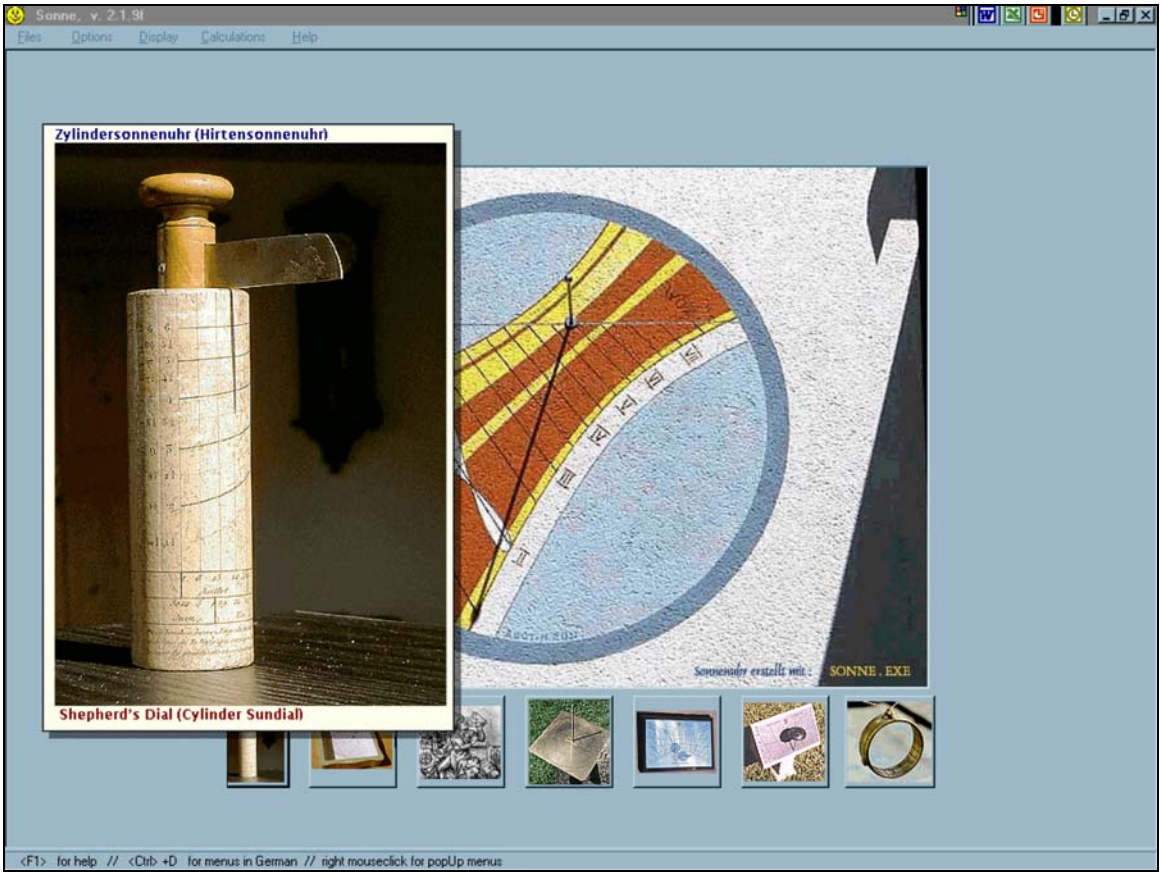

At this point I assume that you have downloaded and set up SONNE on your computer and have also read the overview document. If not please read "Getting Started with SONNE" and "SONNE and Your Sundial".

These instructions will help you learn how to use SONNE to design a cylinder or Shepherd's sundial. Initiate the program SONNE. After entering the required information in the "Location and Reference Year" screen you will go to the "Type of Sundial" screen shown in Figure 1. There is a selection here for a cylinder sundial.

