Shadow Plane Sundials

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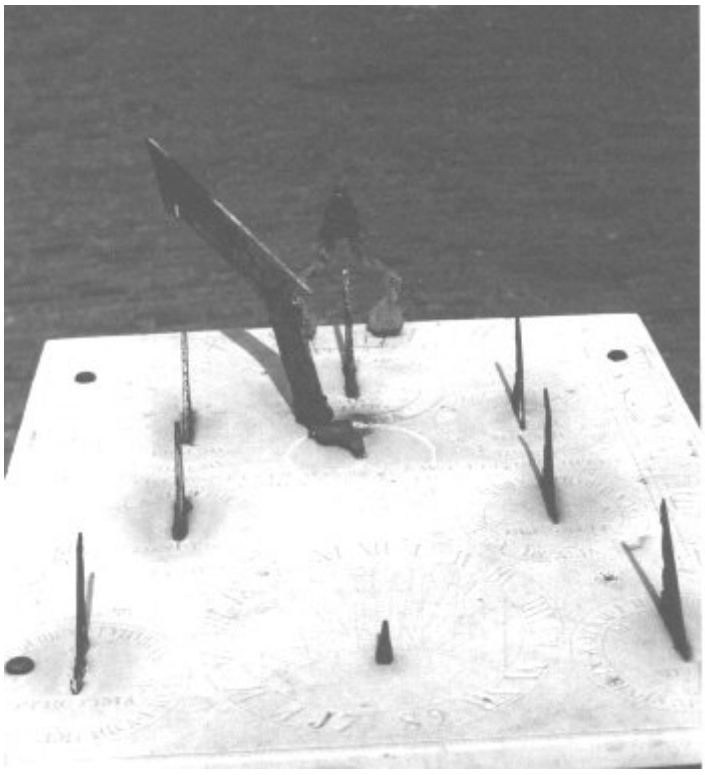
Shadow Plane Sundials, part 2

Introduction

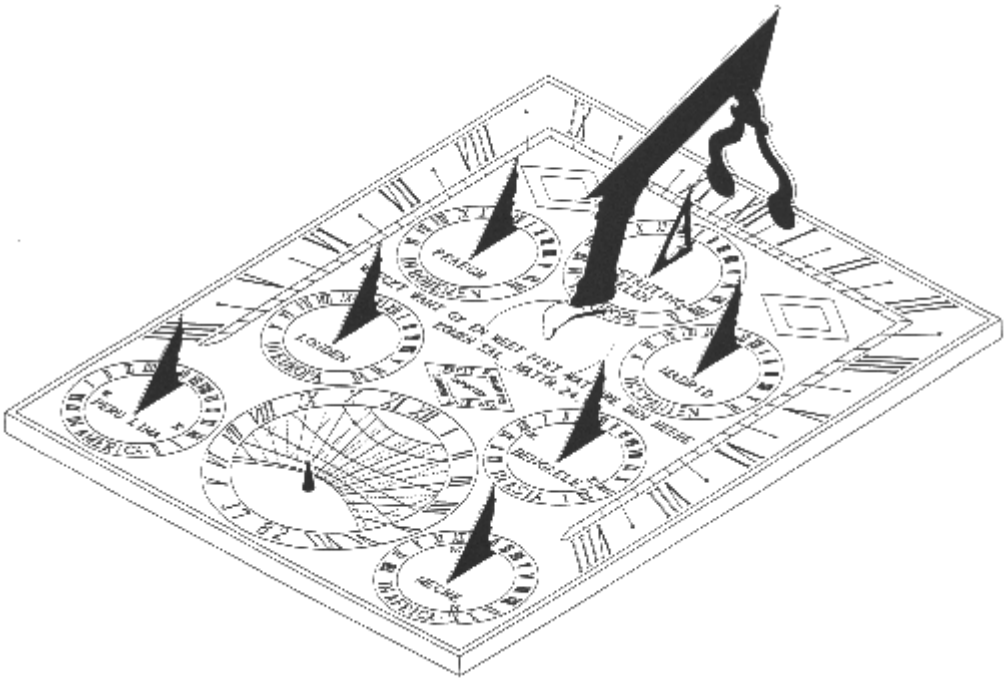
Thinking in shadow plane terms allows a dialist to separate or 'deconstruct' the functional parts of familiar dial forms, and then to rearrange these elements into a great variety of possible configurations. This flexibility can offer solutions to aesthetic needs, create adaptive responses to site limitations, or yield special-purpose indicators, such as devices to commemorate particular dates and times.

