAz can be used for simple sight planning or to search around a point on the celestial sphere. Modifying the bodies to show, columns displayed and then sorting the results will quickly identify the items of interest.

Restricting the selection to the main stars is recommended when planning a sight as these are least likely to have other stars nearby.
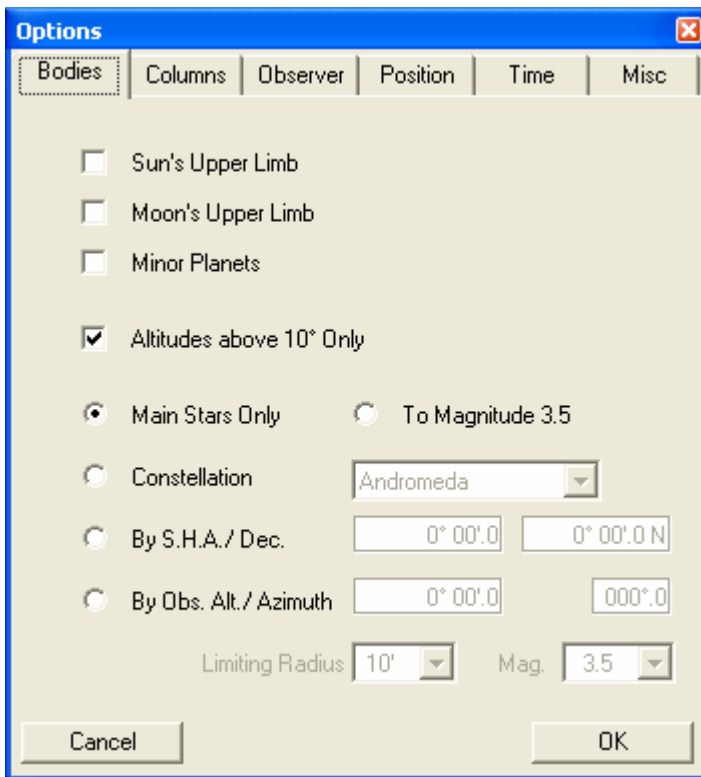
The column content can be sorted by right-clicking on the column heading and selecting the order.
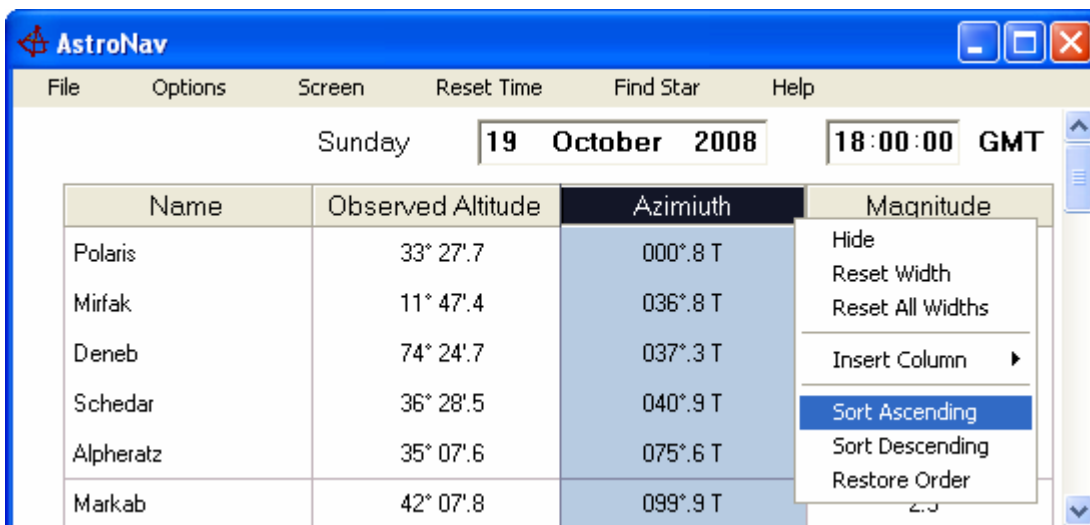
AltAz (Continued.)

The Altitude column heading will show Sextant, Observed or Apparent altitudes depending on which corrections apply. The Sextant Altitude is given if Index Error applies and the Observed Altitude is given if a Height of Eye is in use. If neither correction applies then it is labelled Apparent Altitude.

The Constellation selection is confined to bodies that have a Bayer, Flamsteed or Variable designation e.g. 21 Alpha Andromeda or CG Andromeda. It does not include all bodies within that constellation. Generally stars with these designations are visible to the Naked eye (brighter than Magnitude 6) though not all stars visible to the naked eye have designations.

Only one designation will be shown. The order in which they are chosen are Bayer, Flamsteed and finally the GCVS designation.

