# The Sundial Primer - "Dialling Guides" Analemmatic Sundial

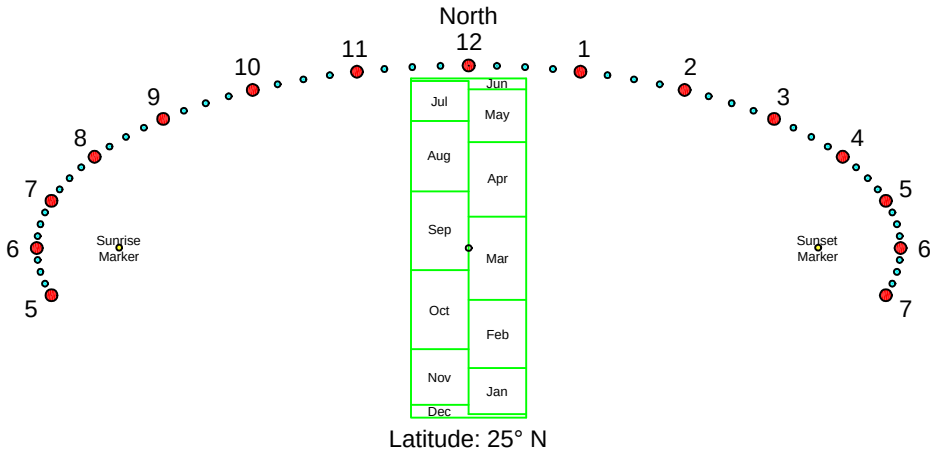
created by
Carl Sabanski

The purpose of the "Dialling Guides" is to provide an easy method for laying out the hour points and Date Scales for a number of analemmatic sundials located at various latitudes in either the Northern or Southern Hemispheres. The analemmatic sundials presented here are designed to be used as "human sundials". They are interactive sundials and the user plays the role of the gnomon.

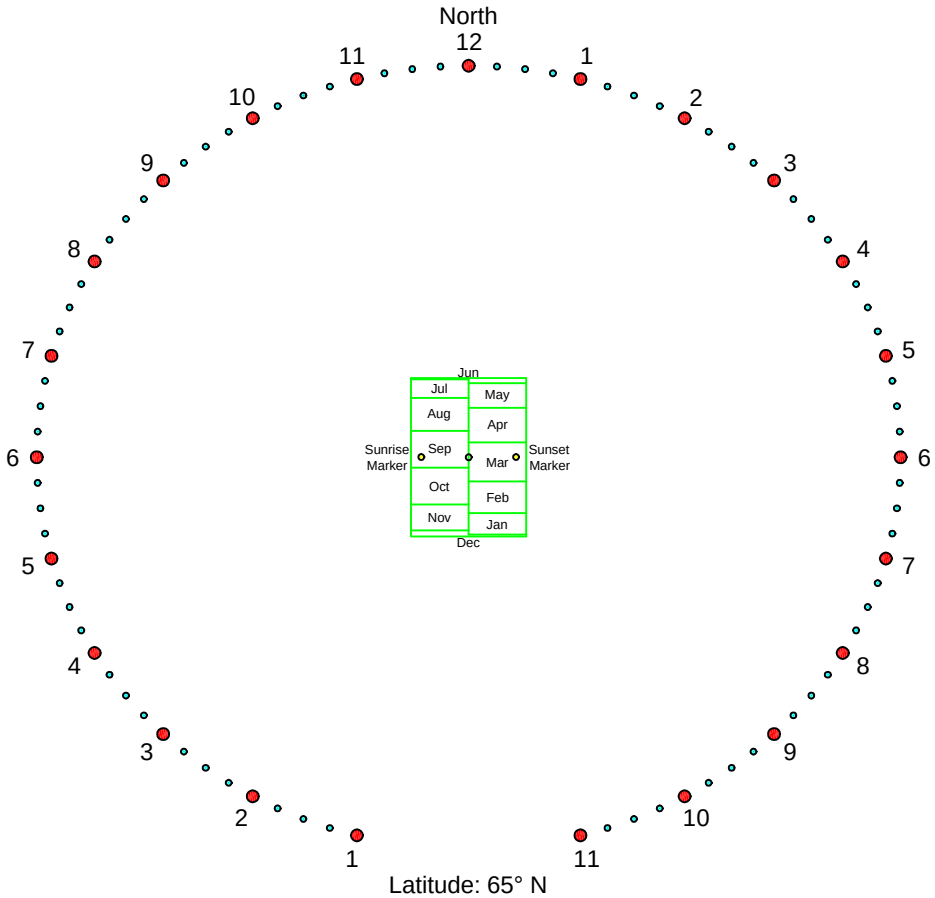
There are a total of 81 "Dialling Guides" that cover the range of latitudes from 25° to 65° inclusive in increments of 0.5°. The "Dialling Guides" are in the form of tables and provide the co-ordinates for the hour points and the Date Scale. The hour points are provided in increments of 5 minutes and the Date Lines for the Date Scale are provided for days 1,5,6,10,11,15,16,20,21,25 and 26 for each month. The "Dialling Guides" are designed so the sundial will show local apparent or solar time.

Each "Dialling Guide" contains 4 sets of tables. As the sundials are intended for people there is information available to construct sundials with east-west widths of 2,3,4 and 5 metres. Each set of tables contains data for the hour points and Date Scale for one of these sundials.

There are many combinations of analemmatic sundials that can be created from the "Dialling Guides". Figure 1 shows two sundials located at either extreme of the latitude range. All the other sundials will fall between these two. Sundials for the Southern Hemisphere will look similar except for the hour point numbering and Date Scale layout. This will be discussed later.




Latitude: 25° N




Latitude: 65° N

**Figure 1**

# The Sundial Primer - "Dialling Guides"
# Analemmatic Sundial

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The analemmatic sundial uses hour points and not hour lines to indicate the time. These points are located on an ellipse. As the gnomon must be moved on the Date Scale to a position corresponding to the current date, the origin of its shadow will change from day to day. The analemmatic sundials presented here are actually projections of an equatorial ring sundial on to a horizontal surface. As the sundial approaches the equator the ellipse becomes flatter until, at the equator, it becomes a straight line. The Date Scale continues to become longer. As the sundial approaches the poles it becomes a circle. The Date Scale becomes shorter and it is difficult to define the months. At the poles the analemmatic sundial is an equatorial sundial. Analemmatic sundials near the equator and the poles will not work well.

