Gnomonic and Monumental Sundials in Cotentin

Monumental works of Lecoquière (1740-1807) § Dancel (1761-1836)

C18-19 catholic priests § teachers

By

Dominique Béneult (2018)

«…. *Il voit des gnomons partout*… »

Translation : Richard Ainsworth

Extant mistakes my own

.

Custom early C17 South facing sundial Alleaume ch. (Valognes)

Cadran solaire de l’église d’Alleaume, premier quart du XVIIéme siècle

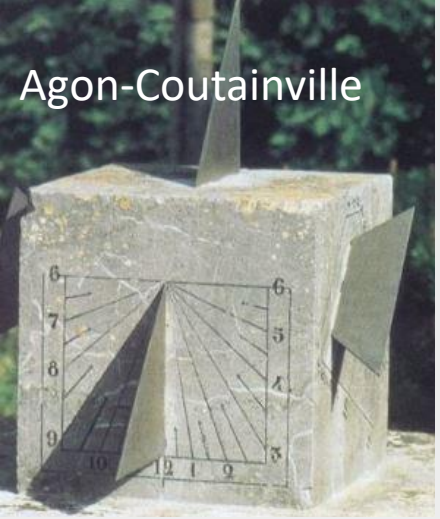
(Objets d’Art de la Manche)

Sundial theory

As the Earth rotates on its axis, so the Sun appears to move uniformly across the sky and if a rod is placed parallel to the Earth's axis its shadow will naturally move uniformly around itself.

In other words, as the Sun moves through an arc of 15° in the sky in one hour so will the shadow move at the same rate. This is the principle on which most sundials are based.

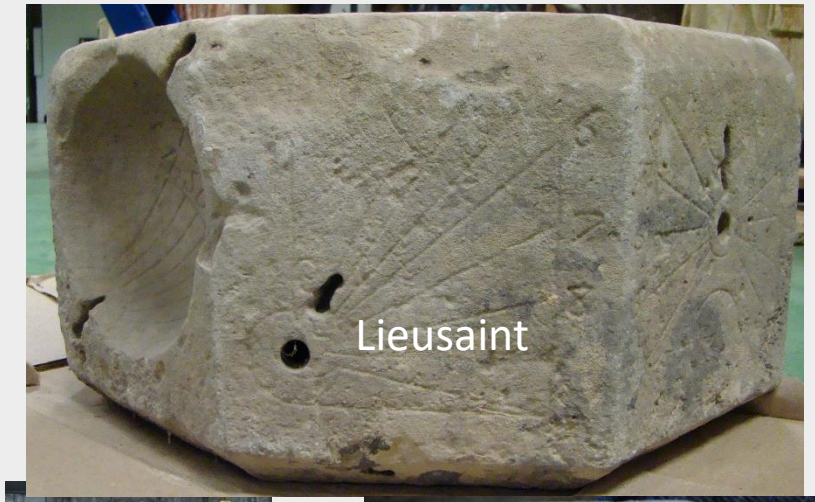
If the monument show several dials, it is called monumental dial, or polyhedral dial or multi faced dial.
Then all the styles of the multi faced dial are parallel and should show the same time.
Some examples in Cotentin


Agon-Coutainville


Equilly


Emondeville


NIGO - OGNI
Valognes


Lieusaint


St Martin le Hébert


Lycée Cornat


Magneville

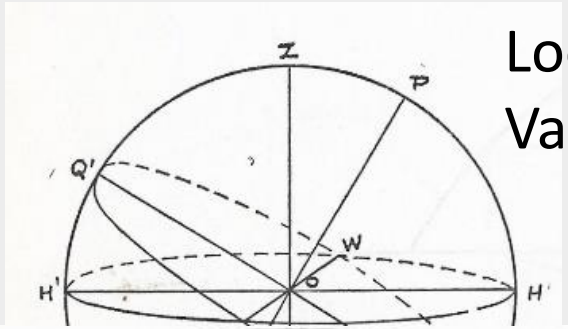

Valognes


Valognes

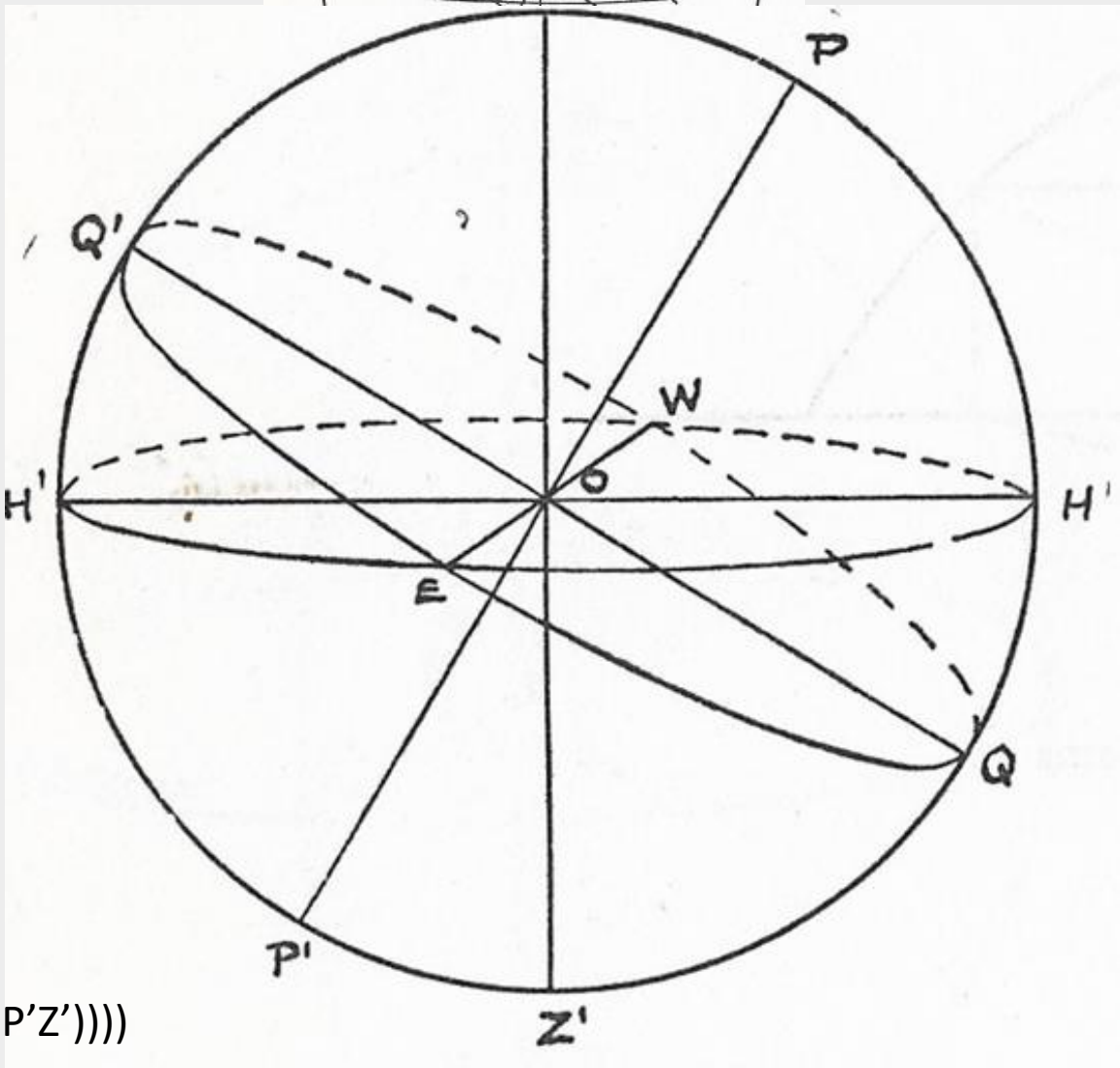
Cosmography is the study of the motions of the sun

Gnomonic is the use of cosmography to build sun dials

In both case you have to use mathematics, space geometry, spheric geometry and trigonometry