More detailed information is available for any star using the Find Star screen. (This can be called for any particular star by right clicking on the appropriate row.) The Solar Bodies screen fulfils the same purpose for the Sun, Moon and planets and also provides data over a period.
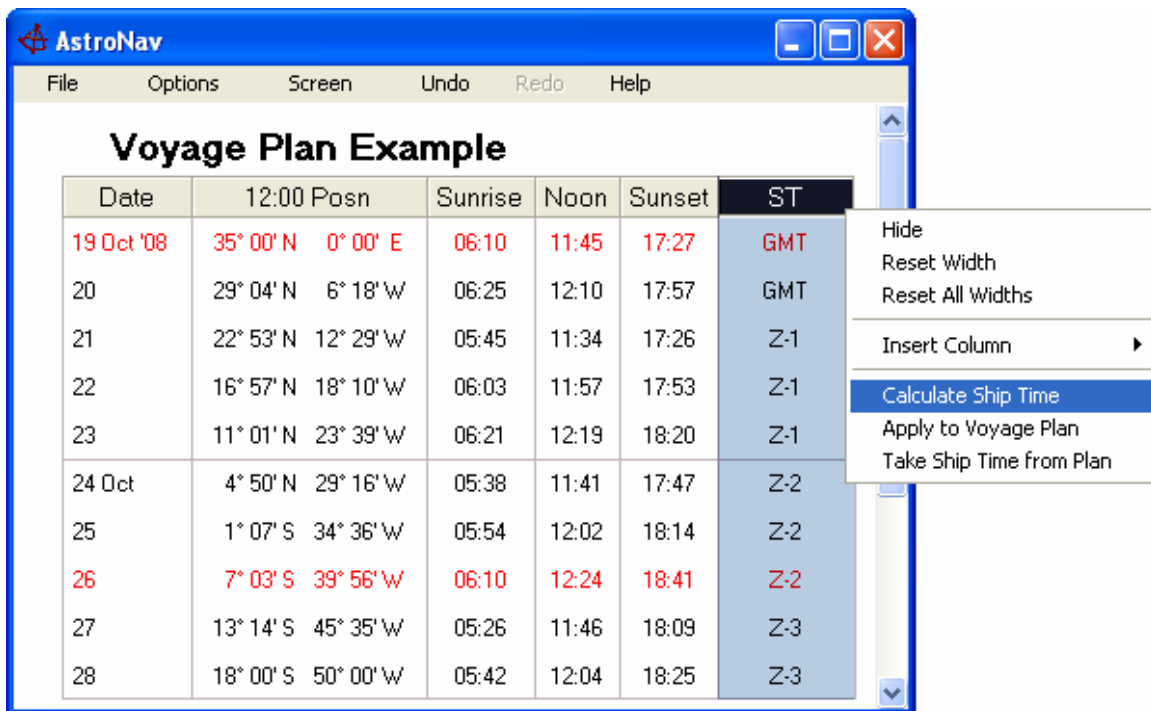
Note that the "Radius" column is only used when a search around a point is being used. Furthermore, the search radius is applied without allowing for any differences in refraction.

Clocks (Twilights)

The days for which information is shown depends on whether a voyage plan is in use. If one is in use then information is shown for the duration of the voyage. Otherwise the month ahead is displayed.

Ship's Time can only be modified when a voyage is in use. When a fixed position or single track is in use, ship's time is determined by the time zone settings in use. This includes summer time changes if appropriate.

The column order cannot be changed but, with the exception of the date, the display of other columns is optional. Sundays are always shown in red.

"Calculate Ship's Time" sets Noon (Meridian Passage) between 11:30 and 12:30. This can then be modified for weekends or to adjust the time of Civil Twilights to suit the working day.

Times for Sunrise, Sunset and Noon can be shown to the nearest second. Twilight times are always rounded to the nearest minute. (See Refraction.)

Standard Altitudes for Sunset and Sunrise
Most tables use a true altitude of 50' below the horizon to calculate the time of Sunrise and Sunset. This can be adopted using the Options/ Misc tab.

Unless "Standard Altitude" is adopted then current settings for dip and refraction are used. In that case corrections for the Sun's actual semi-diameter and parallax are included.

Note that changes to Ship Times using the Voyage screen will reset the Clocks screen.

Main/ Initial Screen

This provides an overview of the day. The position, and therefore magnetic variation, is for the time displayed at the top of the screen. The other data is based on the calculated position at the time of the event.
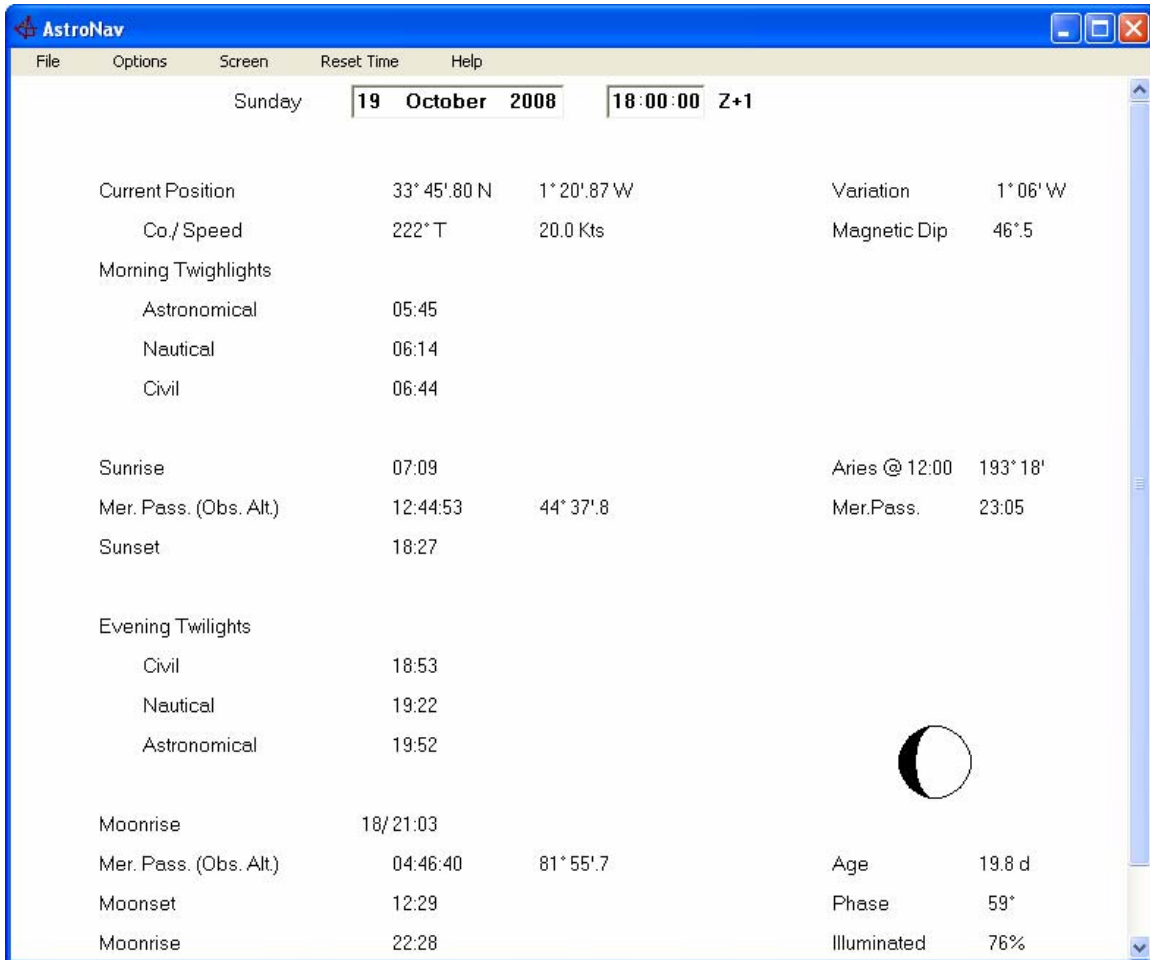
If the positions may be invalid then ⚠ will be appear next to the date.