As all the hour points are located on an ellipse let's examine one. Figure 2 illustrates a typical ellipse positioned in a rectangular co-ordinate system defined by the X and Y axis. The dimension of the major axis of the ellipse is 2a and the minor axis is 2b. The dimensions provided at the beginning of these instructions for the width of the sundials are the dimensions of the major axis.

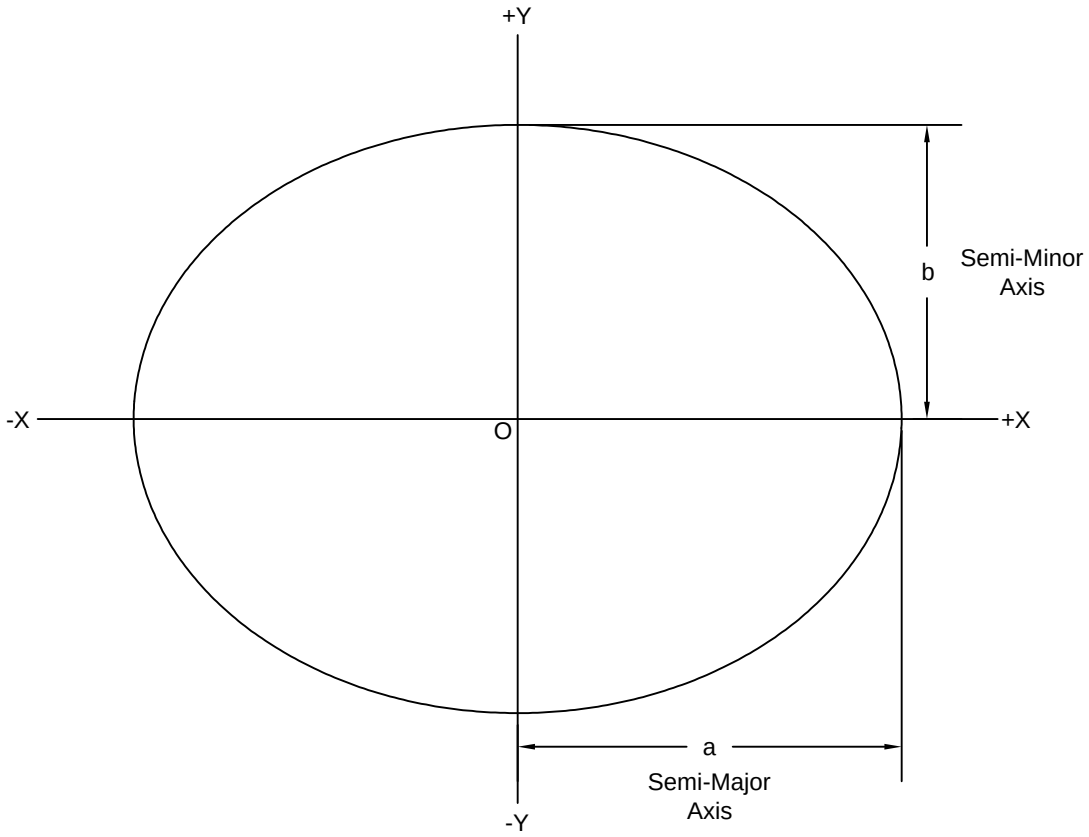


**Figure 2**

It is not difficult to draw an ellipse once you have determined the dimensions of the semi-major (a) and semi-minor (b) axis. You may wish to do this for your analemmatic sundial. A scale must first be made using any suitable material such as a length of wood. Figure 3 shows the layout of the scale and how to use it to draw an ellipse. Always position point A on the major axis and point B on the minor axis. Point E is a point on the ellipse. The more points the more accurate is the ellipse.

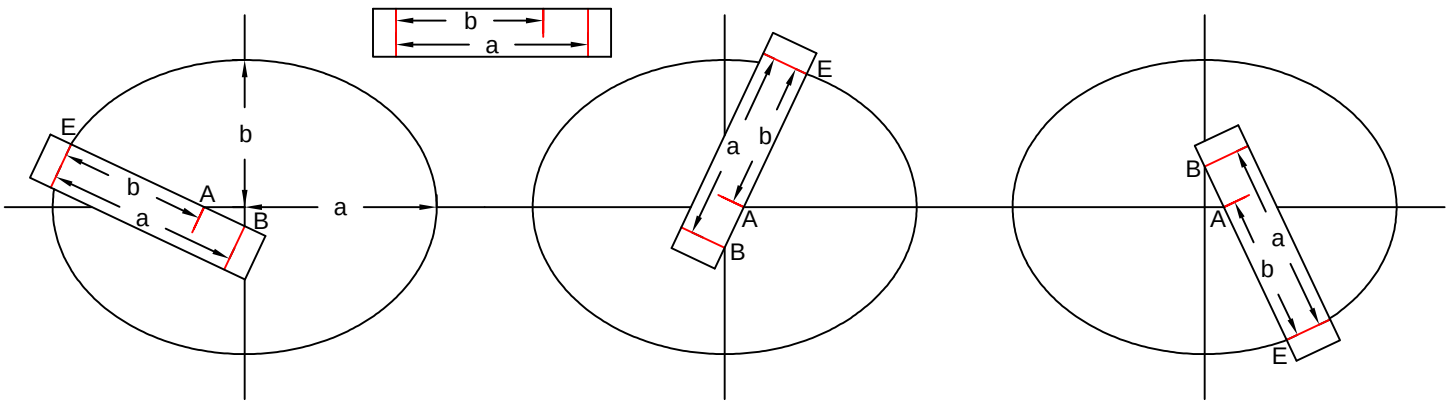


**Figure 3**

# The Sundial Primer - "Dialling Guides"
# Analemmatic Sundial

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Obtain a set of analemmatic sundial "Dialling Guides" that are closest to the latitude where the sundial will be located. The tables provided in each "Dialling Guide" are based on the dimension of the semi-major axis. The four sizes available are 1000, 1500, 2000 and 2500 millimetres. The 1000 mm "Dialling Guide" can be used to calculate the information required to construct any size of analemmatic sundial should you not find a suitable one. All you need to do is calculate a multiplier as follows: (Desired semi-major axis in mm / 1000).