The Snellegem Sundial

In our first article on shadow plane sundials (1) we discussed sundials which use a movable cord for a shadow caster. In this follow-up article we first discuss the historical sundial at Snellegem (2), near Brugge, in Belgium. Graphics 1 and 2 show a photo and drawing of the dial.



Graphic 1



Graphic 2

On the horizontal plate of this sundial, dated 1782, there are 7 small sundials, each with its own triangular gnomon and polestyle. These are ordinary horizontal dials, constructed for the latitude of Snellegem, but each has the appropriate longitude correction to display the time at a selected location elsewhere in the world. The dial's maker, B. Amantius, has chosen the following places, written here as spelled on the dial:

Constantinopelen in Europa Praegh in Bohemen Madrid in Spanien Londen in Europa Bengaele in Asia Peru Lima in America Meche in Africa

On several of the dials, local noon is marked with a capital M. Sadly, the gnomon for the Madrid dial has been broken off by vandals.

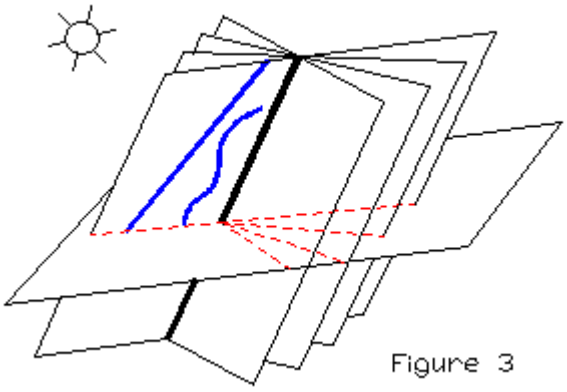
In the center of the dial is a motto in old Dutch language: "Waekt want gij en weet niet wat ure den Heere komen sal." The note on the dial, "Matth. 24.4" isn't correct - it probably should be "Matth. 24.42", where the English text, according the King James Bible, is: "Watch therefore: for ye know not what hour your Lord doth come."

Centered in the southern portion of the dial plate there is an 8th sundial, with a pin gnomon, that shows local suntime, antique time, and has zodiacal lines. Here we also find the date of the dial, 1782.

Those are the 8 "normal" dials. The object of particular interest for this article is the 9th dial, consisting of an unusual shadow caster mounted at the northern end of the dial plate, together with the hourlines, whole and fractional, for a large horizontal sundial drawn around the perimeter of the plate. The shadow caster's edges are not parallel to the earth's axis, so it isn't a polestyle. When lifted from its support, this shadow caster could be tilted and rotated around a vertical axis, located at the center of a circle scraped on the dial plate. We understand that this adjustable shadow caster was meant to be moved until one of its upper edges lay in the appropriate hourplane, indicated by the shadow of the style's edge falling exactly along an hourline at the perimeter of the dial plate. If the style didn't lie in the hourplane, its shadow intersected the hourlines. Although the hourlines are quite short - we should have preferred longer ones - it was nontheless possible to decide when the shadow of the style was coincident with an hourline, and thus to read the time.

This arrangement will work well and the movable style allows this dial to operate as a shadow plane dial similar to those described in our previous article, but only if the intersection of the movable style (extended) with a point which is vertically above the point of rotation also lies on the (imaginary) polestlye of the dial. However there is an anomaly in the Snellegem example, for the intersection doesn't lie on the dial's polestyle. Perhaps the maker made a mistake, or perhaps a restoration introduced this error. We can only speculate, for, sometime after the photo was taken, vandals removed the shadow caster pictured.