"Standard" values can be used for the times of rising and setting. These use the simplified assumptions of printed tables. (Options/ Misc.)

If "Standard" values have been chosen, then Sunrise, Sunset, Moonrise and Moonset are given as hours and minutes. Otherwise, seconds are shown and all corrections, including Dip, are applied. Quoting twilight times to the nearest second would be misleading due to the unpredictability of refraction.

The type of altitude at meridian passage i.e. Sextant, Observed or Apparent is shown. The Sextant Altitude is given if Index Error applies and the Observed Altitude is given if a Height of Eye is in use. If neither correction applies then it is labelled Apparent Altitude.

Moon Phases & Eclipses

The Eclipse diagram can be toggled between a map showing the areas affected and a plan showing the passage of the shadow.
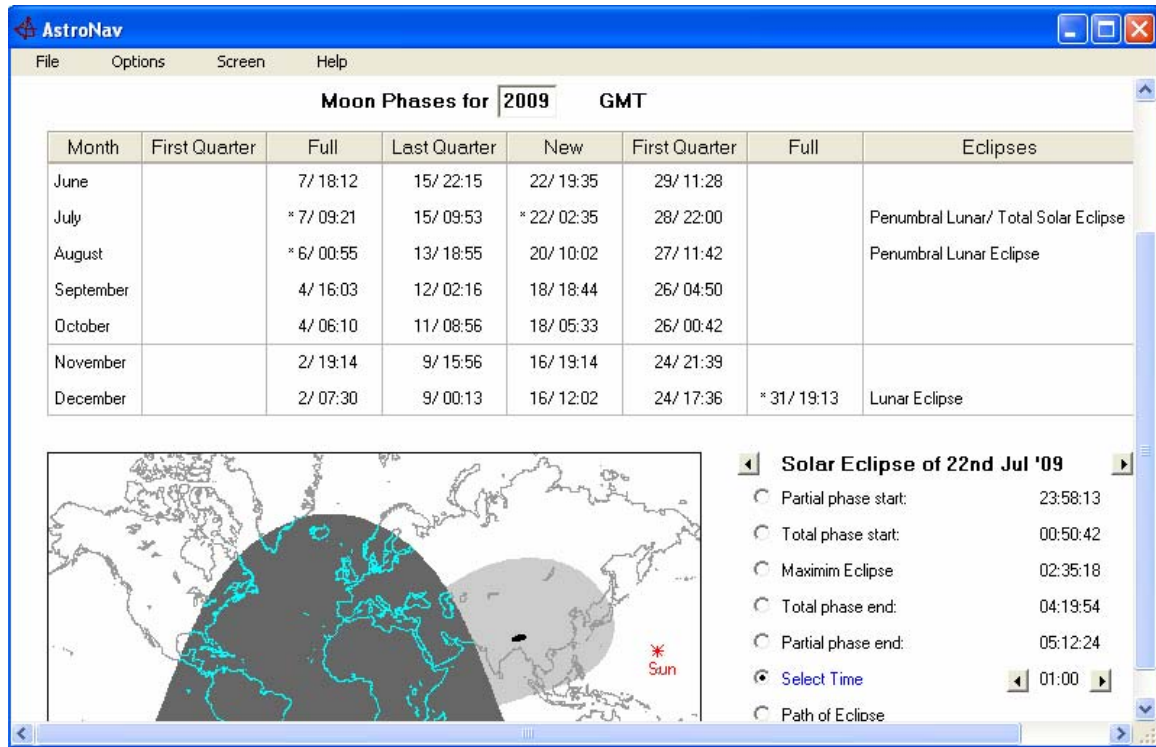
The Map view allows the circumstances of the eclipse to be progressed in one minute intervals. Selecting "Path of Eclipse" involves intensive calculations and may be slow.

Eclipse Terms

Annular Eclipse
The Sun's semi-diameter is greater then the Moon's which allows the Sun's outline to be seen.

Total Eclipse
The Sun is totally obscured by the Moon because the Sun's semi-diameter is less than the Moon's.

Hybrid Eclipse
The eclipse changes between an Annular and Total eclipse during the event.

Umbra
The area (in space) where the Sun is totally obscured by the Earth

Penumbra
The area where the Sun is partially obscured by the Earth. (The Moon is darkened rather than obscured during a Penumbral Eclipse.)

Solar Bodies

The available columns are similar to AltAz but arc-seconds can be shown. There is also an additional column for the distance from the Earth. Except for the Moon, this is given in Au. (Astronomical Units - the mean distance between the Sun and Earth.)

Sun's Lower Limb

Sunday 19 October 2008 12:00:00 GMT

Date	Time	Latitude	Longitude	Obs. Alt.	Azimuth	GHA	Dec
19 Oct '08	12:00	35° 00'.0 N	0° 00'.0 E	44° 29'.1	185°.2 T	3° 46'.8	10° 12'.8 S
	13:00	34° 45'.2 N	0° 16'.3 W	41° 33'.8	204°.7 T	18° 46'.9	10° 13'.7 S
	14:00	34° 30'.3 N	0° 32'.5 W	35° 07'.3	221°.4 T	33° 47'.0	10° 14'.6 S
	15:00	34° 15'.5 N	0° 48'.7 W	26° 13'.8	234°.7 T	48° 47'.1	10° 15'.5 S
	16:00	34° 00'.6 N	1° 04'.8 W	15° 47'.8	245°.4 T	63° 47'.2	10° 16'.4 S
19 Oct '08	17:00	33° 45'.8 N	1° 20'.9 W	4° 30'.7	254°.4 T	78° 47'.4	10° 17'.3 S
	18:00	33° 31'.0 N	1° 36'.9 W	-	262°.6 T	93° 47'.5	10° 18'.2 S

Voyage Plan

A plan is the most versatile method of providing positions as it allows for changes in course and speed.

