ANALEMMA

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Sidereal time for the Homogeneous Analemmatic Sundial

The Homogeneous Analemmatic Sundial has a homogeneous distribution of the hour lines. It indicates the local solar time for a place on earth. Because the sundial has to be adjusted to the sun when read, it is easy to indicate the sidereal time with the sundial. This principle is discussed in the text below.

The homogeneous Analemmatic sundial

An example of a homogeneous analemmatic sundial[1] is shown in *Figure 1*. The sundial is aligned to the north and next, the disc with the gnomon is rotated until the shadow intersect the date on the yellow disc. While rotating the disc, the yellow central disc moves. This movement deforms the ellipse of the analemmatic sundial to a circle with homogeneous hour lines.
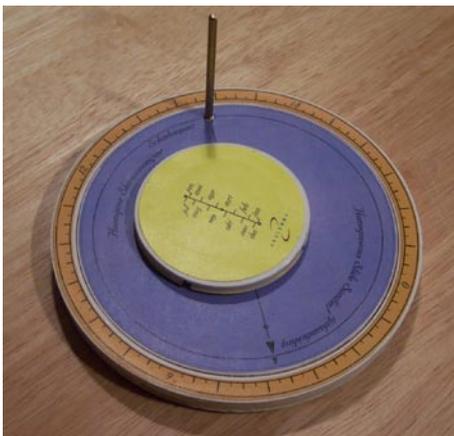

Figure 1: de homogeneous analemmatic sundial, the small arrow indicates the solar time.

Sidereal time

The sidereal time equals the hour angle of the vernal equinox. The vernal equinox is a fixed spot at the celestial sky. After a period of 24 (star-) hours the vernal equinox has returned to the same place in the sky. Like the local solar time refers to the place of the sun (the sun is south at 12.00 o'clock solar time), the sidereal time refers to the place of the stars (the vernal equinox is south at 12.00

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[1] see Dutch sundial-Bulletin 97, mei 2008 and Compendium Volume 15 nr 2, June 2008 and www.shop.analemma.nl>publicaties for article and a small movie.

o'clock sidereal time). The configuration of 0.00 sidereal time and 12.00 solar time at the start of the spring is shown in *Figure 2*. The vernal equinox (indicated with ♈) is south at 0.00 sidereal time. Due to the start of spring the sun is also south.

Figure 2: start of spring, at 12.00 solar time and 0.00 sidereal time, the sun and the vernal equinox join south

Considering the location of the sun around 20th of April at 0.00 sidereal time we will find the sun east of the vernal equinox, see *Figure 3*. The angle α is called the right ascension.
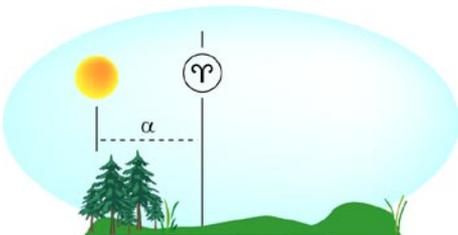

Figure 3: approx. 20th of April, 0.00 sidereal time, the sun is east of the meridian

A bit later, at 12.00 solar time, the sun is south and the vernal equinox is rotated α degrees to the west, see *Figure 4*.
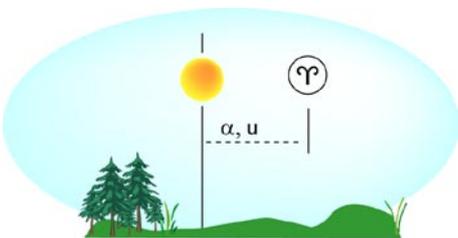

Figure 4: approx. April the 20st, 12.00 solar time, the angle u indicates the sidereal time.

The angle α equals the hour angle u and therefore the sidereal time[2] Apparently, the solar time and the sidereal time differ the angle α (and an additional 12 hours). So we can add a circle with the dates to the sundial to indicate the sidereal time.

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[2] Actually: -α=u.

Indication of the sidereal time

The sidereal time is implemented with dates on the disc with the gnomon, see *Figure 5*. In fact, the right ascension is drawn for each day with reference to the vernal equinox around the 20th of March. Besides the month, the 10th and 20th day of each month is indicated. The gnomon is placed in the small circle at the vernal equinox. The shadow in the figure is 20th April, 0.00 sidereal time.
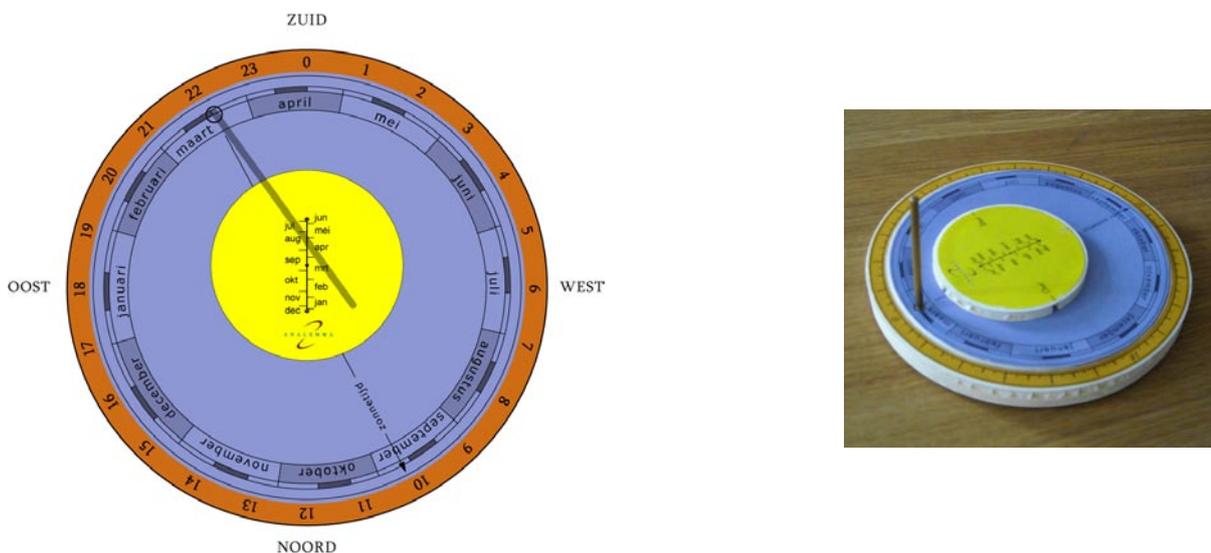

Figure 5: the sidereal time is read at the date of today, the solar time is read at the small arrow as usual. The shadow shown is 0.00 sidereal time (some minutes after 10.00 solar time) , April 20th.

Considering the configuration of *Figure 2*, the shadow of the gnomon intersects the date on the yellow central disc and 12.00 solar time is read at the small arrow. At the indication of March 20th on the disc the sidereal time 0.00 is read. With the configuration of *Figure 4* around April 20th, the arrow indicates 12.00 solar time again and at April 20th the sidereal time is read: approx. 2.00 o'clock.

The principle of a scale which is able to rotate with the dates to indicate sidereal time can be used on every homogeneous sundial. The homogeneous analemmatic sundial however has to be adjusted to the sun to read the solar time so the indication of the sidereal time does not introduce any additional steps.