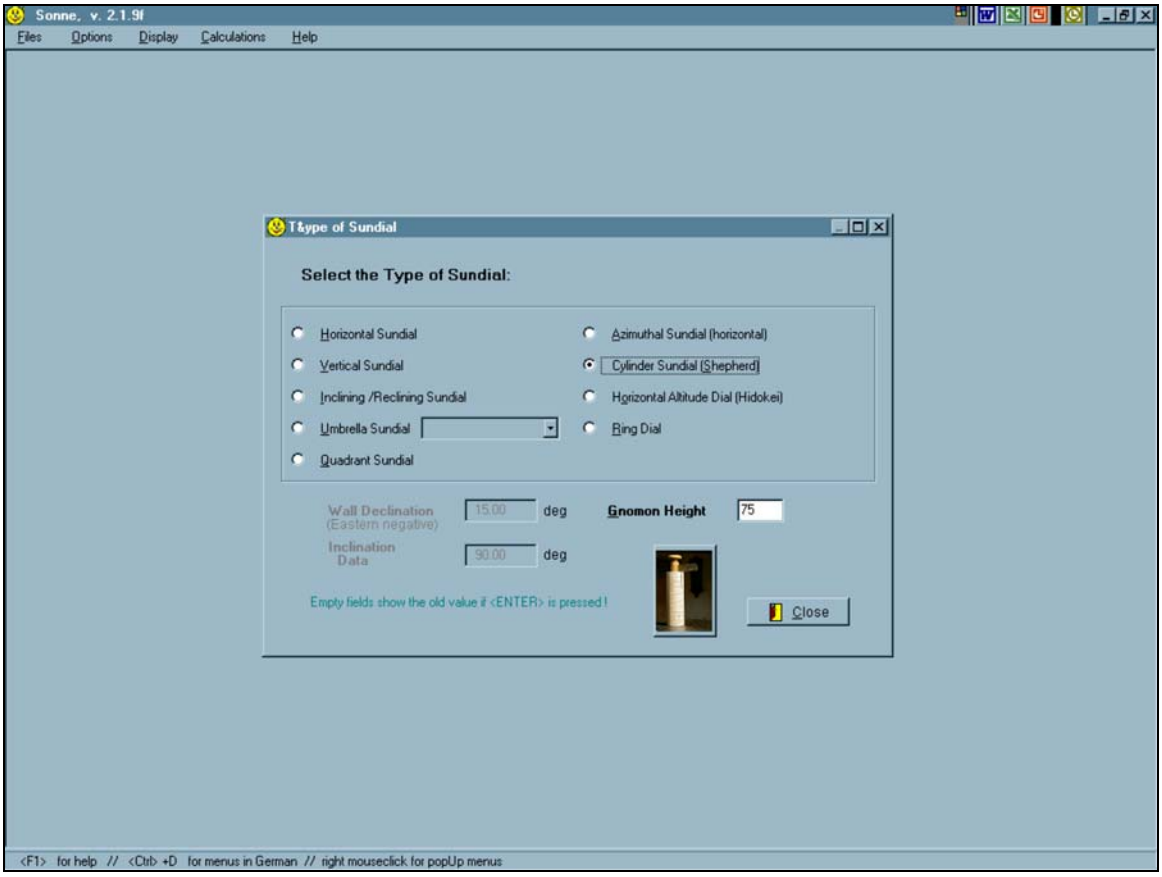

Figure 1: Type of Sundial

The parameters for the cylinder sundial are entered on a single input sheet. This is shown in Figure 2 and is the "Parameter of Sundials" screen. Here information is entered that is relevant to the design of the sundial. The following describes the various entries and selections that can be made in this screen.

The cylinder or Shepherd's sundial consists of a tall cylinder with a long narrow gnomon mounted on the top. The gnomon can be rotated and aligned with the scale of dates.

Length of Gnomon

The "Length of Gnomon" is the distance in millimetres it extends horizontally beyond the surface of the cylinder. The shadow of the narrow edge of the gnomon is of importance here. The "Length of Gnomon" is influenced by the height of the cylinder.