Data is presented as it would be written. Positions and speed do not show the second decimal place when it is zero and time related columns will not show the day unless it is relevant. Leading zeros are cropped in most cases to improve presentation and legibility.

Way Points can be entered directly or calculated by entering a course and distance from the previous one.

The speed at the top of the screen (between ETD and ETA) is a default speed that will automatically be applied to new tracks. Alternatively, the speed for each leg can be entered directly, calculated by changing the ETA for a row or by changing the final ETA at the top of the screen.

The title and descriptions accept any keyboard characters. The degree symbol [°] can be inserted by pressing Ctrl + D.(e.g. "Fairway Buoy 125°T @ 3'.2 ") A second line for additional remarks is available as required.

The ID and WPt columns record personal references. The ID column accepts up to 6 characters. The Way Point number may be any number between 1 and 999. F, G, R and V can be used in the WPt column to indicate the source of positions. These show as Fix, GPS, Ra or Vis.

Locking Rows

Changing the default speed or any of the ETAs will change the speed for all rows unless a way point is "locked." Fixes should therefore be locked to prevent inadvertent recalculation. Locked row shows in Magenta while the earlier, disabled rows, are shown in blue.

The only item that is not affected is Ship Time which allows ETAs to be planned and then the ship's clocks to be modified separately.

<u>Voyage Plan (Continued)</u>

<u>Time Zones</u>
The Time Zones for the main ETD and ETA at the top of the screen can be set from the Options/ Times tab. The ship's times used by the first and last way points are independent of these.

Ship's time can be entered for each way point directly or the Clocks screen can be used to set clocks according to the expected times of Noon or Civil Twilight.

Ship's times determined/ modified using the Clocks screen, may be transferred back to the plan directly. New way points are created, if necessary, for 02:00 old time and other way points are set with the appropriate time offsets.

<u>Data from Sights</u>
Positions can be inserted from the Sights screen regardless of the type of position or if the plan is in use. If the plan is being used as the source for positions then the change will be applied to any sights that are affected.

<u>Speeds</u>
There are three fixed speed columns for ETA and TTG (Time to go.) These and the default speed are set from the "Voy. Plan" tab in Options.

<u>Using a Plan</u>
A plan must be set as the programme's default and **then** set as the position source separately. The assumption is that the plan will be compiled/ considered before it is used.

The default plan is loaded automatically on start-up but need not be discarded to use a different position method.

If a plan is in use as the position source but a date is selected elsewhere that falls outside the plan then either the first or last way point's position will be used as appropriate. The main screen will show a "DR Error" instead of the current course and speed and ⚠ will appear by the date(s) in other screens.

<u>Distances</u>
090°/ 270° distances are calculated for the ellipsoid rather than using dLong x Cos(Lat) which assumes a sphere. Distance is measured in Nautical Miles according to the historical definition of one minute of Latitude. (1,852m is a mean whereas one minute of latitude varies between 1,843m and 1,861m between the equator and poles.)

Almanac

The Almanac screen follows the layout and simplifications of published tables. The main difference is that data covering all three days is always taken for the second/ middle day of each page. Star positions in published tables are usually for the first day but some items such as the passage of Aries vary.

There is a cost in accuracy when presenting the data in an accessible format. The main cause is averaging "v" and "d" corrections. A cursory examination of the Sun's GHA in April or October will show that a "v" correction should apply. In fact all the Sun's GHAs are adjusted to reduce the effect of ignoring a "v" correction. Other "v" and "d" corrections are treated in the same way. The maximum error should be less than 0'.2.

The simplifications mean that entries may not agree with other screens but should agree with published tables for 99.5% of entries.

Errors can be found in published tables but are seldom corrected by "Errata." Venus's position on January 1st prior to 2006 is easily identified but others exist.

High Precession Sources

The divergence from "scientific" data sources such as the Astronomical Almanac should be less than 0".1.

The "Astronomical Details" available in "Manual Calculations" may be used to reconcile entries to high precision sources.

Sights

The initial time in Sights will be the same as the other screens when it opens. File/ New Set will clear any entries and reset the times.

Multiple sights can be calculated and plotted while allowing for a change in position. Seven are available for screen widths up to 1280 pixels and nine above that. This is to minimise the need to scroll the screen.