Local sphere
Valognes



Globe

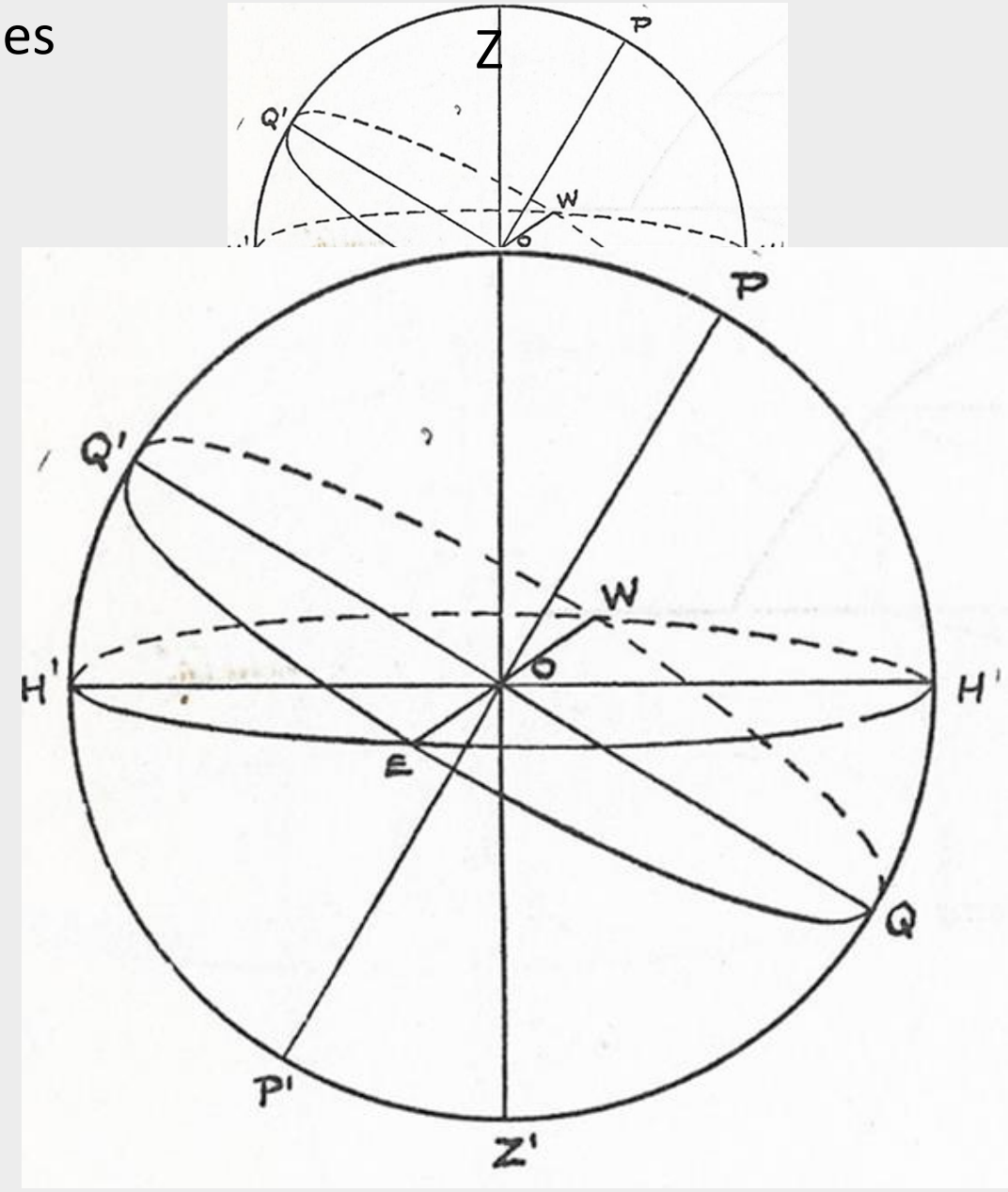
((((Pole line PP', Equator EQWQ', latitude POH, méridian plane HPZQ'H'P'Z'))))

Celestial sphere

Sun rays

Earth

Local sphere
Valognes



Assumption of cosmography and sundials is that all sunrays are parallel and reach the earth with the same angle because of the distance earth-sun.

« Tout se passe comme si » Everything happens as if Valognes / Portbail is the center of the world. This is wellknown here !
From this we are allowed to work and measure locally.
Having cut –off what is not useful, local sphere can be represented by the armilliary sphere, which is an universal sun dial, with no azimut no hour limit, nor latitude limit because the style can be adjusted to latitude.

04.30
PM

Equatorial sundial : Wheel divided in 24 hours = 15°each

The shadow of the style, set parallel to N/S poles line shows the local time on a table which is graduated in hours. To make a sundial, we need a style (pointer), table and graduations .

A sundial is designed according to latitude and position of the table: The table may be in any position.
Orientation is satisfactory when style or style edge and noon line are together in meridian plane.

If the monument has several dials, it is called monumental dial, or polyhedral dial or multi-faced dial. Then all the styles of the multi-faced dial are parallel and should show the same time.

Anything could be a style, only position and angle are important: for example this « manche à balais »
When pointed at polar star (latitude 49,5° N), orientated in meridian plane, it becomes a style: needs a table to show the shadow; could be any plane, but the best is this perpendicular wheel divided in 24 parts of 15° each = 1 hour. (360°/24=15°)

From spring equinox to autumn équinox the shadow will be on the upper surface, because declination is positive, from autumn equinox to spring equinox on the lower surface, because declination negative.

This is an equatorial sundial: It could be an auxiliary dial. Using a string I am able to draw another dial on any surface = It is possible to draw a sundial without mathematics.

Further we will speak of True sun time = local sun time :Tvg (time read on the sun dial)
And local mean time Tmg = Tvg + e e is equation of time
And universal time (time at Greenwich) TU =Tmg +G G is longitude (hours, minutes, seconds

Back to C18

Tower clocks in use from C13, table clocks and watches from C16, why an interest in sundials C18 ?
The clocks were expensive and the only way to check and reset them was a sundial especially at noon time.

Bénédictine Mauriste Dom François Bedos de Celles, of Académie Royale des Sciences de Bordeaux, published in 1760 “La Gnomonique pratique, ou l’Art de tracer les cadrans solaires avec la plus grande précision, par les meilleures méthodes, mises à la portée de tout le monde «
This was the up to date treatise.

L A

GNOMONIQUE
PRATIQUE,

OU L'ART DE TRACER

LES CADRANS SOLAIRES

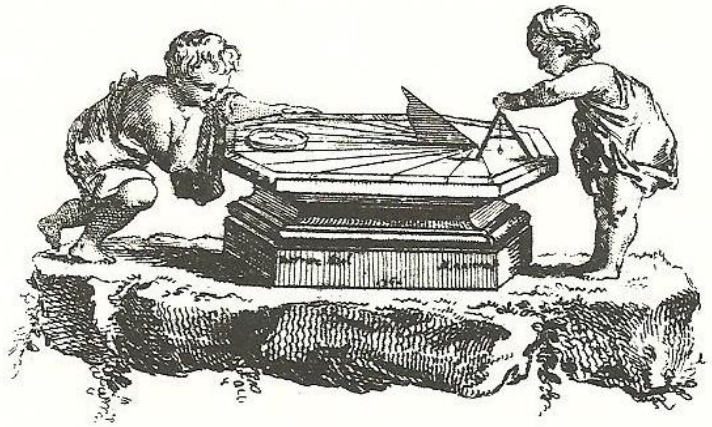
AVEC LA PLUS GRANDE PRÉCISION,
PAR LES MEILLEURES MÉTHODES, MISES A LA PORTÉE DE TOUT LE MONDE.

AVEC
Des Obſervations ſur la maniere de regler les Horloges.

DÉDIÉ
A MM. de l'Académie Royale des Sciences de Bordeaux.

Par Dom FRANÇOIS BEDOS DE CELLES, *Bénédictin de la Congrégation de S. Maur, de la même Académie.*

Prix, 6 liv. en feuilles, & 7 liv. relié, même dans les Provinces.