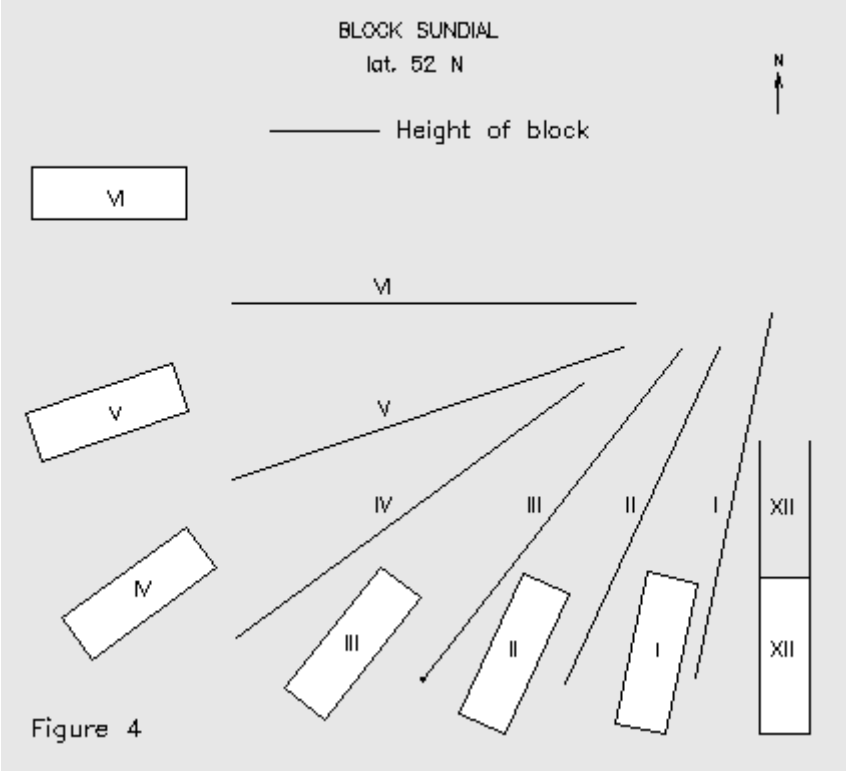
Multiple Gnomon Sundials



Graphic 3

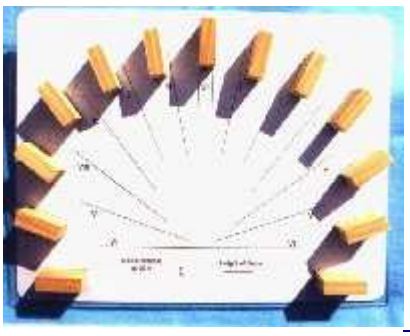
Next, we consider some shadow plane sundials which have multiple gnomons. In Graphic 3 we review the principle that a style of any shape which lies entirely within a particular hourplane will cast its shadow onto the hourline associated with that hourplane.

If you place one such style in your garden and draw the appropriate hourline, you have a sundial for a single hour. If that isn't enough, you can make styles and hourlines for whatever hours you wish and place them in any regular pattern or at random in the garden to have a more complete sundial. To read the time, just walk about to see which style casts its shadow onto an hourline. A disadvantage of such a dial is that it's hard to interpolate the time between whole hours. Of course, half-hour, or even quarter-hour styles may be added, but perhaps for such a sundial it's sufficient to read the time as simply being between two hours.



Graphic 4

Instead of a style made of a rod or something similar, the edge of a solid shape may be used. Rectangular blocks of wood or concrete may be arranged in a park to create a sundial as well as sitting places for the people strolling about. Graphic 4 shows the plan for half of such a dial. Just mirror the drawing for the morning hours.