After an altitude and azimuth have been entered, a selection of bodies is offered showing the intercept and magnitude. Sights' Options allows the selection to be controlled by Magnitude and/ or deviation from the altitude or azimuth entered. The selection will not include stars when the Sun is definitely above the horizon. "Definitely" is determined by the altitude filter setting.
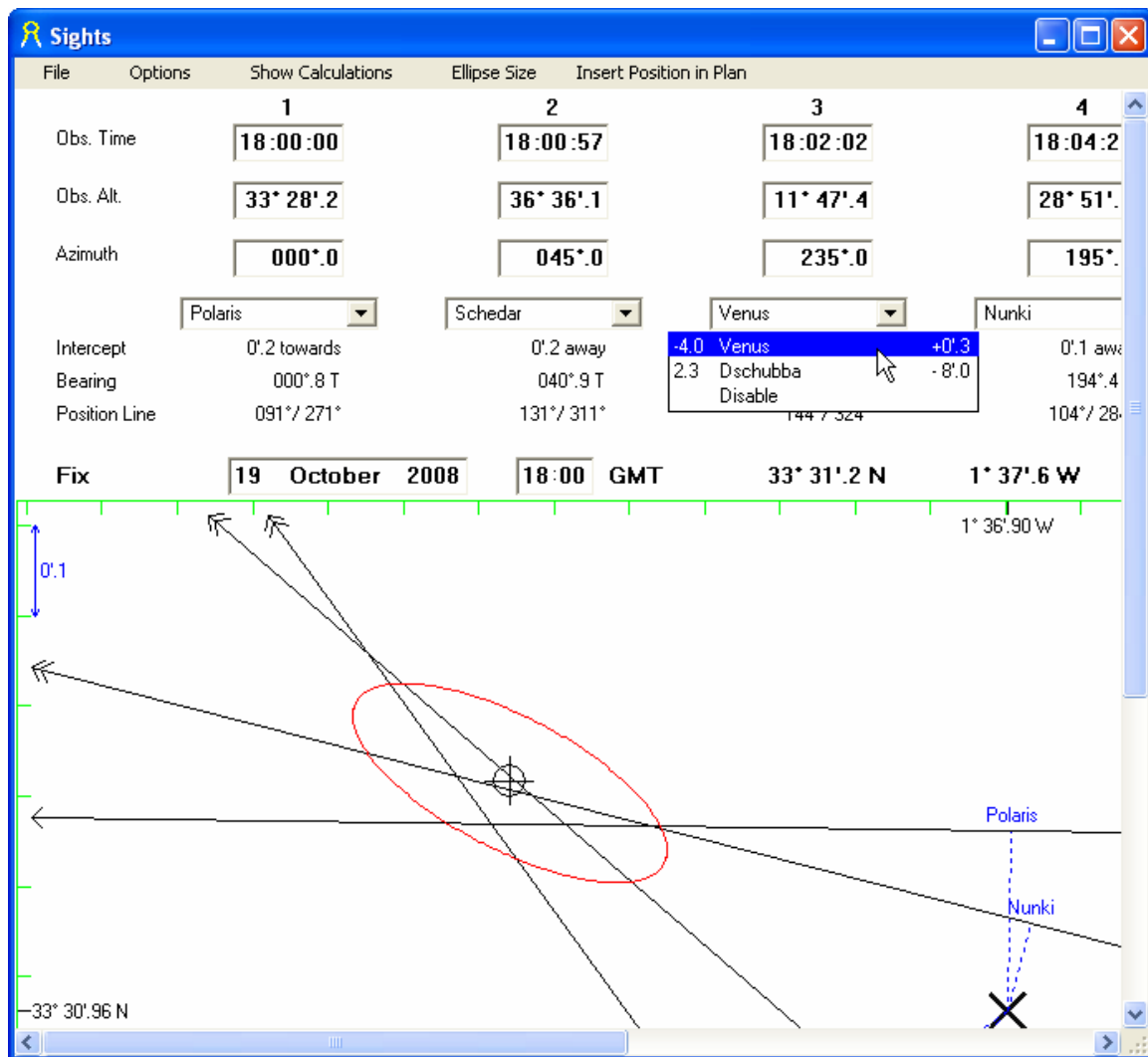
In the example, Venus, with a magnitude of -4.0, has an intercept of 0'.3. Dschubba also satisfies the criteria applied. These were stars brighter than magnitude 3.5, +/- 10' in altitude and +/-20° in azimuth. Either alternative may be accepted or the sight may be disabled/ discarded from the fix calculation if considered unreliable.

Sights (Continued)

The scale in use is indicated by the blue line on the left-hand side/ near to the top of the plot. This can be changed by left/ right clicking on the plot.

The estimated (DR) position is marked by a thick, diagonal cross and the mean intersection of the position lines is shown by an encircled cross. A red confidence ellipse is drawn around the calculated position once three sights are in use. Its shape and size will vary according to the dispersal of the position lines and their angle of intersection.

The confidence ellipse sizes are calculated using 98% (large,) 90% (medium) and 67% (small) probability methods but the sample size is too small for the probability to be reliable.

After consideration of the results, the position can be transferred to the voyage plan. If the plan is being used to generate positions then any resulting change in track/ DR will be reflected in the plot. Care should be exercised in iterating the results using a voyage plan for positions and inserting revised fix positions in it. It is very easy to coerce a series of position lines into a tight group around an erroneous position. The underlying cause of the difference should be addressed as a separate issue.

Saving and Reloading Sights
Sights are saved together with current settings. When reloading sights, the date/ time and settings for all screens will revert to the values for those sights. If a fix was inserted in the voyage plan then it should be deleted to restore the original intercepts/ position lines.

Comparison with Manual Calculations
"Show Calculation" can be used to compare results with a manual calculation. It provides a breakdown of each sight together with errors due to the simplifications/ rounding errors inherent in manual methods.

Star Atlas

This opens in a separate window to allow side by side comparisons.

The brightness of the stars can be controlled using a mouse-wheel. [icon] and [icon] fulfil the same function.

The Options screen is available without disabling the plot. This enables the presentation to be changed easily but it can also be hidden to reclaim screen area..

Names or designations will only apply to stars selected for details. Similarly the information pop-up will only respond to those stars.
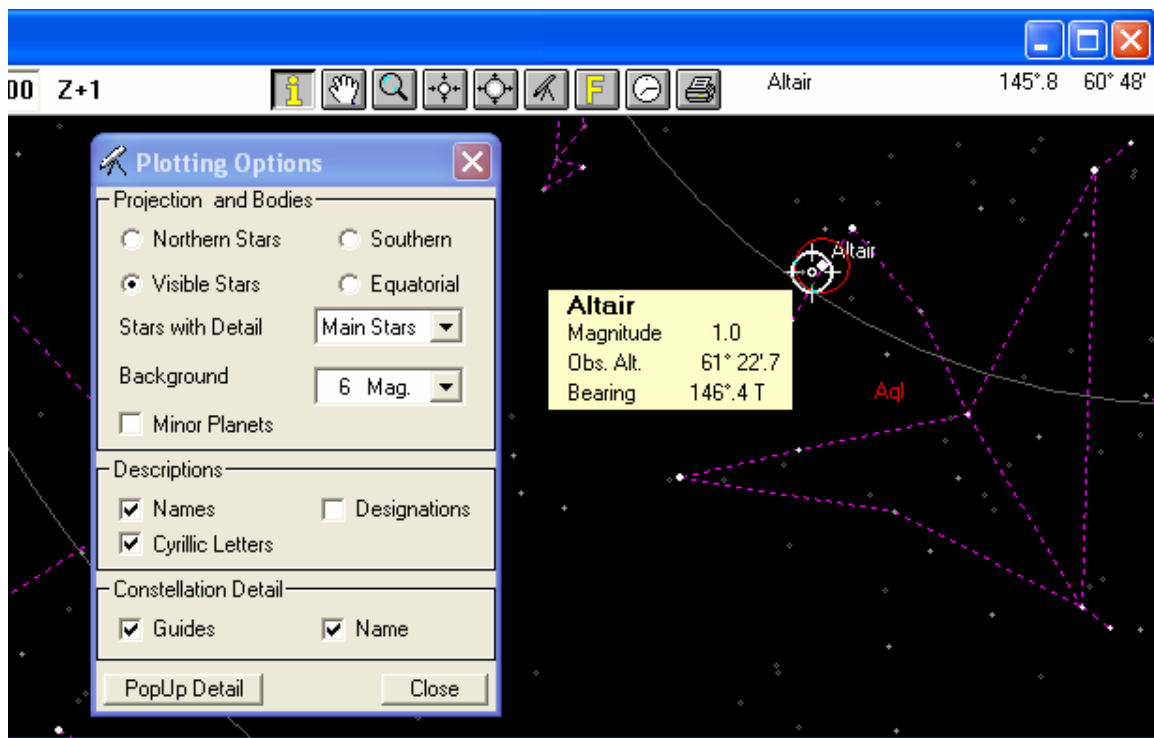
[icon] is used for information. The mouse pointer changes to a white target circle over the plot. As the mouse moves over stars for which detail has been selected, a red circle appears around them. If the mouse is stopped then the information pop-up will appear.