Length of Scale for Months

Normally this is the circumference of the cylinder in millimetres but does not have to be. If the cylinder is large only part of the circumference can be used for the scale.

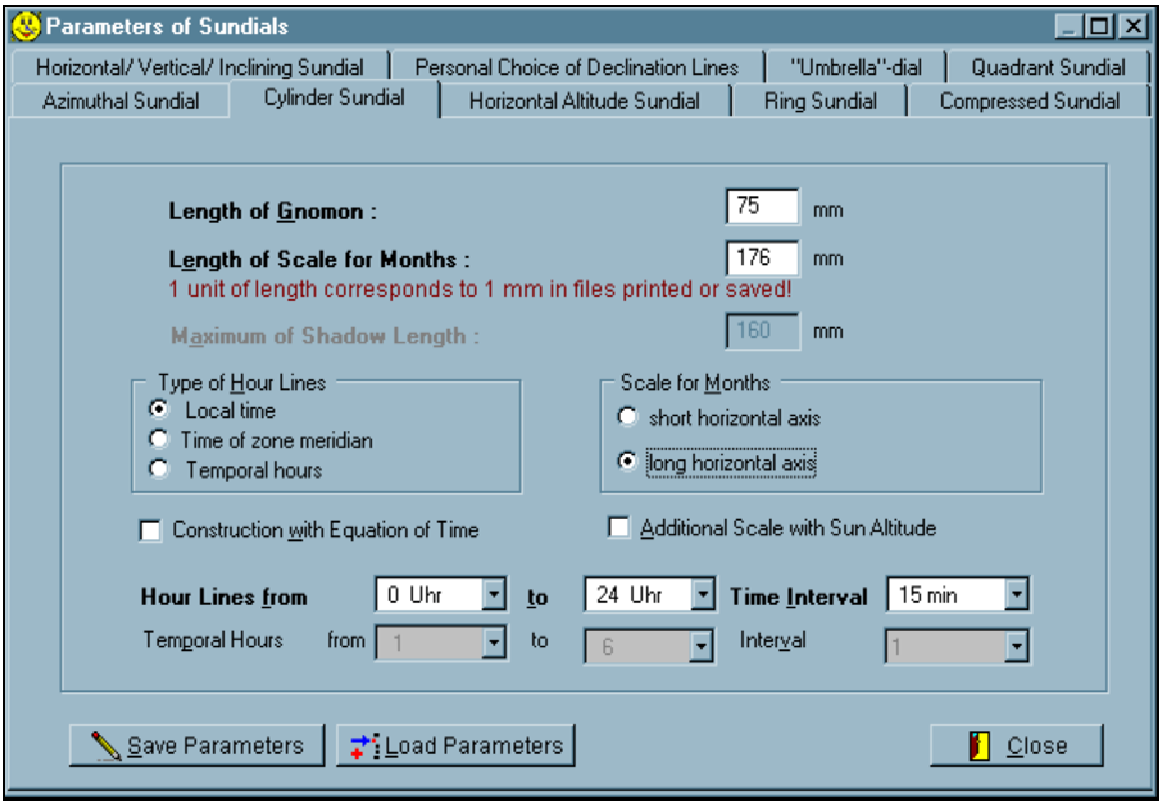

Figure 2: Cylinder (Shepherd's) Sundial

Type of Hour Lines

Select the type of hour lines that will be shown. "Local time" will display hour lines that show local apparent or sun time. "Time of zone meridian" will display hour lines that show zonal solar time, which is local apparent time corrected for longitude but not the Equation of Time. "Temporal hours are described in the "SONNE Glossary".

Hour Lines from … to

Select the range of hours the sundial will display using the 24 hour clock; midnight = 0/24 Uhr, 6 a.m. = 6 Uhr, noon = 12 Uhr, 6 p.m. = 18 Uhr. Enter the earliest time in "from' and the latest in "to". If the range is entered as "from" 0 Uhr "to" 24 Uhr the program will automatically display only the hours that the sundial is illuminated at a given location.