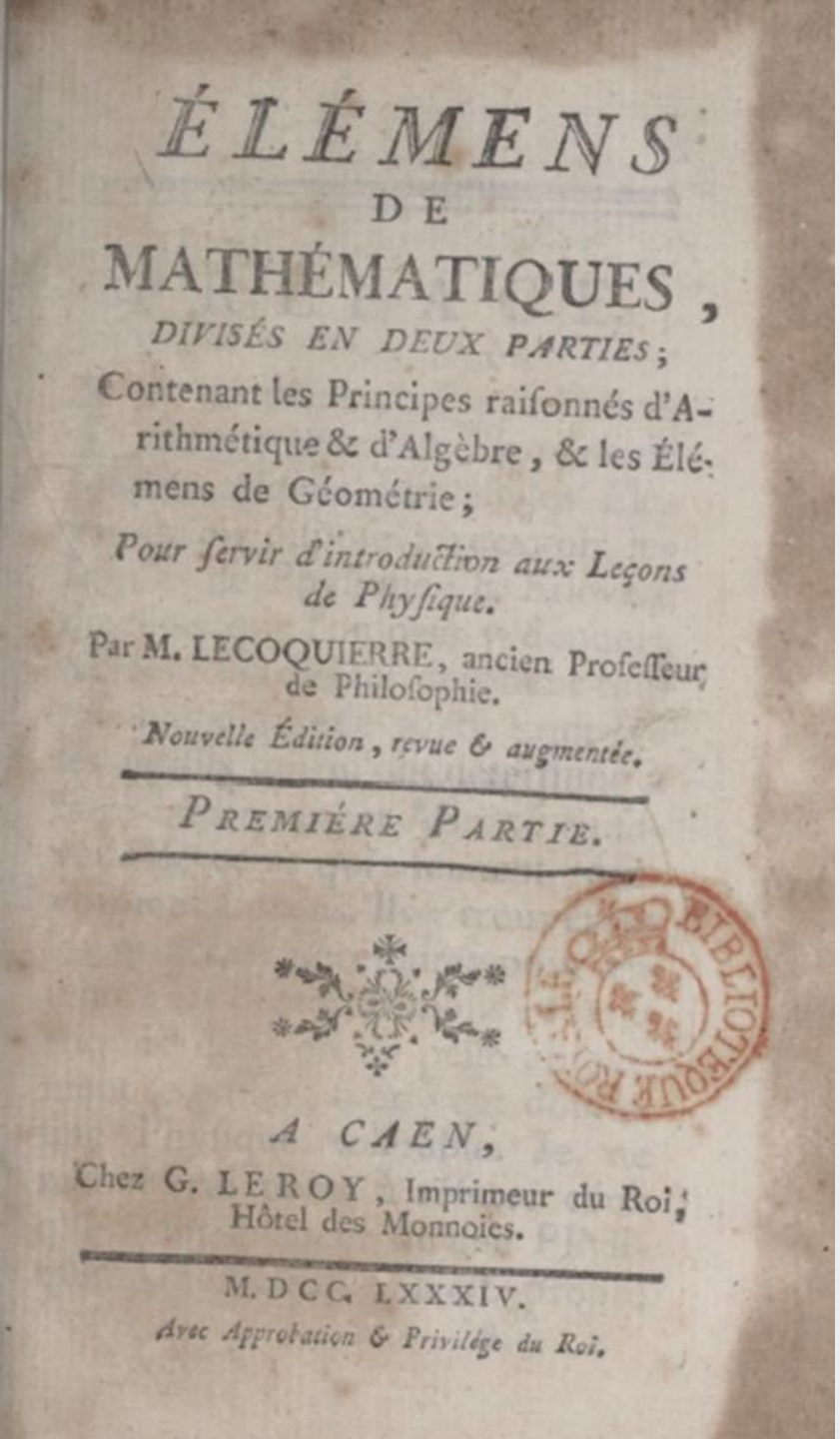


A PARIS

First actor of the Valognes gnomonic saga :
Jean François Lecoquière (1740-1807) Eudiste priest and teacher;1773-1782, Philosophy teacher, Valognes Seminary, now Lycée Henri Cornat.

Then University professor in Caen.
 Emigrated to England and Russia during French Révolution (1791-1802) ; 1802 Chaplain in nuns covent in Caen , died 1807 in Caen.
Member of Société académique de Cherbourg from 1775.

In Valognes seminary, he teached philosophy and mathématics (1773 -1785) and published « Abrégé des éléments de géométrie pour servir d'introduction aux leçons de physique…. »
He designed and built sundials.



ÉLÉMENS
DE
MATHÉMATIQUES,
DIVISÉS EN DEUX PARTIES;
Contenant les Principes raisonnés d'Arithmétique & d'Algèbre, & les Élémens de Géométrie;
Pour servir d'introduction aux Leçons de Physique.
Par M. LECOQUIERRE, ancien Professeur de Philosophie.
Nouvelle Édition, revue & augmentée.
PREMIÈRE PARTIE.
A CAEN,
Chez G. LEROY, Imprimeur du Roi, Hôtel des Monnoies.
M. DCC. LXXXIV.
Avec Approbation & Privilége du Roi.

Mercure de France , 12 novembre 1785, p. 142 :

Élémens de Mathématiques pour servir d'Introduction aux Leçons de Physique, par M. Lecoquierre, ancien Professeur de Philosophie. A Caën, chez Leroy. Prix, 1 liv. 16 sols broché.

Cet Ouvrage contient l'Arithmétique, l'Algèbre jusqu'aux Equations du second degré, la Géométrie & la Trigonométrie rectiligne & sphérique, dont on ne peut se passer si on veut faire quelques pas dans l'Astronomie. On y a ajouté des Tables de logarithmes, des sinus & tangentes de 15 en 15 minutes de degré, & des nombres naturels jusqu'à 360, afin que les jeunes gens puissent s'exercer à faire quelques opérations sans être obligés d'acheter des Tables plus étendues, qu'un grand nombre ne pourroit pas se procurer facilement. Depuis un an que cet Ouvrage paroît, il a déjà été adopté par six Colléges, ce qui est un bon préjugé en sa faveur.

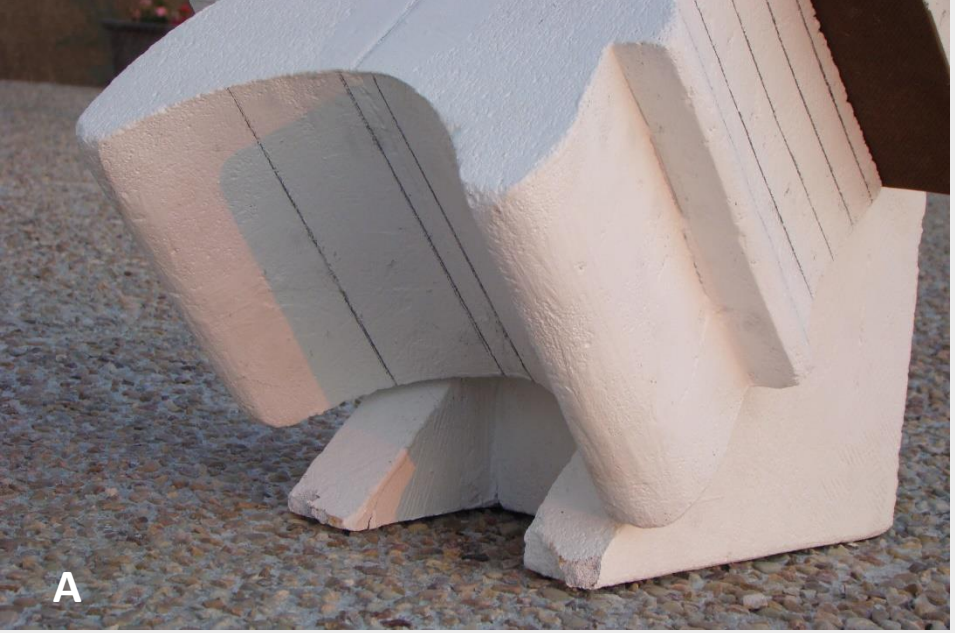
La trigonométrie »rectiligne » et la trigonométrie sphérique sont les éléments indispensables au traçage des cadrans solaires par le calcul.

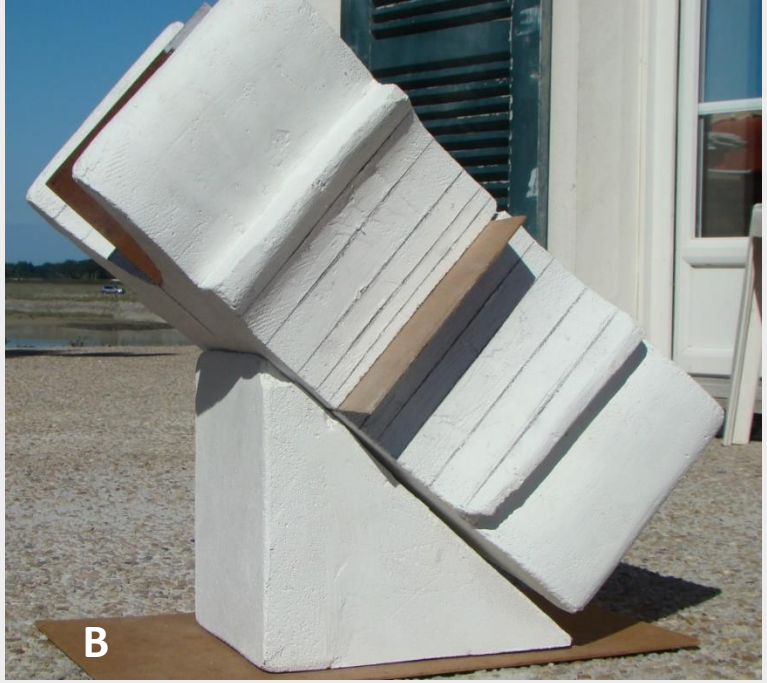
This one, still to be seen in the garden of Lycée Henri Cornat