[icon] allows the plot to be dragged by holding down a mouse button and moving the mouse. Holding the <Shift> key down has the same effect in other mouse modes.

[icon] is to magnify the plot. A left click zooms in and a right click zooms out. Holding the <Ctrl> key down has the same effect.

[icon] reopens the option screen, [icon] resets time to the present and [icon] prints the current screen view

Find Star

This supplements the AltAz and Star Atlas to provide access to all of the information for all of the stars available. The lists are therefore extensive but a quick way to bring the combo boxes in range is to press the first letter of the item sought.
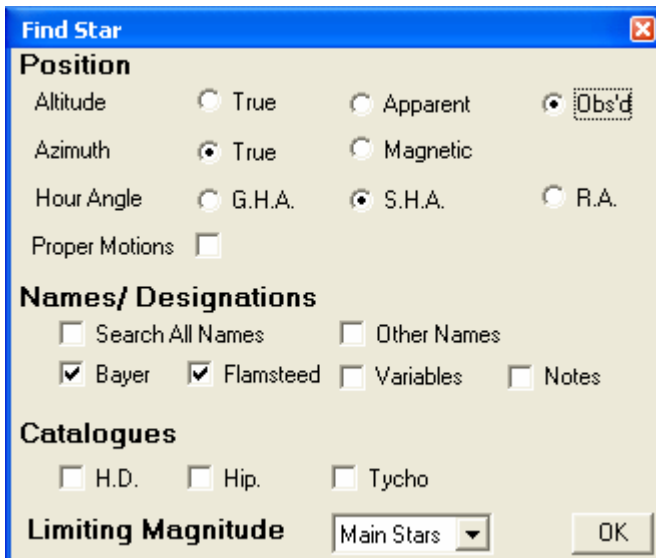
Find Star's options filter the information and restrict the search capabilities by magnitude. Thus if the Limiting Magnitude is set to Main Stars then the combo boxes will only contain these and the constellation list will exclude minor constellations such as Sextans.
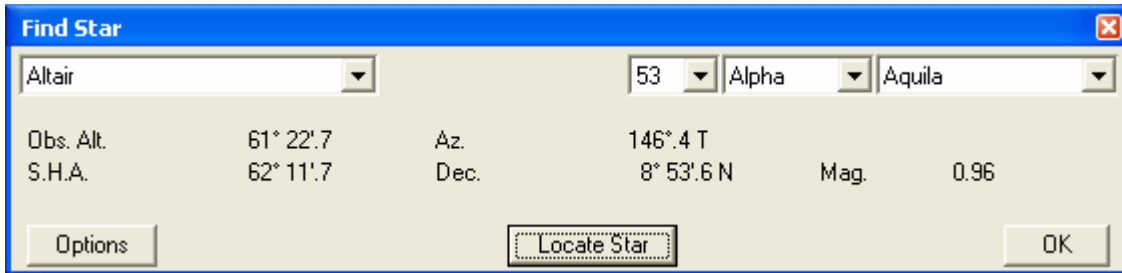

Every star has a Tycho catalogue reference but some of the other catalogue designations may refer to more than one star in the Tycho catalogue. Similarly the other catalogues are incomplete so that a star may not have a reference.

Entering a designation that is beyond the magnitude limit will move to the nearest entry. The limit will not be automatically increased by an inadvertent entry.

Tycho designations must be deliminated by either a space or a hyphen.

Arc-seconds are only shown when Right Ascension is in use.

Find Star (Continued)

LOCATE STAR
The "Locate Star" button is used in conjunction with the Star Atlas to bring the star into view. It will increase the background stars sufficiently to display the star if necessary but is disabled if a star cannot be shown using the current projection.

Manual Calculations

This allows long-hand calculations to be reconciled with the results of the Sights screen. Each value is rounded to one decimal place and the net effect can be shown for the TZD and Intercept.