The dimensions of the analemmatic sundial to be constructed must be determined. Think about the people who will be using the sundial. Will they be mostly young children, adults or a combination? If the sundial is to be located in a playground where it will be used by children then it shouldn't be too large. During the summer the shadows will be shorter than in the winter. Table 1 lists the shortest shadow lengths that occur at solar noon on the summer solstice. These are multipliers based on a gnomon one unit high.

| LATITUDE DEGREES | SHORTEST SHADOW | LATITUDE DEGREES | SHORTEST SHADOW |
|---|---|---|---|
| 25 | 0.027 | 46 | 0.415 |
| 26 | 0.045 | 47 | 0.436 |
| 27 | 0.062 | 48 | 0.457 |
| 28 | 0.080 | 49 | 0.478 |
| 29 | 0.097 | 50 | 0.500 |
| 30 | 0.115 | 51 | 0.522 |
| 31 | 0.133 | 52 | 0.544 |
| 32 | 0.151 | 53 | 0.567 |
| 33 | 0.168 | 54 | 0.590 |
| 34 | 0.186 | 55 | 0.614 |
| 35 | 0.205 | 56 | 0.639 |
| 36 | 0.223 | 57 | 0.663 |
| 37 | 0.241 | 58 | 0.689 |
| 38 | 0.260 | 59 | 0.715 |
| 39 | 0.278 | 60 | 0.742 |
| 40 | 0.297 | 61 | 0.769 |
| 41 | 0.316 | 62 | 0.797 |
| 42 | 0.336 | 63 | 0.826 |
| 43 | 0.355 | 64 | 0.856 |
| 44 | 0.375 | 65 | 0.887 |
| 45 | 0.395 | | |

**Table 1**

Example: At a latitude of 50° north or south a gnomon that is 1 metre high will cast a shadow that is 0.5 metres long on June 21 in the Northern Hemisphere and December 21 in the Southern Hemisphere.

Other factors play a part in determining the size of the sundial. These include your latitude, the minimum time increment you wish to display and the number of Date Lines in the Date Scale. At lower latitudes more hour points will require a larger sundial. At higher latitudes more Date Lines will require a larger sundial.

Remember that a person can stretch their arms above their head to make themself into a taller gnomon.

There may also be a limited area at the sundial's location for it to fit into. Check the space available for both the major and minor axis. The space required along the minor axis varies with latitude. At higher latitudes the hour points can go well below the bottom of the Date Scale. At lower latitudes the Date Scale will take up quite a bit of extra space. Take a look at Figure 1. All these dimensions can be determined from the "Dialling Guides".

For purposes of the instructions let's design analemmatic sundials for the latitudes 50.0° North and South with a semi-major axis of 1000 mm, 15 minute time increments, Date Lines for days 1 and 15 of each month and a time range from 5:00 a.m. to 7:00 p.m.

The following two tables are taken from the "Dialling Guide" for latitude 50.0° N/S. Table 2 is the information required to lay out the Date Lines for the Date Scale and Table 3 are the co-ordinates for the hour points. Table 2 shows the Date Scale for the Northern Hemisphere. The Date Scale for the Southern Hemisphere is obtained by multiplying all the values by -1.

**Latitude: 50.0° N/S**

**Date Scale**

Semi-Major Axis (E-W): 1000 mm  Semi-Minor Axis (N-S): 766.0 mm

| Month | Date | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 5 | 6 | 10 | 11 | 15 | 16 | 20 | 21 | 25 | 26 |
| January | -272.7 | -267.6 | -266.0 | -258.9 | -256.8 | -248.0 | -245.6 | -235.1 | -232.3 | -220.5 | -217.3 |
| February | -197.3 | -182.9 | -179.1 | -163.8 | -160.0 | -144.0 | -139.9 | -123.4 | -119.2 | -102.3 | -97.9 |
| March | -85.0 | -67.6 | -63.1 | -45.5 | -41.1 | -23.3 | -19.0 | -1.1 | 3.3 | 21.0 | 25.4 |
| April | 51.7 | 69.0 | 73.4 | 90.3 | 94.6 | 111.3 | 115.3 | 131.6 | 135.6 | 151.2 | 155.0 |
| May | 173.7 | 188.0 | 191.4 | 204.6 | 207.9 | 220.1 | 223.0 | 234.1 | 236.8 | 246.5 | 248.7 |
| June | 260.7 | 267.0 | 268.5 | 273.1 | 274.2 | 277.1 | 277.5 | 278.6 | 278.7 | 276.7 | 277.6 |
| July | 274.2 | 269.8 | 268.5 | 262.6 | 260.9 | 253.2 | 251.1 | 242.0 | 239.6 | 229.1 | 226.4 |
| August | 208.6 | 195.7 | 192.4 | 178.5 | 175.0 | 160.4 | 156.6 | 141.3 | 137.4 | 121.6 | 117.5 |
| September | 93.0 | 76.2 | 72.0 | 54.9 | 50.6 | 33.3 | 29.1 | 11.7 | 7.3 | -10.2 | -14.6 |
| October | -36.4 | -53.9 | -58.2 | -75.5 | -79.7 | -96.9 | -101.1 | -117.9 | -122.0 | -138.4 | -142.4 |
| November | -165.9 | -180.9 | -184.6 | -198.7 | -202.2 | -215.3 | -218.4 | -230.4 | -233.2 | -243.8 | -246.4 |
| December | -257.4 | -264.8 | -266.4 | -271.8 | -273.0 | -276.4 | -277.1 | -278.6 | -278.7 | -278.0 | -277.6 |

Northern Hemisphere

**Table 2**

# The Sundial Primer - "Dialling Guides"
# Analemmatic Sundial

created by
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**Latitude: 50.0° N/S**

Earliest Sunrise: 3:49 a.m. Latest Sunset: 8:11 p.m.
Semi-Major Axis (E-W): 1000 mm Semi-Minor Axis (N-S): 766.0 mm
Sunrise/Sunset Markers: X = ± 371.3 mm