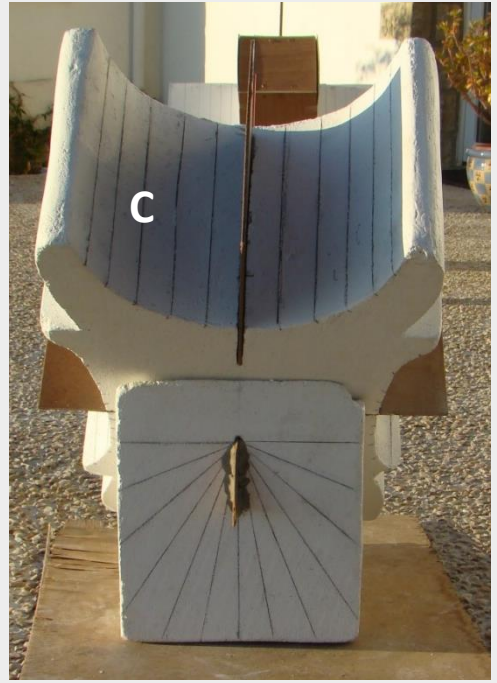
Multi faced monumental sundial with 6 dials: 1 equatorial on top
1 vertical south facing
2 polar equatorial curved dials (East and West facing)
2 Polar equatorial hemicylindric dial