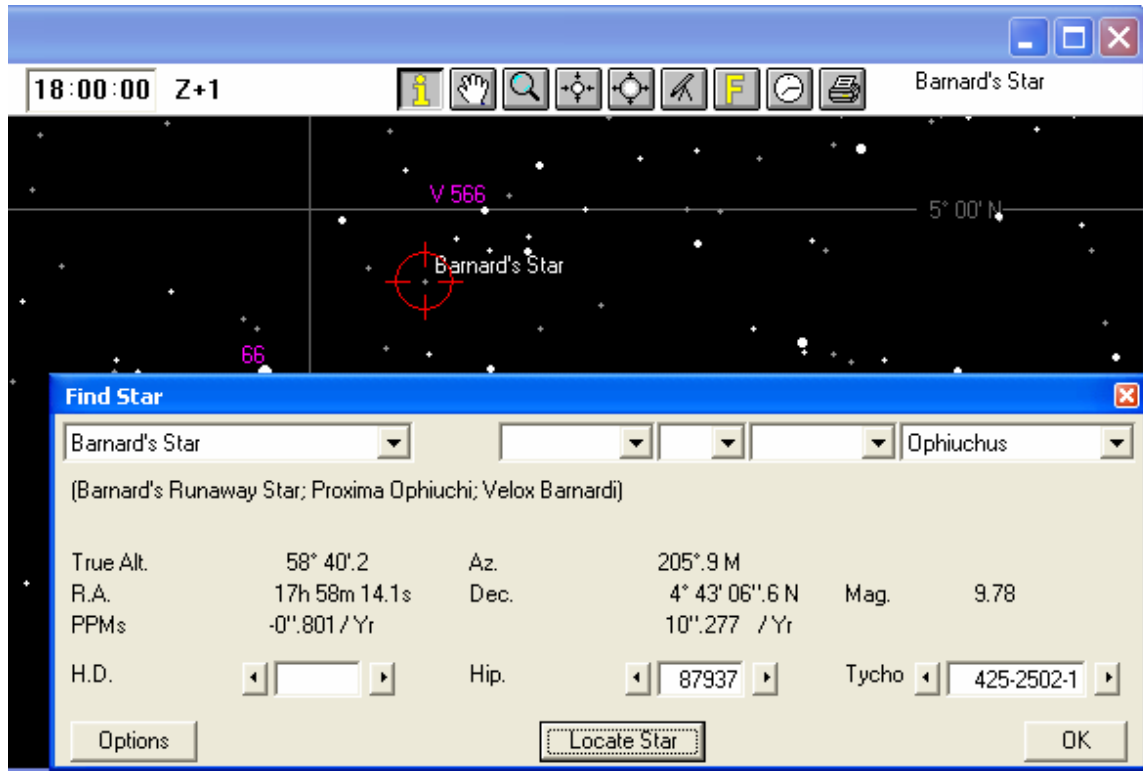Astronomical values are based on the Almanac simplifications. Other values are generated against common formulae used by tables and/ or abridged methods.

Sight Calculation

File   Position Options   Sight Options   Detail

Sight 3   19 October 2008   18:02:02   Course 222.1°T   @ 20.0 Kts

Venus

Original Position Time	12:00:00	Observed Altitude	11° 47'.4	GHA	59° 46'.2
Run Time (Hours)	6.03	Index Error		Increment	0° 30'.5
Distance Run	120'.6	Dip	-5'.6	v Corr'n	0'.0
		Apparent Altitude	11° 41'.8	GHA	60° 16'.7
Original Latitude	35° 00'.0 N	Refraction	- 4'.6	DR Long	1° 37'.4 W
dLat	1° 29'.5 S	True Altitude	11° 37'.2	LHA	58° 39'.3
DR Lat	33° 30'.5 N				
		Semi Diameter	00'.1	Declination	21° 29'.2 S
Mer Parts (New DR)	2,123.29	Parallax		d Correction	0'.0
Mer Parts (Original DR)	2,231.08	True Altitude	11° 37'.3	Declination	21° 29'.2 S
DMP	-107.79				
		True Zenith Distance	78° 22'.7	True Zenith Distance	78° 22'.7
Original Longitude	0° 00'.0 E	(TZD Error	0.8")	Calculated Zenith Distance	78° 22'.9
dLong	1° 37'.4 W			Intercept	0'.2 Towards
DR Long	1° 37'.4 W			(Total Errors)	- 8''.5)
				A	0.40 S
				B	0.46 S
DR Lat	33° 30'.5 N			C	0.86 S
dLat	0'.1 S				
ITP Latitude	33° 30'.4 N			Bearing	S 54°.4 W
				Azimuth	234°.4 T
Departure	-0.2				
Cos(Mean Lat)	0.8338			Position Line	144°/ 324°
dLong	-0.2				
DR Long	1° 37'.4 W				
dLong	0'.2 W				
ITP Longitude	1° 37'.6 W				

The DR position and ITP may be calculated using Plane or Mercator Sailings. The "Clarke 1866" ellipsoid is offered as an option as this is used by most tables to calculate Meridional Parts.

Inclusion of minor corrections is adjusted using the "Sight Options" menu.

0.96/ Tan(Alt) or expected tabular values may be used for refraction above 11°. For lower altitudes, more complex formulae are inevitable. (See Refraction.)

The rounding effect can be shown from the "Detail" menu. There is also an option to show the Astronomical Data necessary to reconcile GHA and Declinations to high precision sources such as the Astronomical Almanac.

General Notes

ACCURACY

Positions for the Sun, Moon and most Planets are within 0".1 between 1900 and 2100. Accuracy will deteriorate beyond these dates to about a minute of arc two thousand years either side of these dates. Pluto's accuracy is lower at 0".2 and will deteriorate faster.

The positions and proper motions of stars are accurate to within milliseconds for the present era, but the definition of magnitude can vary. (cf Stellar Magnitudes and Catalogues.)

Names, Bayer designations and principle names for a star vary between sources. There is no definitive source and therefore the choices were sometimes subjective.

Comets are not included because frequent updates would be necessary for their positions/ track to have any validity.

CATALOGUES

General Catalogue of Variable Stars (GCVS)

A few stars retain their Bayer notation though most have capitalised Roman letters such as R, CG or V123. NSV designations apply to stars that had not been positively identified as variables by 1980. NSV stars are not referenced to constellations.

Mean Hipparchos/ Tycho magnitudes are used which sometimes conflict with the GCVS data. Furthermore, not all GCVS entries could be reconciled even when catalogue identifiers were given.

Henry Draper (HD)

Though some of the content has been superseded, the HD identifier is widely used as a reference. Some HD numbers apply to two Tycho entries and sometimes the same star has more than one HD identifier.

As with the majority of catalogues, the Henry Draper catalogue contains only a fraction of stars. The Tycho2 catalogue contains two million stars whereas the Henry Draper catalogue, including the extension list, contains only 358,881 to a similar magnitude.

Hipparchos

Some Hipparchos entries were resolved into different entries in the Tycho2 catalogue. When this is the case, a Find Star search using the Hipparchos reference will identify the brightest star but the others will show the original Hipparchos identifier when the Tycho designation is used as the search criteria.