 Click for picture, 45 kB

Graphic 5. Model by Mac Oglesby

A sundial model where the blocks are arranged a little differently is shown in Graphic 5. In neither case do the hour lines converge to a single point. A builder of this type of sundial has the freedom to move the hourlines, as long as each hourline maintains the correct angle with the meridian, and the shadow caster rectangular block is parallel to, and the proper distance from, its hourline.

The Pingré Sundial

The Pingré sundial (3), a huge cylindrical dial that was erected in Paris in 1764, has multiple gnomons, with each gnomon placed along an hourline of a horizontal sundial. Since each gnomon lies in an appropriate hourplane, this rare sundial is an historical example of a shadow plane sundial.

Shadow Plane Sundials Without Hour Lines

Although all of the dials mentioned so far in this article use hourlines, it is possible to design and construct sundials without hourlines. If a plate or the plane side of a body is placed so that it lies in an hourplane, the hourline is not necessary. The shadow caster may be of any profile which lies in the hourplane. An incised design or a cutout makes it easier to see exactly when the sun and the flat surface are in the same plane.

 Click for picture, 55 kB

Graphic 6. Model by Mac Oglesby

Graphic 6 shows a model of a sundial with 12 gnomons, one for each hour. Here they are placed in a regular way, as on a clock face, with the noon gnomon having two holes. The photo was taken at 10 am. The designer could have placed the gnomons anywhere, as long as the proper angles to the meridian and the horizontal were maintained.

 Click for picture, 22 kB

Graphic 7. Model by Kate Pond ©

Graphic 7 shows "Sunpo," a maquette by Kate Pond (4), a sculptor whose work is known worldwide. Proposed material for the full-sized sculpture is weathering steel, 3/4 inch thick by 40 inches tall (children sized). In the photo the numerals are placed along a north-south line, but they could also be placed randomly along a winding pathway on a hillside, in a formal circle, or in some other configuration depending on the site. Kate says she can envision the numerals in a park or children's playground, or at the center of a pedestrian outdoor mall, where people can ponder the passing of time. Children might amuse themselves by watching the shadows move and be climbing on the sculpture at the same time. Of course, when the shadow of a numeral is at its thinnest, then that numeral gives the time.

Other examples of shadow plane sundials may be found in an article by Gary Rolfe (5), who recently patented his designs.

Literature

1. *William S. Maddux, Mac Oglesby, Fer J. de Vries, "Shadow PlaneSundials", The Compendium, vol. 6 no. 3, september 1999.*
2. *Ignace Naudts, "Uurvlakzonnewijzers" (Hour plane sundials), Heelal (Belgian astronomical magazine), June 1993. Also published in the Bulletin of De Zonnewijzerkring, January 1994.*
3. *Denis Savoie (Paris, France), translated by Fred Sawyer, "The OldSundial of Catherine de Medicis' Column in Paris", The Compendium, vol. 6, no. 1, March 1999.*
4. *(4) Fred Sawyer, "Sculptor Kate Pond", The Compendium, vol. 1 no. 2, May 1994.*
5. *Gary Rolfe, "A Twist on the Helix Dial", BSS Bulletin 98.2 (June 1998)*

Appendix

(A) Calculations for a block sundial as shown in Graphics 4 and 5:

Each block is oriented parallel to an hourline and the hourlines are calculated as for a normal horizontal sundial, with the formula

*Tan z = Sin phi * Tan t,*

where phi = latitude of the place, t = hour angle of the sun, and z = angle of the hourline relative to the meridian.

An hourplane has an angle alpha with the horizontal plane,

Tan alpha = Tan phi / Sin z.