Time Interval

Select the "Time Interval" between the hour lines; 15, 20, 30 or 60 minutes.

Construction with Equation of Time

Because this particular sundial has a date scale the Equation of Time can be applied to the hour lines. Applying the EoT to a sundial with small "Time Intervals" will result in a busy sundial. Try it and see.

Additional Scale with Sun Altitude

A scale is applied to the sundial that indicates the sun's altitude. The altitude scale adds 7.5 mm to the "Length of Scale for Months" and therefore the circumference of the cylinder.

Scale for Months

- **short horizontal axis**

  The sundial design will display only the months from July to December. The printout or saved file contains more information. This selection will work only with designs that are symmetrical about the vertical axis defined by June 21. Do not apply the Equation of Time to this selection.

- **long horizontal axis**

  The sundial design will display all 12 months of the year.

When all the sundial parameters have been entered select the "Save Parameters" button.

HAPPY DIALLING!

Let's work through an example that you can use to design a cylinder sundial for your specific location. This design will be saved as a dxf file and opened in DeltaCad where it will be modified so a sundial can be made from card stock, a heavy cardboard tube or plastic pipe and styrofoam.

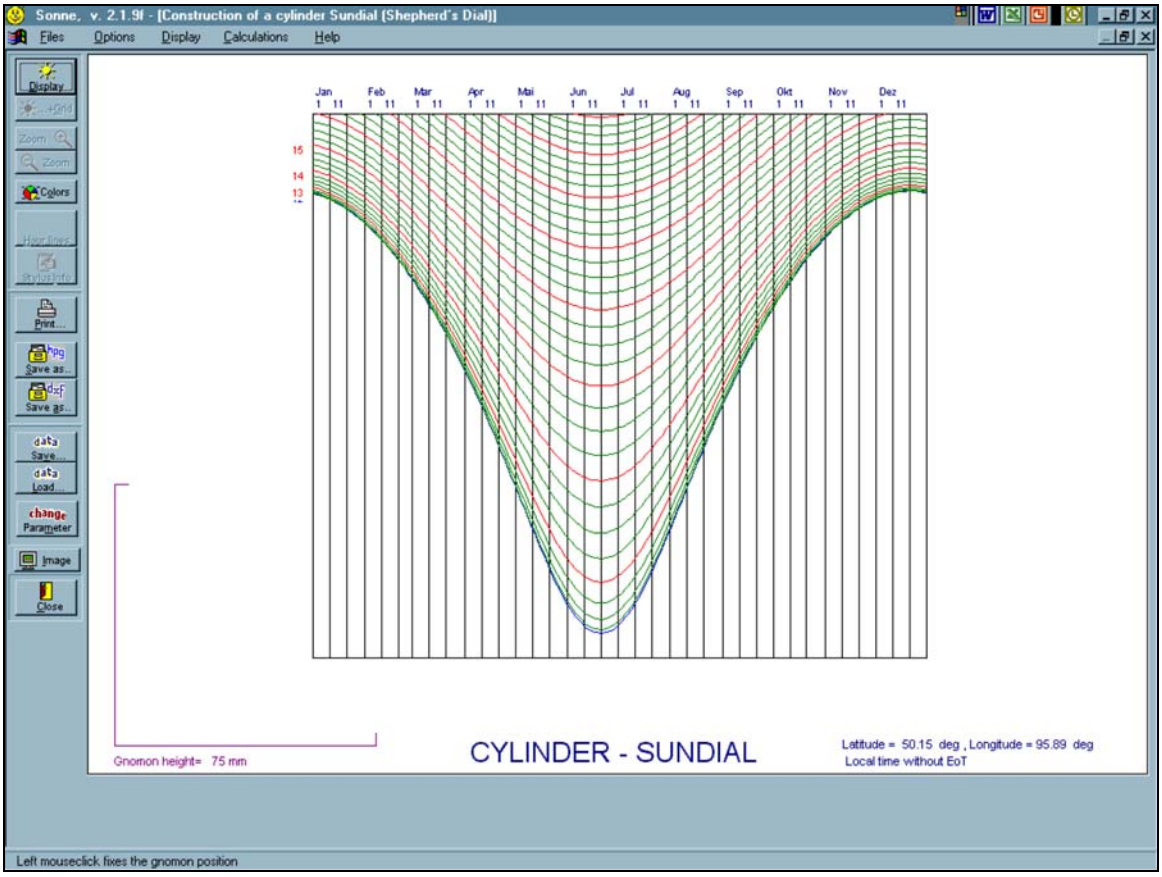

Figure 3: Cylinder Sundial

This sundial design will be for my location and the following information was entered in the "Location and Reference Year" screen:

- Latitude: 50º 08' 56" North
- Longitude: 95º 53' 26" West
- Time Zone: 90º 00' 00" West
- Selected Year: 2007

In the next screen, "Type of Sundial", the "Cylinder Sundial" was selected as shown in Figure 1. The "Gnomon Height' will be entered in the next screen, "Parameters of Sundials". The sheet for "Cylinder Sundial" is selected as shown in Figure 2.

The sundial will be designed to fit a cylinder constructed from a heavy cardboard tube with an outer diameter of 56 millimetres and an inner diameter of 51 millimetres. If your measurements are in inches, as all the entries on this sheet are in millimetres some conversions will have to take place along the way. Remember that 1 inch is equal to 25.4 millimetres.

The sundial parameters are shown in Figure 2 and are as follows:

- Length of Gnomon: 75 mm.
- Length of Scale for Months: 176 mm. This is the circumference of the cylinder.
- Type of Hour Lines: Local Time. The sundial will show local apparent or sun time.
- Hour lines from 0 Uhr to 24 Uhr.
- Time Interval: 15 minutes.
- Scale for Months: long horizontal axis. All 12 months will be displayed.

The parameters "Length of Gnomon" and "Length of Scale for Months" were determined as follows.

The "Length of Scale for Months" is fixed by the outer diameter of the cylinder. It is determined by calculating the circumference of the cylinder. If the "Additional Scale with Sun Altitude" is included it will take 7.5 mm of the circumference of the cylinder. If the cylinder diameter is fixed subtract 7.5 mm from the circumference to give the available space left for the "Length of Scale for Months".

Circumference = π x Diameter = π x 56 = 175.929 mm

The "Length of Gnomon" (L) is determined by the height (H) of the cylinder that will contain the hour lines.

L = H / tan (a) where "a" is the sun's altitude at local apparent noon on the summer solstice.

At this time the sun will reach its highest altitude and the shadow will be the longest. You can use "Sun.exe" to determine the altitude. At the location for this example the sun's altitude will be 63°17'30" or 62 2917°. Assume a cylinder height of 152 mm (6 inches).

L = 152 / tan (62.2917) = 79.83 mm. Let's make it 75 mm.

Some space is required at the bottom of the cylinder, below the lowest hour line, for the date scale. With a cardboard tube the length can be cut to suit the final design. If the cylinder has a fixed length the "Length of Gnomon" must be selected to leave sufficient room for the date scale.

The sundial is now ready to be drawn. Select "Display" and then "Drawing the Sundial" or just press "F8". The sundial design shown in Figure 3 will be automatically displayed. This design

can now be printed. The printout can be glued to the cylinder and rotating gnomon constructed. The sundial would function.

If you would like to modify the design then you can do it by hand or use a computer aided design or CAD software package. To do this the design must first be saved as a dxf file. To save the design as a dxf file that can be opened in a CAD package select "Save as…dxf". Follow the instructions. Open the dxf file with your CAD package and have fun!