| Local Time | | X | Y | Z | W | Local Time | | X | Y | Z | W |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12:00 | | 0.0 | 766.0 | 766.0 | 0.0 | | | | | | |
| 11:55 | 12:05 | 21.8 | 765.9 | 766.2 | 21.8 | 8:25 | 3:35 | 806.4 | 453.0 | 925.0 | 865.1 |
| 11:50 | 12:10 | 43.6 | 765.3 | 766.6 | 43.6 | 8:20 | 3:40 | 819.2 | 439.4 | 929.6 | 881.9 |
| 11:45 | 12:15 | 65.4 | 764.4 | 767.2 | 65.4 | 8:15 | 3:45 | 831.5 | 425.6 | 934.1 | 898.5 |
| 11:40 | 12:20 | 87.2 | 763.1 | 768.1 | 87.2 | 8:10 | 3:50 | 843.4 | 411.6 | 938.5 | 914.8 |
| 11:35 | 12:25 | 108.9 | 761.5 | 769.2 | 109.0 | 8:05 | 3:55 | 854.9 | 397.4 | 942.8 | 931.0 |
| 11:30 | 12:30 | 130.5 | 759.5 | 770.6 | 130.7 | 8:00 | 4:00 | 866.0 | 383.0 | 946.9 | 946.9 |
| 11:25 | 12:35 | 152.1 | 757.1 | 772.3 | 152.4 | 7:55 | 4:05 | 876.7 | 368.5 | 951.0 | 962.7 |
| 11:20 | 12:40 | 173.6 | 754.4 | 774.1 | 174.0 | 7:50 | 4:10 | 887.0 | 353.7 | 954.9 | 978.2 |
| 11:15 | 12:45 | 195.1 | 751.3 | 776.2 | 195.6 | 7:45 | 4:15 | 896.9 | 338.8 | 958.7 | 993.4 |
| 11:10 | 12:50 | 216.4 | 747.9 | 778.6 | 217.2 | 7:40 | 4:20 | 906.3 | 323.7 | 962.4 | 1008.5 |
| 11:05 | 12:55 | 237.7 | 744.1 | 781.1 | 238.7 | 7:35 | 4:25 | 915.3 | 308.5 | 965.9 | 1023.3 |
| 11:00 | 1:00 | 258.8 | 739.9 | 783.9 | 260.1 | 7:30 | 4:30 | 923.9 | 293.2 | 969.3 | 1037.9 |
| 10:55 | 1:05 | 279.8 | 735.4 | 786.9 | 281.5 | 7:25 | 4:35 | 932.0 | 277.6 | 972.5 | 1052.2 |
| 10:50 | 1:10 | 300.7 | 730.6 | 790.1 | 302.8 | 7:20 | 4:40 | 939.7 | 262.0 | 975.5 | 1066.3 |
| 10:45 | 1:15 | 321.4 | 725.4 | 793.4 | 324.0 | 7:15 | 4:45 | 946.9 | 246.2 | 978.4 | 1080.2 |
| 10:40 | 1:20 | 342.0 | 719.8 | 797.0 | 345.1 | 7:10 | 4:50 | 953.7 | 230.4 | 981.1 | 1093.9 |
| 10:35 | 1:25 | 362.4 | 714.0 | 800.7 | 366.2 | 7:05 | 4:55 | 960.0 | 214.4 | 983.7 | 1107.3 |
| 10:30 | 1:30 | 382.7 | 707.7 | 804.6 | 387.1 | 7:00 | 5:00 | 965.9 | 198.3 | 986.1 | 1120.4 |
| 10:25 | 1:35 | 402.7 | 701.2 | 808.6 | 407.9 | 6:55 | 5:05 | 971.3 | 182.1 | 988.3 | 1133.4 |
| 10:20 | 1:40 | 422.6 | 694.3 | 812.8 | 428.7 | 6:50 | 5:10 | 976.3 | 165.8 | 990.3 | 1146.1 |
| 10:15 | 1:45 | 442.3 | 687.0 | 817.1 | 449.3 | 6:45 | 5:15 | 980.8 | 149.4 | 992.1 | 1158.5 |
| 10:10 | 1:50 | 461.7 | 679.5 | 821.5 | 469.8 | 6:40 | 5:20 | 984.8 | 133.0 | 993.8 | 1170.7 |
| 10:05 | 1:55 | 481.0 | 671.6 | 826.1 | 490.2 | 6:35 | 5:25 | 988.4 | 116.5 | 995.2 | 1182.7 |
| 10:00 | 2:00 | 500.0 | 663.4 | 830.7 | 510.4 | 6:30 | 5:30 | 991.4 | 100.0 | 996.5 | 1194.4 |
| 9:55 | 2:05 | 518.8 | 654.9 | 835.5 | 530.5 | 6:25 | 5:35 | 994.1 | 83.4 | 997.5 | 1205.9 |
| 9:50 | 2:10 | 537.3 | 646.1 | 840.3 | 550.5 | 6:20 | 5:40 | 996.2 | 66.8 | 998.4 | 1217.1 |
| 9:45 | 2:15 | 555.6 | 636.9 | 845.2 | 570.4 | 6:15 | 5:45 | 997.9 | 50.1 | 999.1 | 1228.1 |
| 9:40 | 2:20 | 573.6 | 627.5 | 850.1 | 590.1 | 6:10 | 5:50 | 999.0 | 33.4 | 999.6 | 1238.9 |
| 9:35 | 2:25 | 591.3 | 617.8 | 855.2 | 609.6 | 6:05 | 5:55 | 999.8 | 16.7 | 999.9 | 1249.4 |
| 9:30 | 2:30 | 608.8 | 607.7 | 860.2 | 629.0 | 6:00 | 6:00 | 1000.0 | 0.0 | 1000.0 | 1259.7 |
| 9:25 | 2:35 | 625.9 | 597.4 | 865.3 | 648.2 | 5:55 | 6:05 | 999.8 | -16.7 | 999.9 | 1269.7 |
| 9:20 | 2:40 | 642.8 | 586.8 | 870.4 | 667.3 | 5:50 | 6:10 | 999.0 | -33.4 | 999.6 | 1279.5 |
| 9:15 | 2:45 | 659.3 | 575.9 | 875.5 | 686.2 | 5:45 | 6:15 | 997.9 | -50.1 | 999.1 | 1289.1 |
| 9:10 | 2:50 | 675.6 | 564.8 | 880.6 | 704.9 | 5:40 | 6:20 | 996.2 | -66.8 | 998.4 | 1298.5 |
| 9:05 | 2:55 | 691.5 | 553.4 | 885.7 | 723.5 | 5:35 | 6:25 | 994.1 | -83.4 | 997.5 | 1307.6 |
| 9:00 | 3:00 | 707.1 | 541.7 | 890.7 | 741.9 | 5:30 | 6:30 | 991.4 | -100.0 | 996.5 | 1316.4 |
| 8:55 | 3:05 | 722.4 | 529.7 | 895.8 | 760.0 | 5:25 | 6:35 | 988.4 | -116.5 | 995.2 | 1325.1 |
| 8:50 | 3:10 | 737.3 | 517.5 | 900.8 | 778.0 | 5:20 | 6:40 | 984.8 | -133.0 | 993.8 | 1333.5 |
| 8:45 | 3:15 | 751.8 | 505.1 | 905.7 | 795.8 | 5:15 | 6:45 | 980.8 | -149.4 | 992.1 | 1341.7 |
| 8:40 | 3:20 | 766.0 | 492.4 | 910.7 | 813.5 | 5:10 | 6:50 | 976.3 | -165.8 | 990.3 | 1349.6 |
| 8:35 | 3:25 | 779.9 | 479.5 | 915.5 | 830.9 | 5:05 | 6:55 | 971.3 | -182.1 | 988.3 | 1357.4 |
| 8:30 | 3:30 | 793.4 | 466.3 | 920.3 | 848.1 | 5:00 | 7:00 | 965.9 | -198.3 | 986.1 | 1364.9 |

**Table 3**

The sign of the X co-ordinates, for the Northern Hemisphere, will be negative for the a.m. hours and positive for the p.m. hours. The sign of the X co-ordinates, for the Southern Hemisphere, will be positive for the a.m. hours and negative for the p.m. hours.