If G is the height of the rectangular block, the distance A between that block and its hourline is

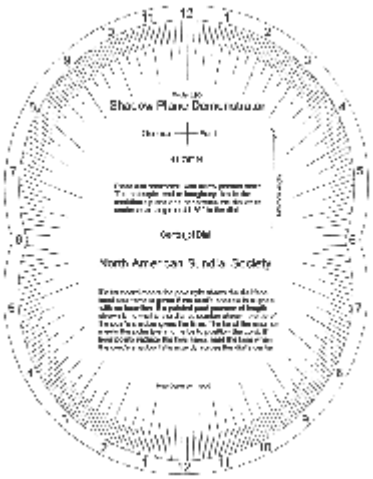
Tan alpha = G / A.

The length of the portion of the hourline needed depends on the sun's altitude at that particular hour during the course of the year. Considering the endpoints of the shadow casting edge of a block, calculate the shadow points for the sun's declinations of 23.5, 0, and -23.5 to choose the part of the hourline you want to use.

(B) Calculations for a sundial as shown in Graphic 6:

Each shadow caster lies in an hourplane which intersects the horizontal dial plate in a hourline which makes angle z with the meridian. The hourplane and the horizontal plane form angle alpha. Calculate z and alpha as given above.

(C) A Shadow Plane Demonstrator:



Click for picture, 66 kB

Graphic 8

To encourage experimentation with shadow plane concepts, we include a sundial plate (Graphic 8) with hourlines marked off on either side of the dial's center, although normally a sundial doesn't need both sets of hourlines. Although calculated for latitude 41.75 N, this dial may be easily used at other latitudes by raising its north or south edge. (For southern latitudes, renumber the hourlines.) A similar dial may be computed for vertical use.

To use this dial, put it horizontal (or, if necessary, rotated about its east-west axis for latitude correction) and place the two noon hourlines in the meridian. Hold a taut string at any angle or height so that a point on the string touches the (imaginary) polestyle of the dial. The string may meet the polestyle anywhere above the dial plate. The shadow of the string gives local solar time when that shadow aligns with an hourline.

In practice, it's difficult to maintain the string's position relative to an imaginary polestyle, so a pointed post of height indicated may be installed at the location shown. Now we can read the time shown by the tip of the post's shadow, should it fall in a location where there are hourlines. But we may also use the tip of the post to keep the string correctly positioned.

Since whenever the string touches the gnomon's tip and the string's shadow is aligned with an hourline the shadow crosses the dial's center, the hourlines may be replaced with hour points. Then the time is read when the string's shadow lies exactly across the center of the dial. Creating a large outdoor sundial is much easier, especially on uneven ground, if one only has to place hour points, rather than draw lines.

Small rectangular blocks may be used with this dial plate to illustrate dials similar to Graphic 5.

Endnote

Although in this article we have focused on horizontal shadow plane sundials, such dials may be constructed on any plane, no matter what inclination or declination. In those cases first calculate the equivalent location on earth where a parallel plane becomes a horizontal plane, and for that latitude and with the appropriate longitude correction calculate a horizontal dial as mentioned above. Keep in mind that the sun may not shine on such a plane during the whole day. To draw hourlines upon an irregular surface, projection can be used to determine those points where each hourplane intersects the surface.

Décembre 2004

Mon cadran "corde" à Bruz (35)

Menu

My "rope" sundial in Bruz, Brittany, France

Une fois n'est pas coutume, ce mois-ci le cadran du mois est une réalisation personnelle de mon jardin de Bruz en Bretagne qui intrigue mes invités et dont je ne sais pas définir le type.

ORIGINAL ? un cadran interactif sans aucun style !

Un cadran où le visiteur doit positionner lui-même le style (une corde) pour lire l'heure.
On voit mieux sur le cadran du Vermont.
Le cadran a été installé en août 2004 mais les dalles en pierre, fendues par la voiture ont été remplacées par des briques en septembre

Cliquez sur l'image pour l'agrandir

ORIGINAL ? an interactive one without style !

Original conception sundial where the visitor takes the style (a rope) to read the time.

The sundial has been installed in my garden in Bruz (Brittany) in August 2004.

Catégorie de cadran - *Sundial kind*

Cadran plan à corde mobile (catégorie définie par Pierre Joseph Dallet)
C'est le premier cadran de ce type enregistré en France mais pas le dernier.