Styles lost, worn, weathered, badly orientated

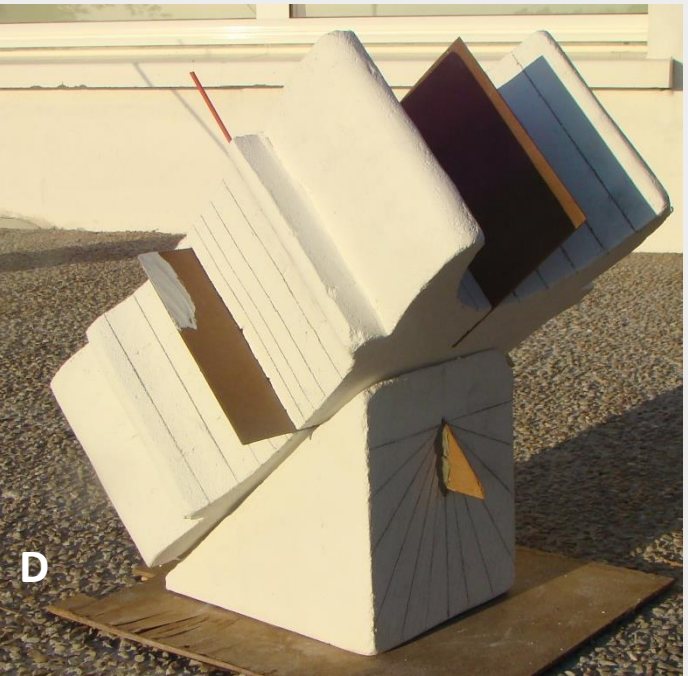
1908:
Well
oriented
2019
Badly
oriented

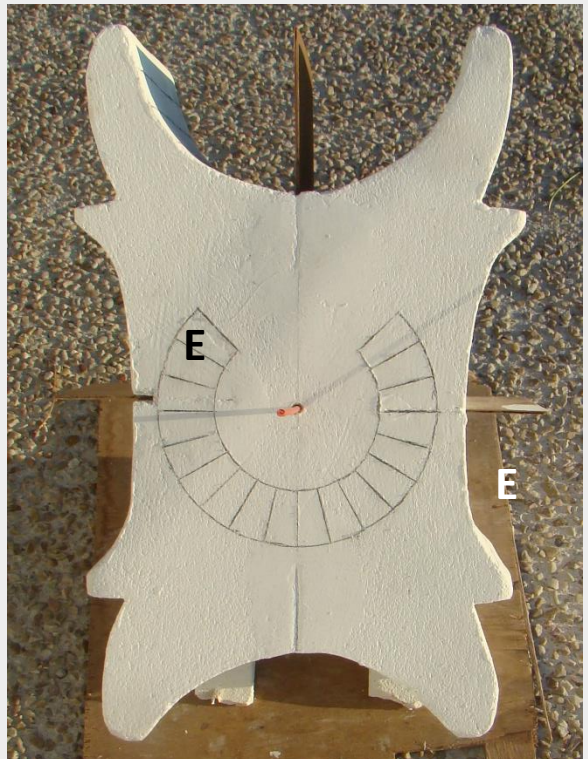


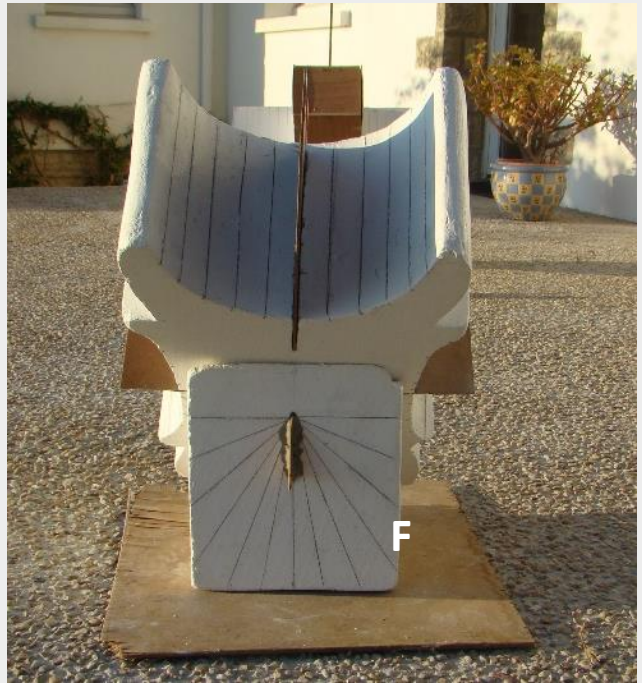


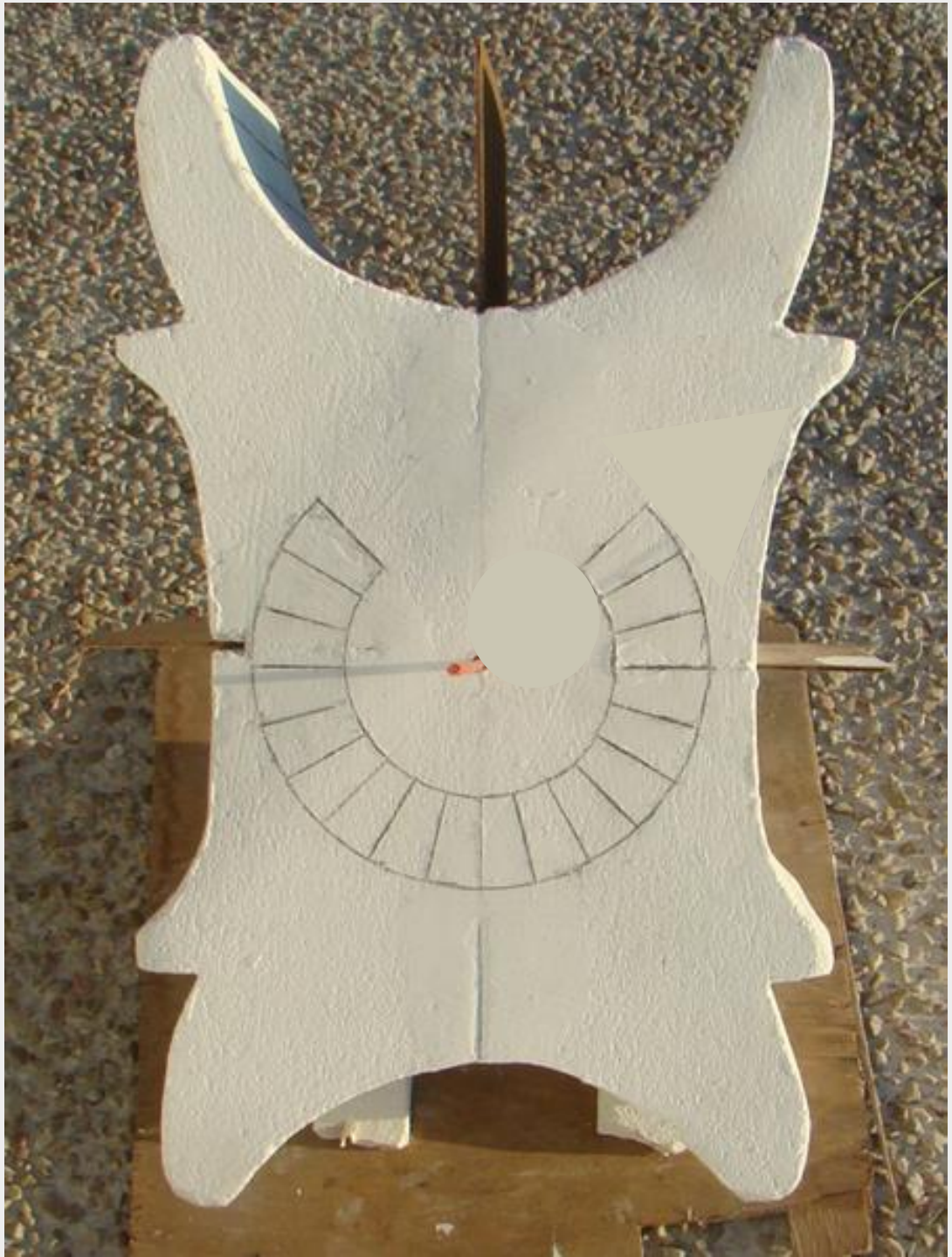


C









E Cadran équatorial

La table est parallèle au plan de l’équateur

Le Gnomon est parallèle à l’axe du monde

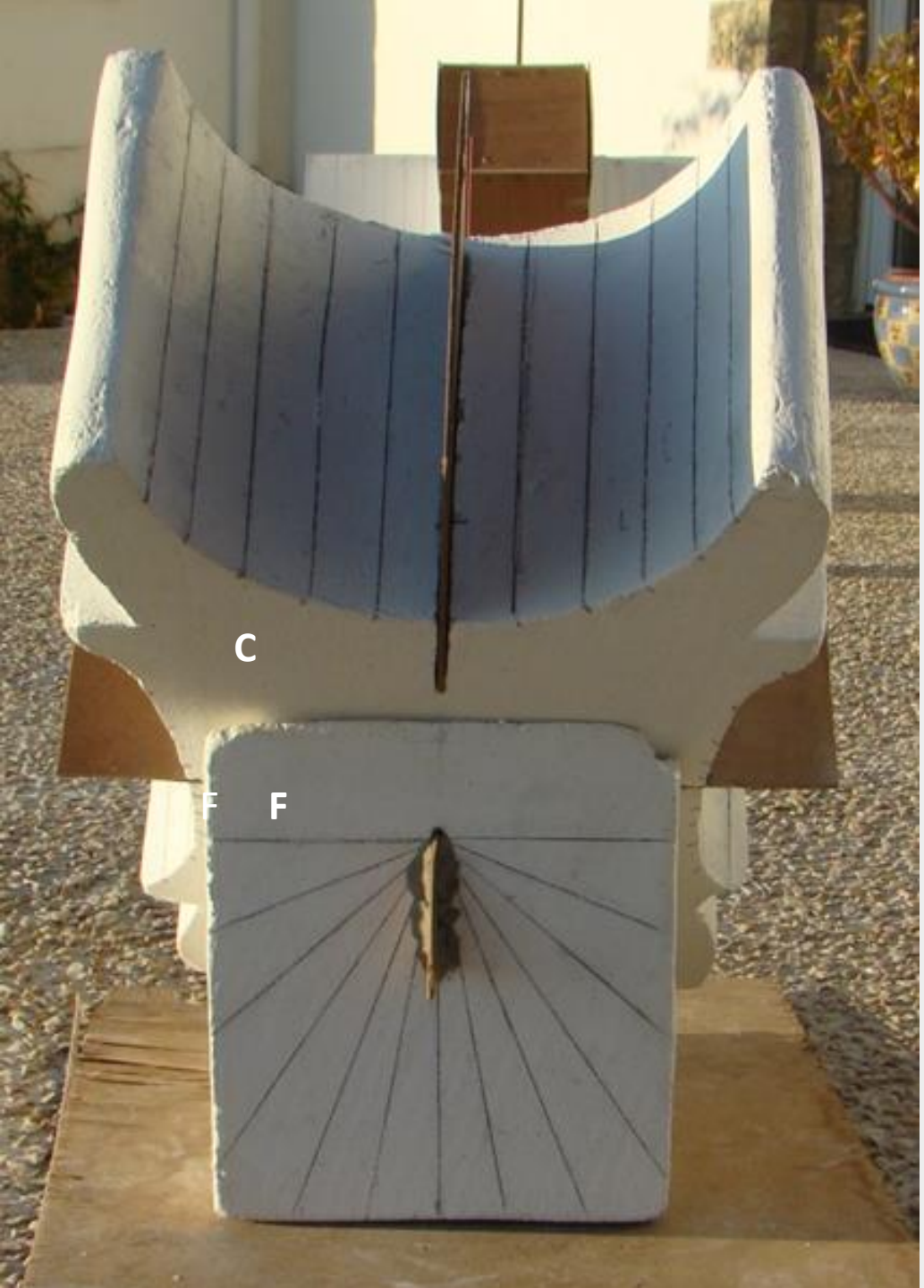
Lecture : 05h50 heure solaire vraie PM (Tvg)

A Cadran septentrional polaire

06h35 heure solaire vraie PM (Tvg)

B Cadran oriental polaire à table courbe

Lecture :9 h heure solaire vraie AM (Tvg)



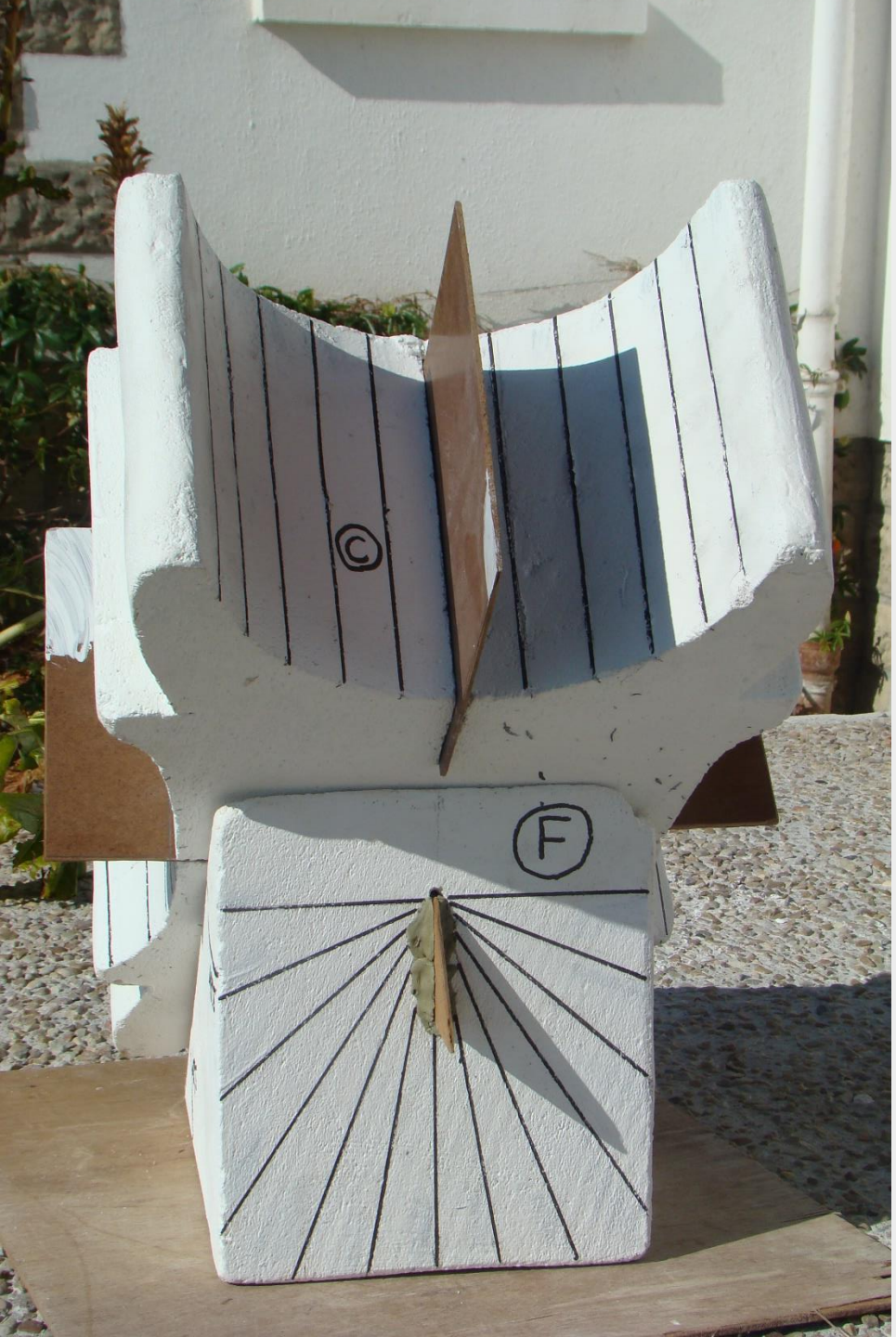
C cadran méridional polaire cylindrique: la table est un demi cylindre

F Cadran méridional vertical

Lecture : 05h30 heure solaire vraie PM

D Cadran occidental polaire à table courbe (curvilinear)