The tables can be made easier to follow by highlighting all the columns or rows of values that will be used in building the sundial. All the extraneous information can also be stroked out. This will help to ensure that the correct values are used during construction.

# The Sundial Primer - "Dialling Guides"
# Analemmatic Sundial

created by
Carl Sabanski

All the information is now available for the construction of the analemmatic sundial. The following is one method that can be used to lay out the sundial. You may find another one that is better suited for you.

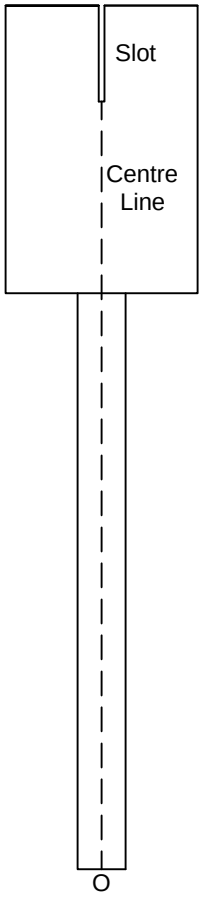


**Figure 4**

The first step is to establish the true north-south line or local meridian line at the location of the sundial. To do this both the latitude and longitude must be known. The time that the sun passes over the local meridian on the day that this procedure will be carried out must be determined. This is local apparent or solar noon. An accurately set clock or watch is also required.

Mark the position of the sundial's origin "O" at the site location. This point is shown in both Figures 1 and 2. A vertical device will be positioned at the origin "O" that will cast a shadow on the ground. The position of the shadow will be marked at solar noon and the line drawn from "O" to the marked point will be the true north-south or meridian line. This line must be established as carefully and accurately as possible because it is the basis of the remainder of the layout. The device can be a "straight" section of pipe or rod. Make it as long as possible. If a solid device is used you will have to estimate the centre of the shadow. Figure 4 illustrates a device that uses a small band of light. Take a thin (1/8") piece of wood and cut a slot the width of a saw blade as shown in the figure. The dimensions of this device can be about 100 mm wide and 150 mm high with a slot 50 mm in length. Attach the device to a "straight" length of wood and draw a vertical line from the centre of the slot to the bottom of the extension. This is the dashed line in the figure.

Position the completed device so the bottom of the dashed line is located on the origin "O". Ensure that the line is vertical in all directions. This is where having a "straight" extension helps. The device can be attached to a step-ladder to hold it in position. You will note that the slot will cast a band of light on the ground. As the time approaches noon the device can be rotated to keep the slot in line with the sun. Any adjustments requiring you to use a ladder should be done from a second step-ladder. A few minutes before noon check that everything is aligned and vertical. If you are marking pavement position a piece of paper where the band of light from the slot is falling. If this procedure is being done on soil then have a couple of small nails ready. You will be marking the two edges of the band of light. Now you are ready.

Be prepared! It is amazing how quickly the sun moves when you are keeping track of time and watching the band of light. At precisely solar noon mark the two egdes of the band of light on the paper with a pen or on the soil with the two nails. Now relax. Mark the spot at the point midway between these two points in the pavement or soil in some permanent manner.

The line between this point and the origin "O" is the local meridian. You may want to carry out this procedure a couple of times just to increase the accuracy. If you get a slightly different position the second time for no apparent reason you can average the two positions.

If this line is shorter than the semi-minor axis of the analemmatic sundial you are building then extend it to the appropriate length. For our example this would be a distance of 766 mm. The east-west line must now be established. To do this a "3-4-5" triangle will be used. Figure 5 illustrates this triangle. The relative dimensions of this triangle makes it simple to calculate the dimensions of the remaining two sides when a value is applied to one. Table 4 provides calculated values that are ready to be used based on pre-assigned values for the "4" side. The multiplier for the "3" side is 0.75 and for the "4" side 1.25. The lengths are in millimetres.

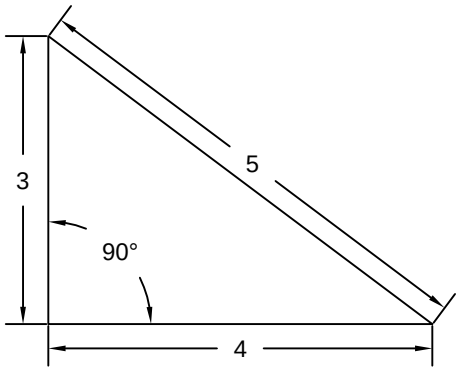


**Figure 5**

| "3" | "4" | "5" | "3" | "4" | "5" | "3" | "4" | "5" |
|---|---|---|---|---|---|---|---|---|
| 37.5 | 50 | 62.5 | 675 | 900 | 1125 | 1312.5 | 1750 | 2187.5 |
| 75 | 100 | 125 | 712.5 | 950 | 1187.5 | 1350 | 1800 | 2250 |
| 112.5 | 150 | 187.5 | 750 | 1000 | 1250 | 1387.5 | 1850 | 2312.5 |
| 150 | 200 | 250 | 787.5 | 1050 | 1312.5 | 1425 | 1900 | 2375 |
| 187.5 | 250 | 312.5 | 825 | 1100 | 1375 | 1462.5 | 1950 | 2437.5 |
| 225 | 300 | 375 | 862.5 | 1150 | 1437.5 | 1500 | 2000 | 2500 |
| 262.5 | 350 | 437.5 | 900 | 1200 | 1500 | 1537.5 | 2050 | 2562.5 |
| 300 | 400 | 500 | 937.5 | 1250 | 1562.5 | 1575 | 2100 | 2625 |
| 337.5 | 450 | 562.5 | 975 | 1300 | 1625 | 1612.5 | 2150 | 2687.5 |
| 375 | 500 | 625 | 1012.5 | 1350 | 1687.5 | 1650 | 2200 | 2750 |
| 412.5 | 550 | 687.5 | 1050 | 1400 | 1750 | 1687.5 | 2250 | 2812.5 |
| 450 | 600 | 750 | 1087.5 | 1450 | 1812.5 | 1725 | 2300 | 2875 |
| 487.5 | 650 | 812.5 | 1125 | 1500 | 1875 | 1762.5 | 2350 | 2937.5 |
| 525 | 700 | 875 | 1162.5 | 1550 | 1937.5 | 1800 | 2400 | 3000 |
| 562.5 | 750 | 937.5 | 1200 | 1600 | 2000 | 1837.5 | 2450 | 3062.5 |
| 600 | 800 | 1000 | 1237.5 | 1650 | 2062.5 | 1875 | 2500 | 3125 |
| 637.5 | 850 | 1062.5 | 1275 | 1700 | 2125 | | | |