Shadow plane sundial with a mobile rope, the first of this kind registered in France, but not the last.

Lecture de l'heure

Pour lire l'heure, il faut faire coïncider l'ombre de la corde avec une marque au sol en gneiss. Les heures sont également marquées par des dalles en gneiss, avec plusieurs dalles pour marquer 9h 12h et 15h.

Martin fait son exercice de lecture sur les photos : un peu plus de 16h (heure solaire vraie).

Cliquez sur l'image pour l'agrandir

Fonctionnement ... quelques indices et un peu de réflexion

Pour comprendre le fonctionnement, un moyen simple est d'imaginer un style polaire fictif situé entre le point d'ancrage de la corde et la marque au sol : ci-contre, ce style virtuel a été dessiné en rouge.
On remarque alors que la corde fait de l'ombre au style virtuel lorsque son ombre passe par la marque au sol, la corde se situe alors dans le plan formé par le soleil et le style.
Les marques horaires au sol sont donc symétriques à celles d'un cadran horizontal classique où l'ombre du style (réel cette fois) se situerait de l'autre côté.

Les points forts du cadran

Il est interactif, ce qui plait beaucoup aux enfants en particulier. Son fonctionnement n'est pas évident au premier abord, ce qui rajoute à son originalité. C'est un cadran pas très fréquent, bien qu'il soit facile à construire, c'est le premier en France. J'avais trouvé sur Internet deux cadrans similaires ci-dessous, ces cadrans m'ont donné l'envie de le comprendre et de le réaliser.

Autre avantages :
- il demande peu de moyens (une corde et des repères au sol) et il peut être installé assez facilement, même sur une zone passante comme dans mon jardin, il a fallu quand même que je remplace les dalles de gneiss par des briques plus épaisses et plus solides.
- il n'a pas besoin d'être entièrement éclairé, ce cadran a pu être installé dans une zone semi-ombragée du jardin (jardin magnifique mais très boisé, ce qui n'est pas simple pour les cadrans solaires).

Idées à développer

Essentiellement, l'idée des cadrans interactifs à corde qui pourraient être géants. Ce cadran pourrait également avoir une autre forme, verticale avec différentes déclinaisons ou équatoriale. On peut aussi faire des marques en 8, ou plutôt en double S pour afficher le temps moyen ou l'heure légale.

On peut imaginer d'autres idées à partir de ce principe.