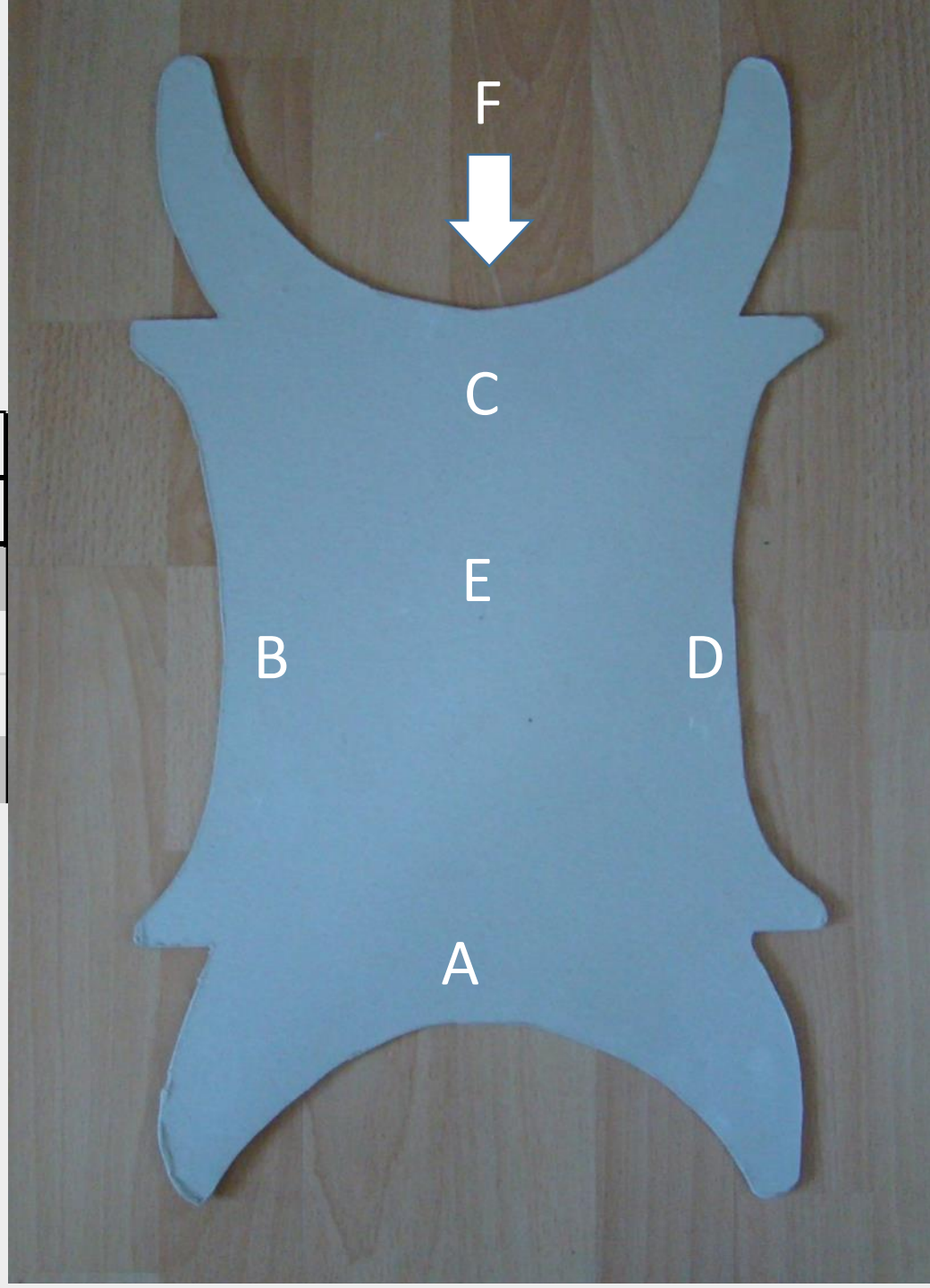
Lecture :05h30 heure solaire vraie PM (Tvg)