**Table 4**

# The Sundial Primer - "Dialling Guides"
# Analemmatic Sundial

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Figure 6 illustrates how to use the "3-4-5" triangle to lay out the east-west line. By using the 4-step process shown, 4 points will be established along the east-west line. For example, in Step 1 measure up the meridian line a distance equal to the selected "4" side measurement. Using two metric tapes set the zero of one at this newly established point and the zero of the second at the origin "O". As you move along the east-west line keep these tapes crossed and note their readings. When the tape starting from "O" reads the selected "3" side measurement and the tape from the meridian line reads the selected "5" side value, mark the point A. Repeat this procedure for Steps 2, 3 and 4 but with the triangle rotated to the positions shown. The five points A, B, C, D and O should be located on a straight line. Extend lines OB an OD to the required semi-major axis length. For our example this would be 1000 mm.

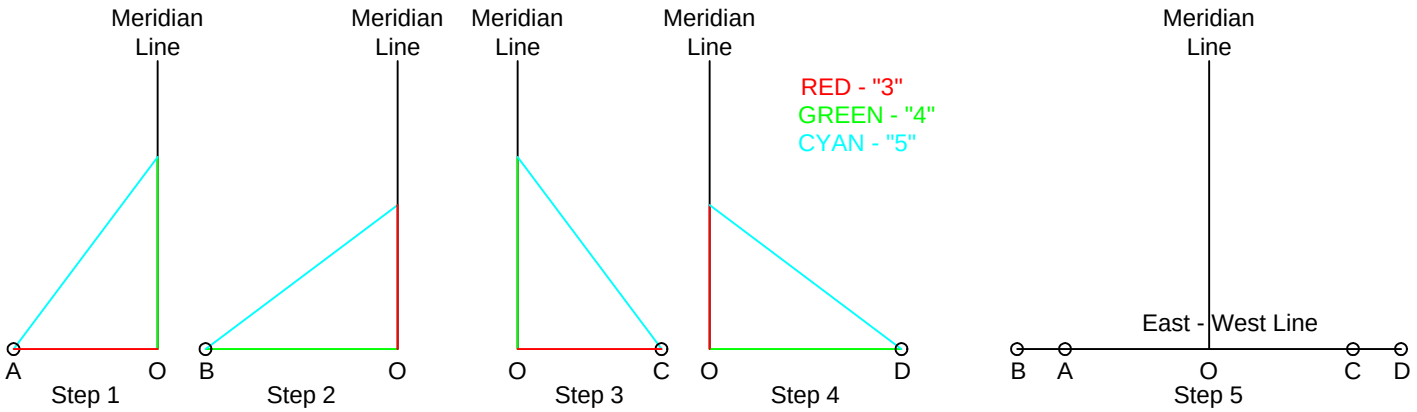



**Figure 6**

The north-south or meridian line needs to extended below the east-west line if the sundial is to show times before 6:00 a.m. and after 6:00 p.m. and for laying out the Date Scale. If the "3-4-5" triangle method is used the two points that will be established should be in line with the existing meridian line. This would make a good check of the layout if you are willing to spend the extra time.

The positions of the hour points can now be determined. The hour points will be placed so the sundial indicates local apparent or solar time. As illustrated in Figure 7 the north-south line, east-west line, origin "O", noon point, 6 a.m. point and 6 p.m. point have all been established. The co-ordinates X, Y, Z and W for any hour point are given in Table 3 and illustrated in Figure 7. Using the two tape method described above a number of methods can be used to find the position of the hour points. By setting the zero of the tapes at the noon point and "O", the distances Z and W are used to find the hour points. If the X and/or Y co-ordinates for the hour points are marked off on the east-west and north-south lines respectively a number of combinations become available including X-Y, X-Z, X-W, Y-Z and Y-W.