Cadrans de type similaire — *Similar sundials*

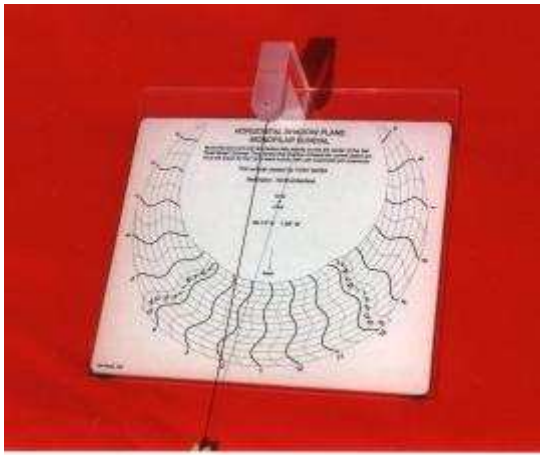
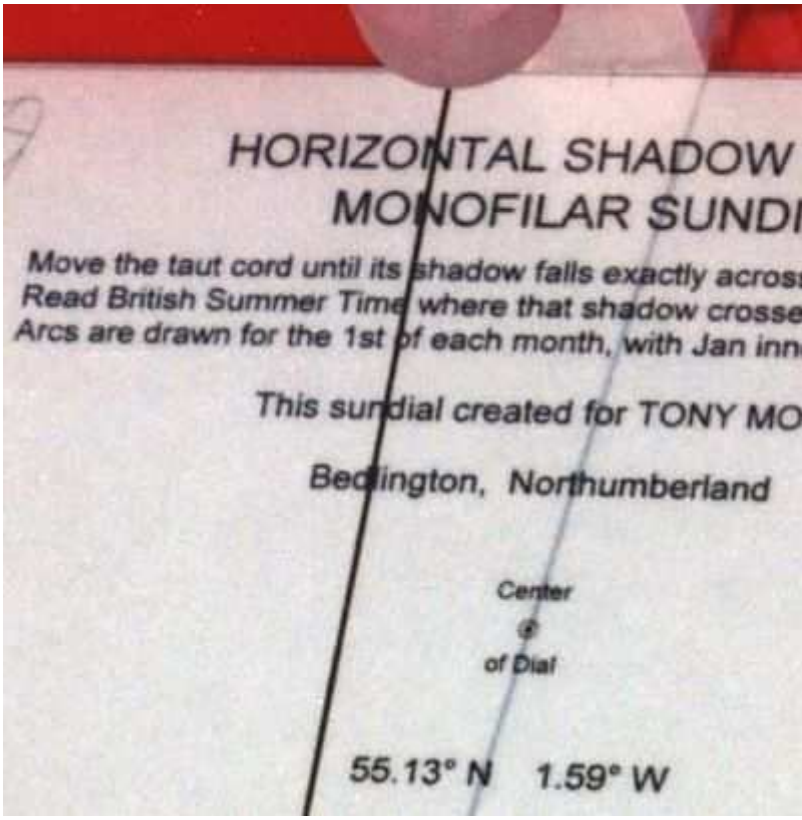


Photo Mac Oglesby

Cette maquette de démonstration a été construite en 2000
par Tony Moss et Mac Oglesby.

A droite un détail avec le mode opératoire (en Anglais)



En France, l'idée fait son chemin ...

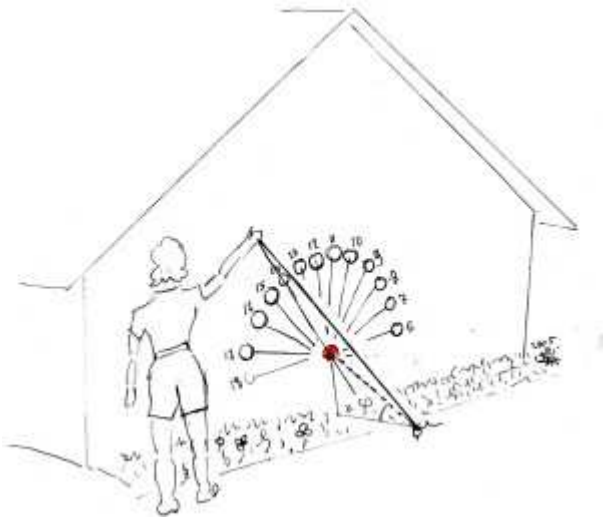
Pierre Joseph Dallet a fait une étude sur ce type de cadran et il commence à réaliser des cadrans dérivés de ce principe, m
pour ajouter à sa collection dans son parc du Limousin :

Un nouveau cadran qui plait aussi au chat

Détail où l'on voit aussi que c'est un cadran

Avec une devise de circonstance gravée sur la tranche :
"HORAM DO DUMMODO DIGITO PETATUR CELERE"

Qui peut se traduire par :
"je donne l'heure, seulement si, d'un doigt agile, on me la dema
"je ne donne le temps que si on me le demande d'un doigt agile



Et aussi un projet pour Sedan sur un mur vertical,

Les cadrans qui m'avaient inspiré - *Sundials who gave me the idea*

Westminster (USA Vermont)

For more information, see the NASS site.

Pays-Bas - Netherland

See more information, on dutch sundial society.

Un grand merci à Pierre Joseph Dallet, Tony Moss et Mac Oglesby qui m'ont aidé à compléter cette page.

Menu