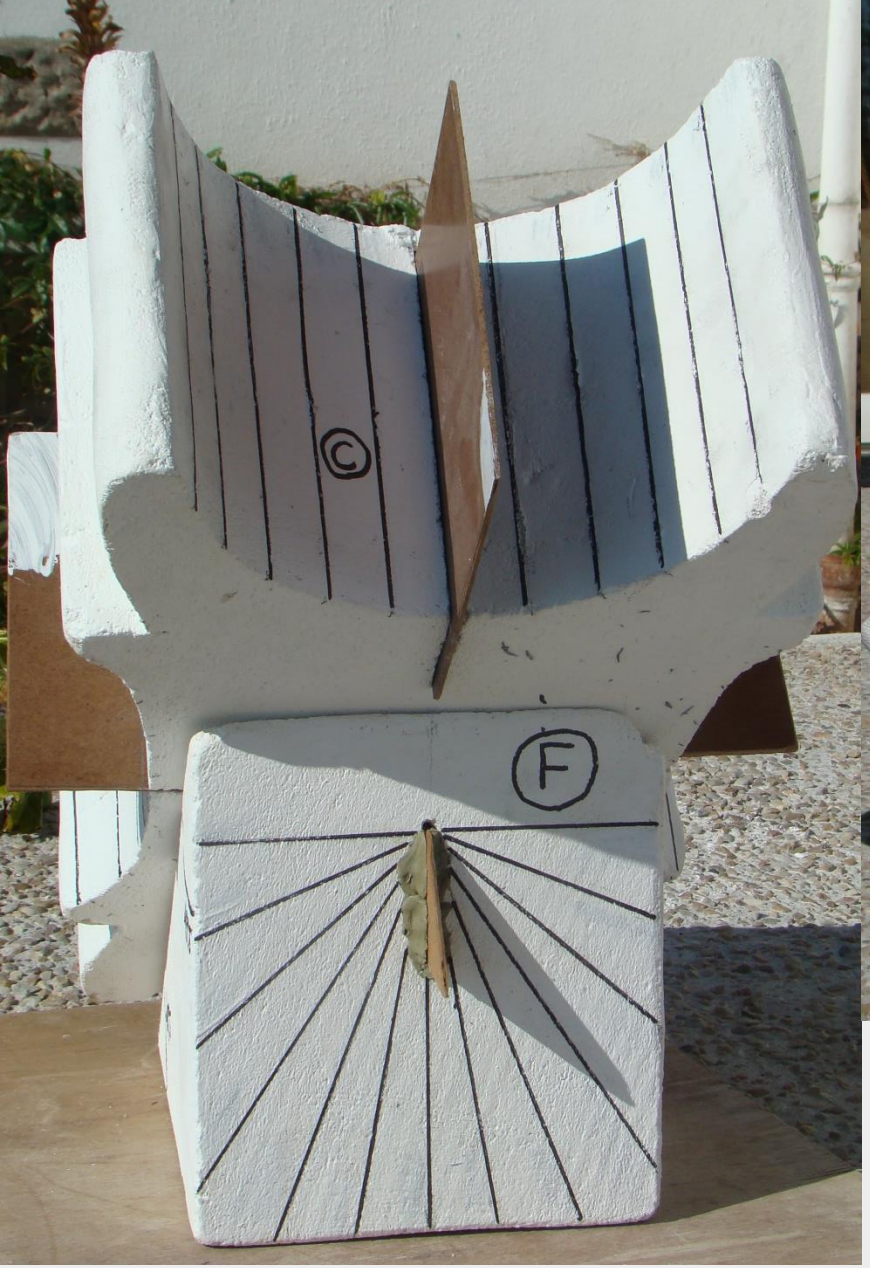


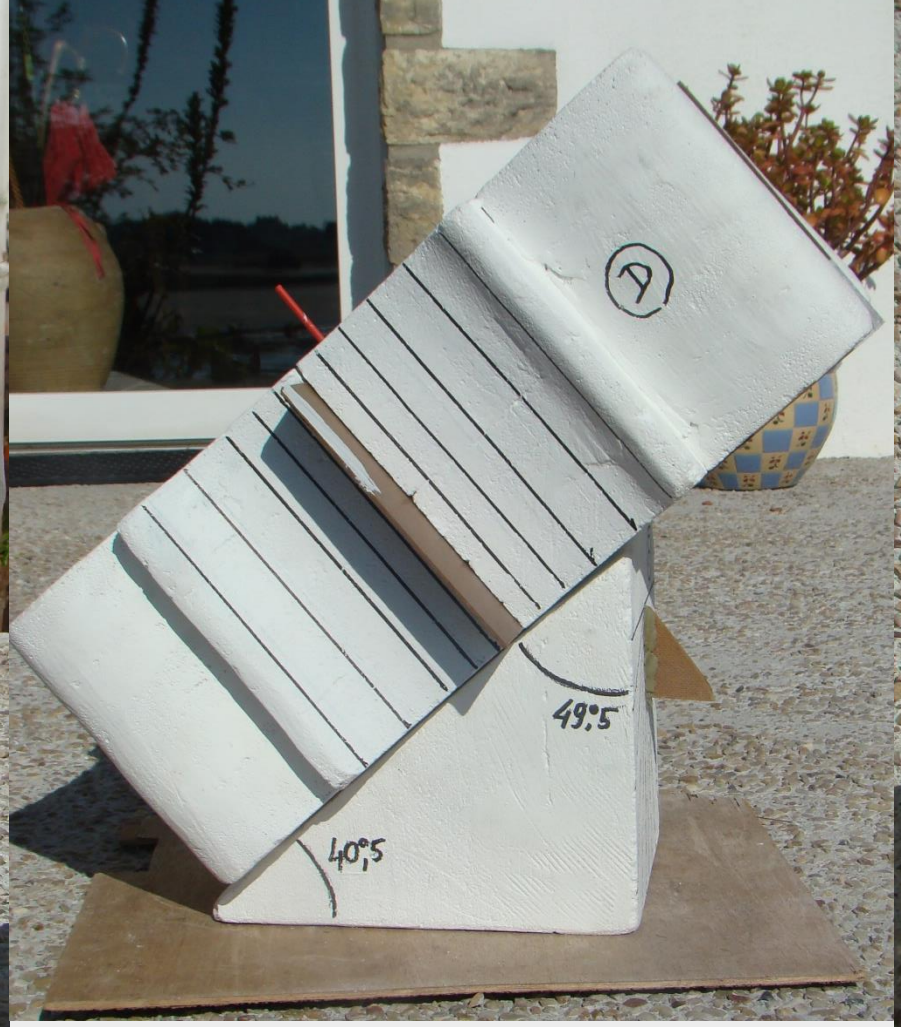
F Cadran méridional vertical

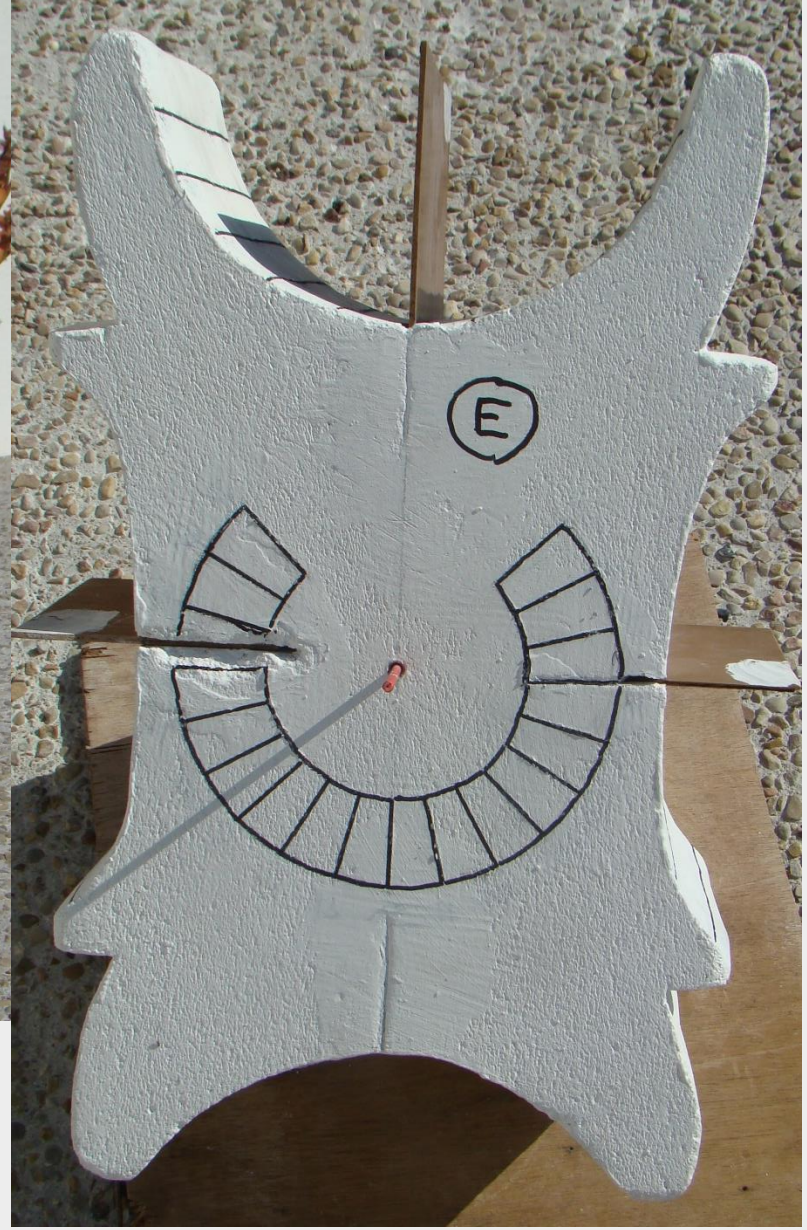
Lecture : 03h20 PM (Tvg)

	Printemps- Été	Automne -Hiver
Heure solaire	21Mars au 21 Septembre	21 Septembre au 21 Mars
4-6	A,B,E	N/A
6-12	B,C,E,F	B,C,F
12-18	C,D,E,F	C,D,F
18-20	A,D,E	N/A





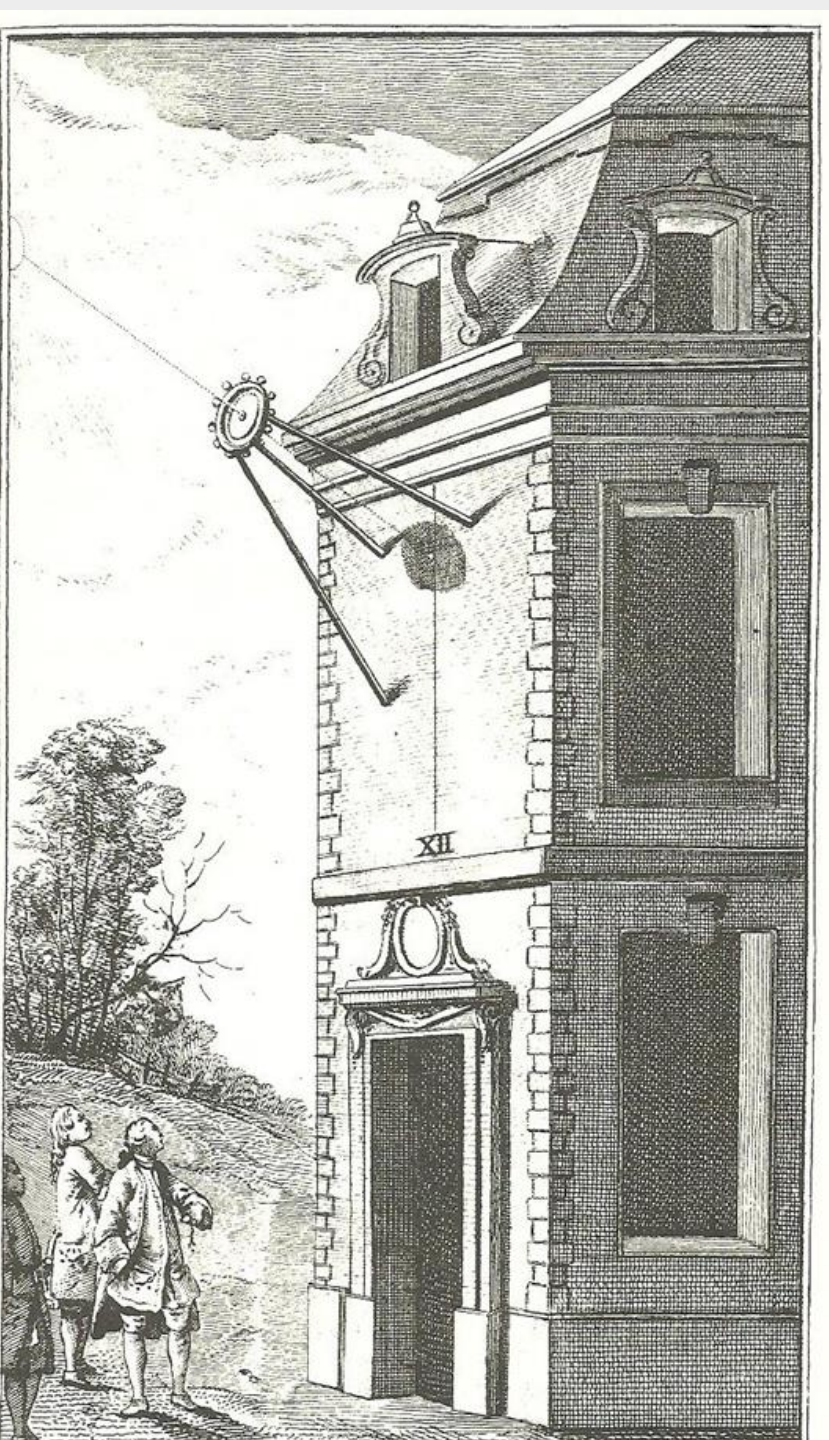




Cadrans C,D,E, F :
Lecture : 03h20 PM le 11 Septembre 2018
(15h20)