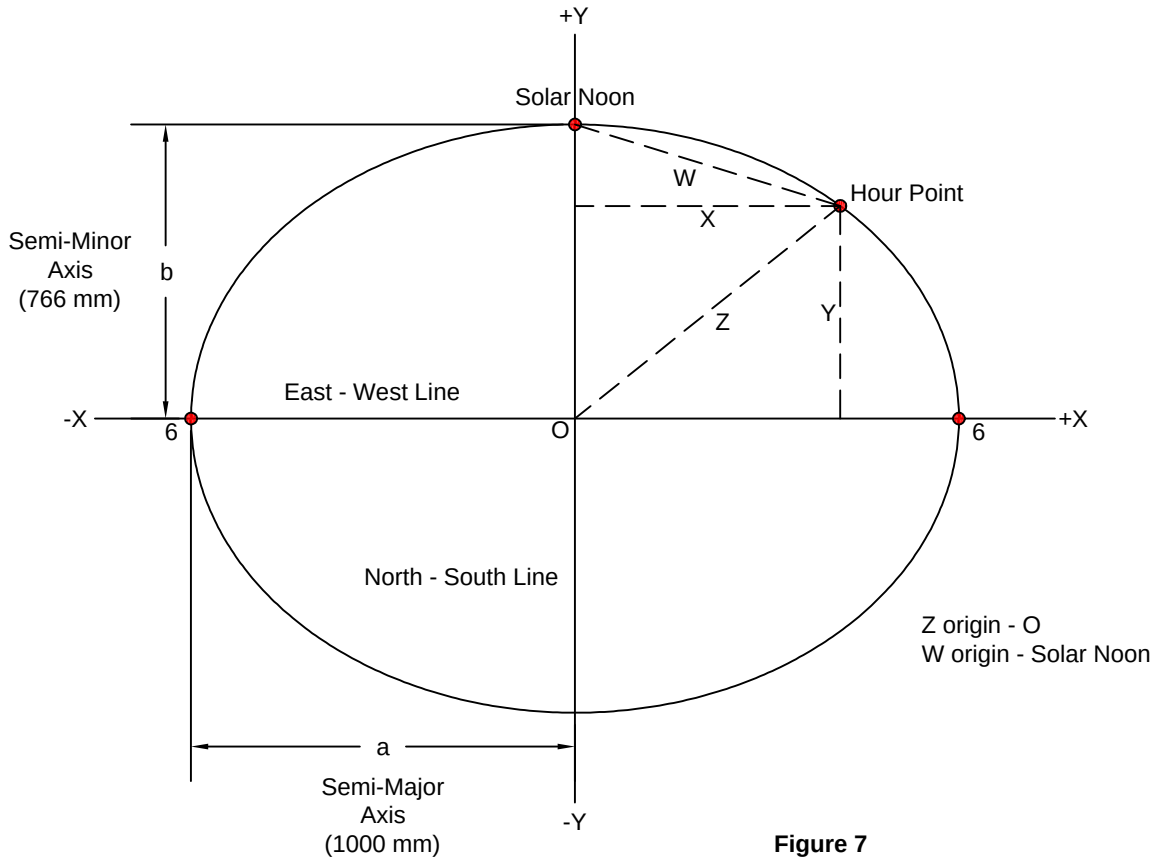



**Figure 7**

# The Sundial Primer - "Dialling Guides"
# Analemmatic Sundial

created by
Carl Sabanski

When the locations of all the desired hour points are established and numbered the analemmatic sundials for the Northern and Southern Hemispheres will appear as in Figure 8. The sundials for our example have hour points every 15 minutes.

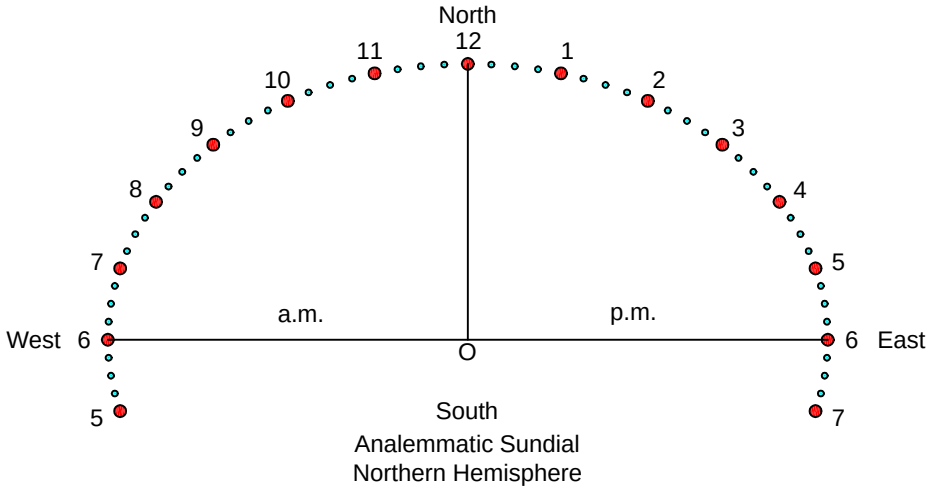
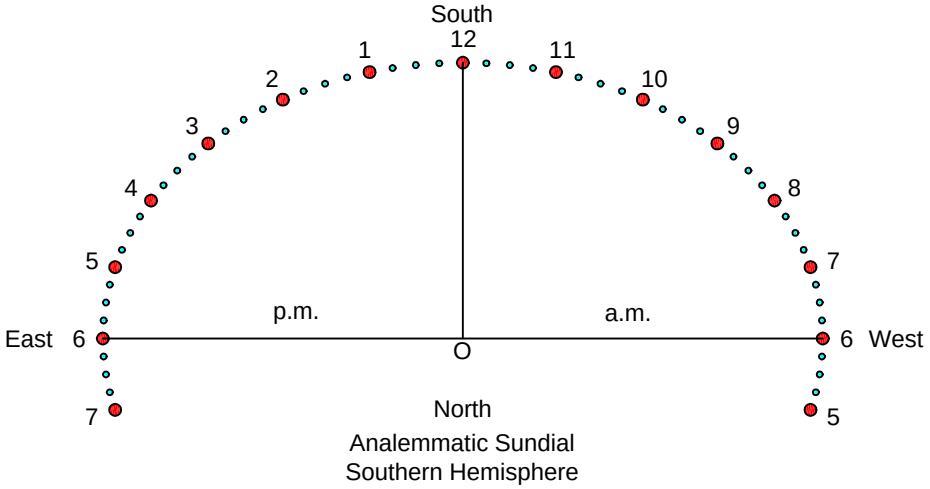



**Figure 8**




The next step is to lay out the Date Lines on the Date Scale. The lines are spaced relative to the origin "O" and their spacing is given in Table 2. In our example only the Date Lines for days 1 and 15 of each month will be shown. There are a number of other combinations listed in the "Dialling Guides". No matter what combination you use the summer and winter solstices must be included as they establish the upper and lower limits of the Date Scale. These dates are highlighted in the "Dialling Guides". Note that the east-west line is the Date Line for the equinoxes when the sun's declination is zero.

The calculation for the position of the Date Lines is dependent upon the sun's declination. The sun's declination varies slightly from year to year and is "reset" every leap year. As a result the Date Scale for each of the four years would appear slightly different. The values calculated in the "Dialling Guides" uses an "average" (not absolutely correct) value so if you perform the calculation you will probably not get the same result but it will be close. Figure 9 shows the Date Scales for the above sundials. The months can be positioned clockwise or counterclockwise.