Tycho

The Tycho numbering system follows the "Guide Star Catalogue" method. The first part of the designation refers to a region followed by the star's number within that region. The third field is a component identifier. (e.g. 123-4567-2)

The Tycho 2 catalogue was the primary source of stellar data. This catalogue was the result of collaboration between the University of Copenhagen and the USNO analyzing data from the European Space Agency's Hipparchos satellite.

DATES

<u>AD/ BC Dates</u>
There is no 0 BC/ AD but astronomical years do have a 0. 1 BC is 0 in astronomical years.

<u>Julian and Gregorian Calendars</u>
The adoption of the Gregorian calendar began on 5th October 1582 according to the Julian calendar or 15th October by the Gregorian calendar. Adoption of the Gregorian calendar was gradual and some countries did not change until 1919. (It is still used by the Orthodox Church.)

Dates prior to 15th October 1582 are calculated according to the Julian calendar. After that date, the Calendar to use is optional. "Julian" will be displayed by the time zone when the Julian calendar is in use.

<u>Ephemeris Time (ET) or Terrestrial Time(TT) and Barycentric Time (TDB)</u>
The offset from GMT to ET/ TT is known as Delta Tau. This can only be calculated by observation. TDB in turn, is slightly offset from ET to the centre of the Earth/ Moon barycentre. TDB is used to calculate the position of Solar System bodies but GMT is used for Aries.

Estimates are used between 1000 BC and 2100. Beyond those dates, the program defaults to GMT. (Delta Tau is assumed to be zero.) This will cause a small misalignment between the stars and the planets.

<u>Julian Day</u>
This is only available from the Manual Calculations page when the option to display astronomical data is used.

The Julian Day is the number of days since 12:00 January 1st, 4712 BC and is a surrogate for the date in high precision astronomy. 12:00 on January 1st, 2000 is JD 2,451,545 and is sometimes quoted as JD 2000.0.

DESIGNATIONS

Where a name or designation can be applied to more than one star then it is usually applied to the brightest star. There are a few cases where designations may apply to either of two stars in which case both are preserved. Suffixes such as α1 and α2 are avoided unless the stars have separate Flamsteed designations.

Only one designation is usually displayed. The Bayer designation is used by preference, followed by Flamsteed and finally the GCVS designation.

The Bayer and Flamsteed lists began as catalogues but the designations have subsequently been extended piecemeal so that there is no definitive catalogue anymore.

Bayer
These are α to ω, a to z and A to P. The original concept was that they were listed by magnitude. Therefore α was brighter than β etc. Designations beyond "R" and double letters are variable designations.

Flamsteed
These are the numeric prefix to the constellation e.g. 21 Centaurus. They were originally assigned in order of their Right Ascension within the constellation.

GCVS
Designations from the GCVS are often used in star charts and therefore included. (See Catalogues.)

DOUBLE STARS

Stars may be optical doubles which means that they cannot be visually differentiated and/ or binary doubles where they are connected by gravity.

Many further doubles remain to be discovered/ resolved as techniques improve. Conversely as the intended user is assumed to be using binoculars, some stars that will appear as a single star have been recombined.

Non-binary double stars with different proper motions were included/ excluded on the basis of their separate magnitudes. Binary doubles closer than 2".5 were combined. (This is the assumed threshold for differentiating two stars using binoculars.)

The ability to differentiate stars with binoculars means that some stars such as Acrux, Arcturus and Castor have separate A/ B entries. Acrux whose two major components are 4" apart at magnitude 1.3 and 1.6 will appear as a single star to the naked eye (magnitude 0.6,) but will separate using binoculars.

MAGNETIC VARIATION

Magnetic Variation data is available between 1600 and 2020. However changes in the Earth's Magnetic field cannot be forecast accurately. The data/ methods used are the same as that used for navigational Charts. Differences can arise due to a revision of the data after the chart was prepared for printing.

REFRACTION
Refraction above 15° is consistent and related mainly to local temperature and pressure.

Refraction below 15° is affected by variations in the temperature gradient and height of the various layers in the atmosphere through which the light travels. Even on days with identical temperature and pressure at the observer, refraction at the horizon can vary by minutes of arc or even degrees.

Between 10° and 15°, refraction is fairly consistent but estimates below 10° should be used with caution. Below 5° it is little better than an approximation without knowing the characteristics of the atmosphere through which the light will travel.

Tables sometimes use different assumptions for low level refraction between editions/ years. The revised assumptions may be more elegant but are little better at forecasting low level refraction accurately than the assumptions they replace.

Using a calculator, Refraction = 0.96/ Tan(Altitude) will generally produce better results than values interpolated from tables for altitudes above 15°.

STELLAR MAGNITUDES
Magnitudes are measured on a logarithmic scale. A star of magnitude 1 is 2.5 times brighter than a star of magnitude 2 and a star of magnitude 9 is 2.5 times brighter than a star of magnitude 10.

Magnitude 6 is normally considered the limit of the naked eye while standard binoculars increase this to nearly 10 under ideal conditions.

There are various ways that magnitude is measured. For consistency Visual Magnitude is used throughout. This measures the band in the middle of the wavelengths seen by the naked eye. It is often quoted as the "Apparent Magnitude," though in other cases the Apparent Magnitude is a quantity derived from the U, B and V magnitudes. (Ultra-violet, blue and visual wavelengths.)

VARIABLE STARS
Stars identified as having variability greater than 2 magnitudes have "V" suffixed to their magnitude and those with a range of 0.5 ~ 2 use "v."

Hipparchos measurements were used in preference to GCVS values where differences arose. Hipparchos measurements are generally considered definitive but are hampered by the limited period of operation. Long period variability may therefore have been underestimated.

Trouble Shooting

AstroNav is designed for use on Windows XP/ Windows 2000 and above. Its behavior on earlier versions is unpredictable.

Starting AstroNav
Personal settings are saved after first use as User.Dat in the folder [C:]\Documents and Settings\<YOUR NAME>\Application Data\NavSoft. Deleting this file will restore all values to their defaults. This will prevent a potentially corrupted voyage plan being loaded by default.

If the above does not work then the software should be uninstalled and then reinstalled.

Please contact NavSoft (feedback@navsoft.com) if any other problems are encountered.