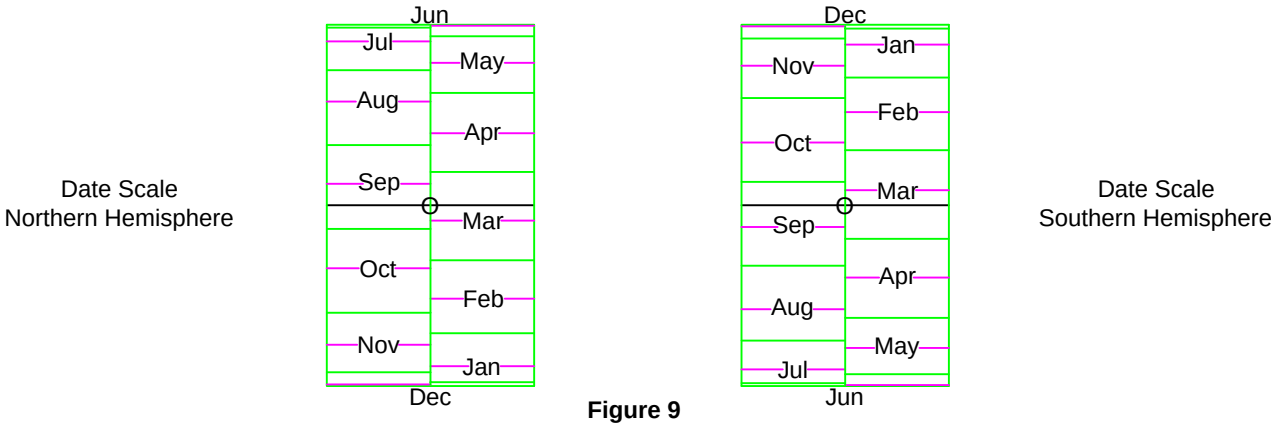
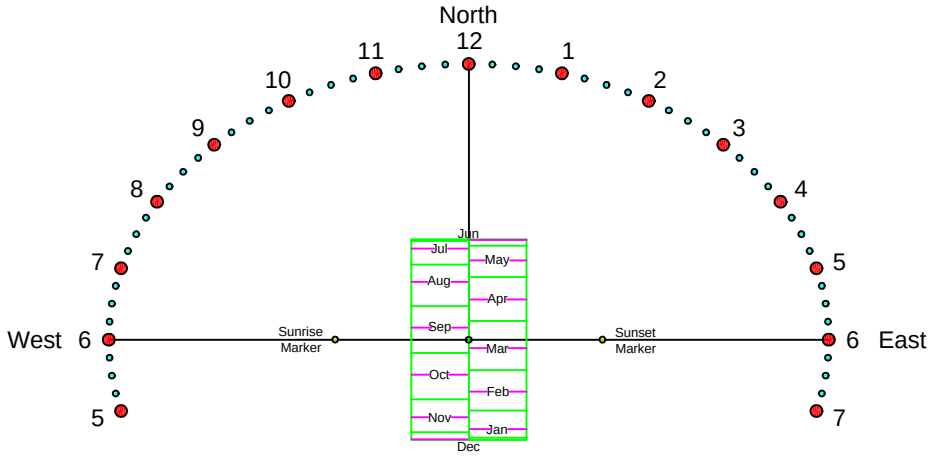



**Figure 9**

# The Sundial Primer - "Dialling Guides"
# Analemmatic Sundial

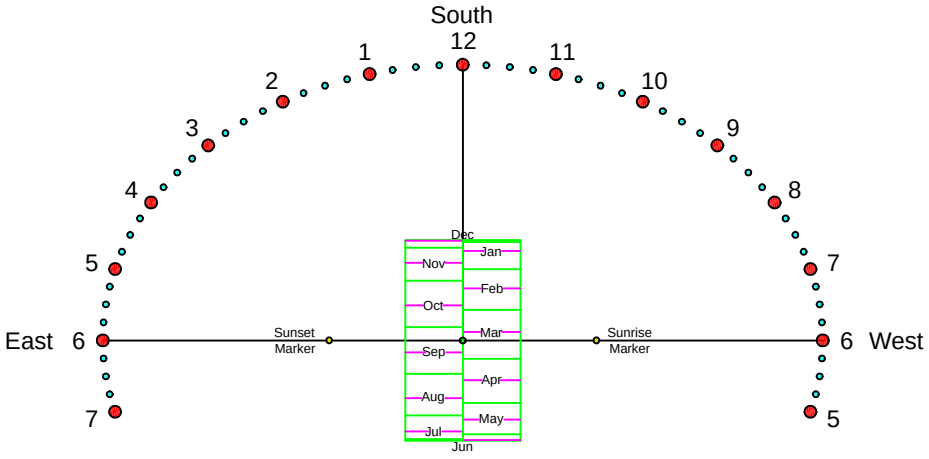
created by
Carl Sabanski

Figure 10 shows the completed sundials with the Date Scales in position.




Analemmatic Sundial
Northern Hemisphere

**Figure 10**




Analemmatic Sundial
Southern Hemisphere

There is one final detail shown in Figure 1 that will be discussed. This is the sunrise and sunset markers. These values are provided in the "Diallling Guides". They are also shown in Figure 10. By passing a line from the current date through the sunrise or sunset marker, the time of sunrise and sunst can be estimated. This is shown in Figure 11 for two different dates. These markers are not fixed and their actual position depends upon the sun's declination and the latitude. The fixed markers will give a good estimate but the error in the reading increases at higher latitudes.

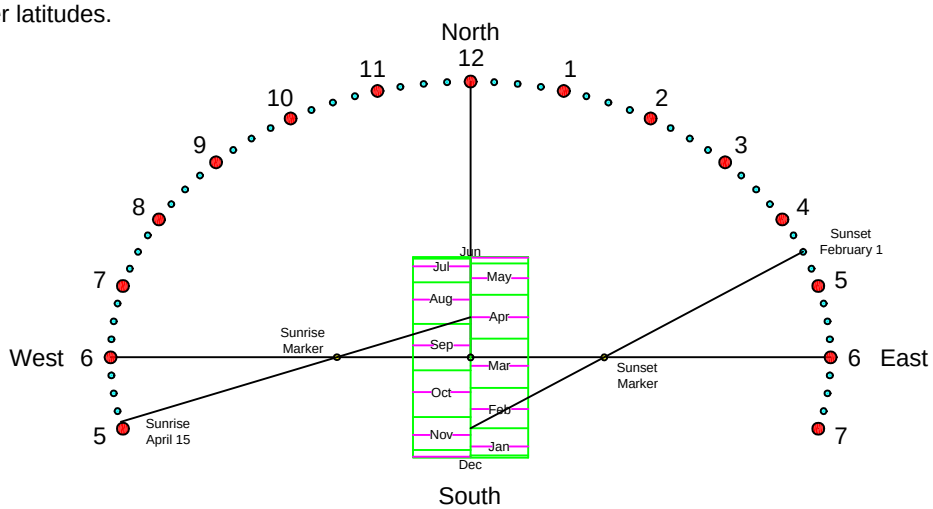



**Figure 11**

**Happy Dialling!**