Les quatre cadrans indiquent la même heure : 03h20 PM heure solaire vraie (Tgv)
Soit Tmg = 03h20 – 4mn = 03h16. et Tco = 03h16 + 5mn 31s = 03h 21mn 31s (G =1°28’ W)

Noon dial (Passage du soleil au méridien supérieur du lieu)

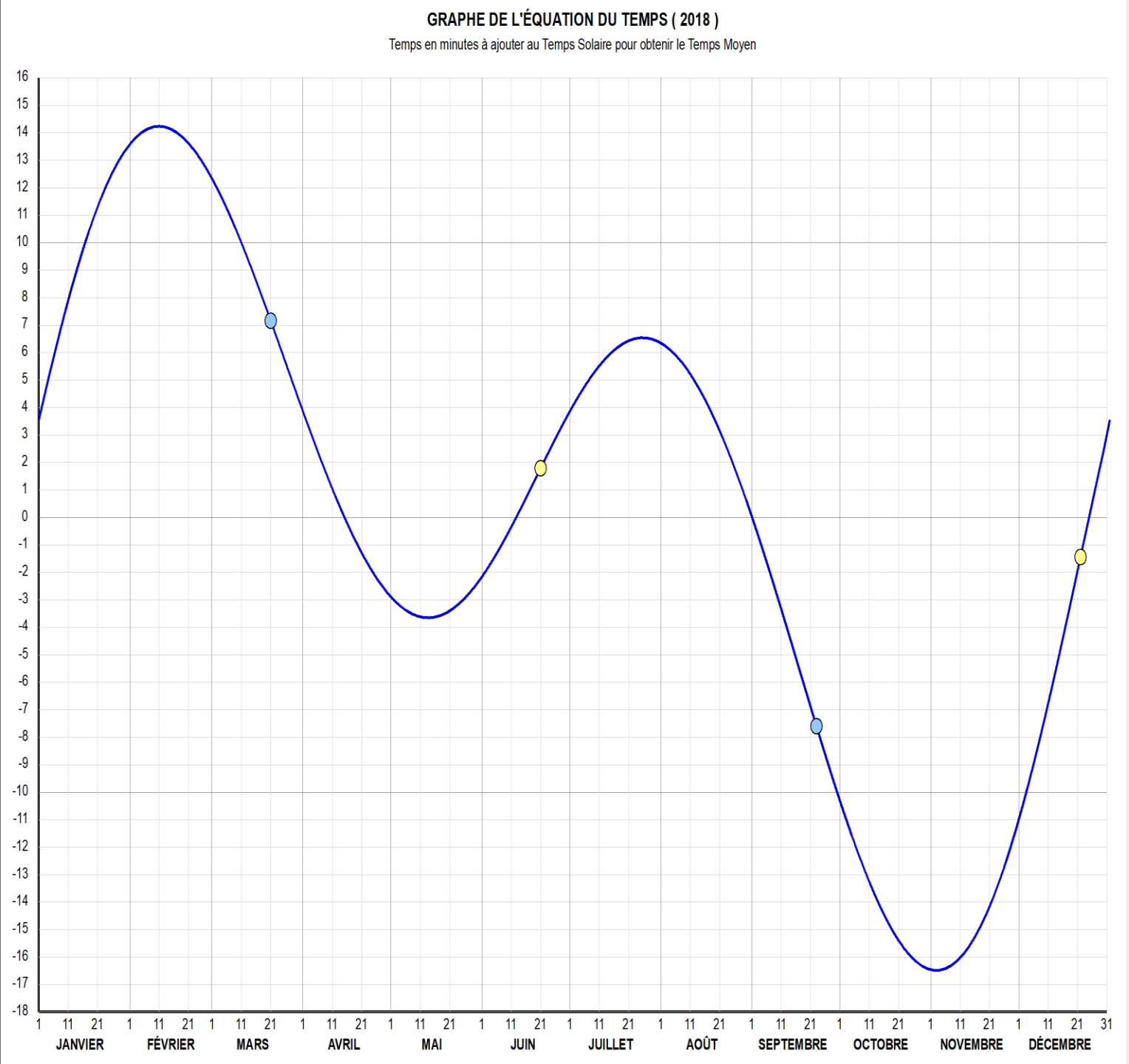


Méridienne verticale (Dom Bedos de Celle)

Méridienne verticale et horizontale de St Sulpice

Because the Earth's distance from the Sun varies throughout the year and also because its equator is inclined to its orbit (by 23.5°), there is a difference between apparent solar time (time told by the Sun) and mean solar time which is the time kept by mechanical and electrical clocks. In fact it is possible for the Sun to be as much as a quarter of an hour fast or slow when compared with a clock which keeps mean solar time (i.e. Greenwich Mean Time). This difference is called the equation of time.

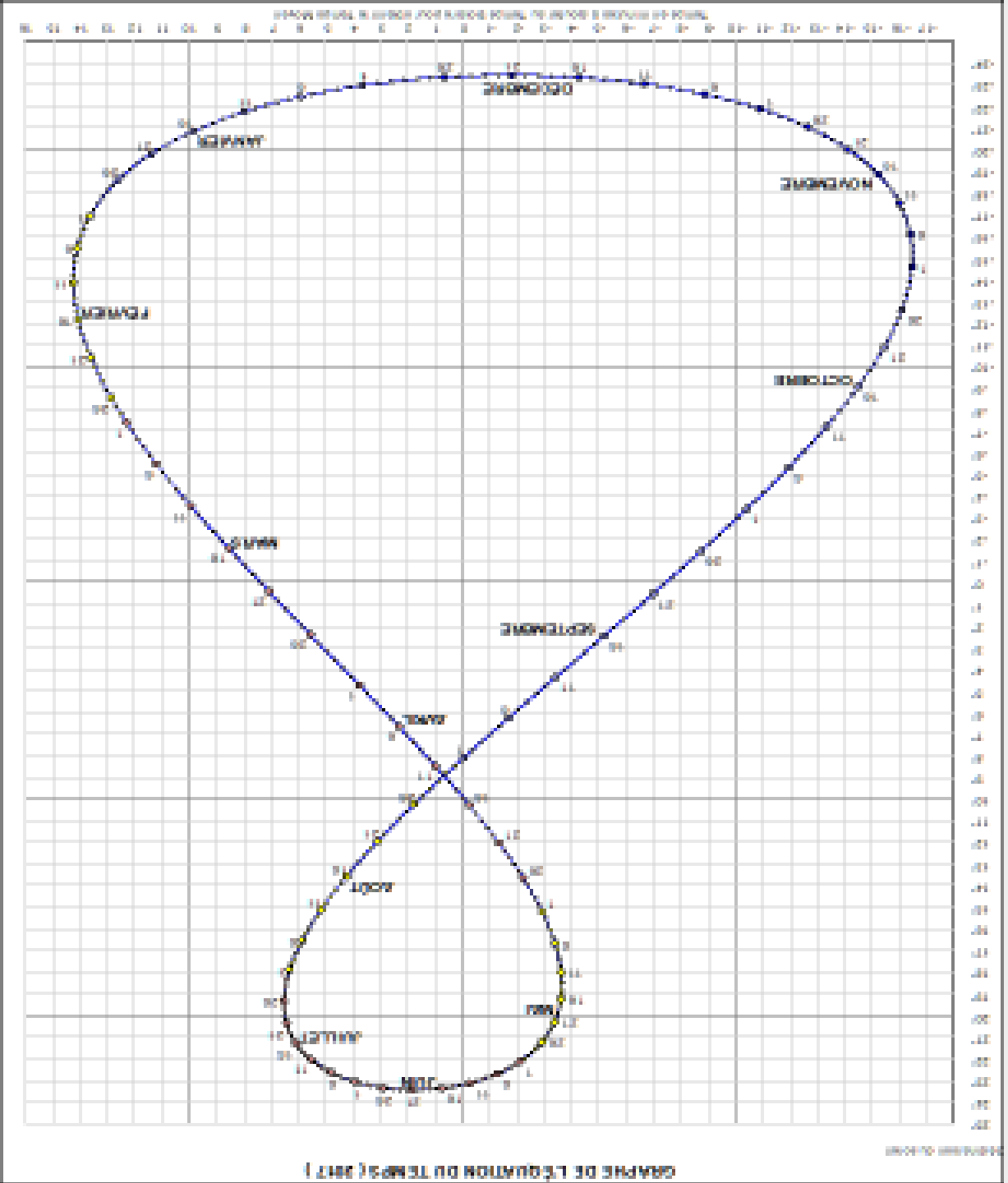
The speed of the relative motion of the sun is not constant as we need it to be.
Dial time, (Tvg) needs to be corrected to keep a constant day length all year round.
Corrections are known and calculated from Ptolémée (C2), published every year in almanacs.
But it is not so easy.
One can draw the correction on a diagram.



One can draw the correction on a diagram.

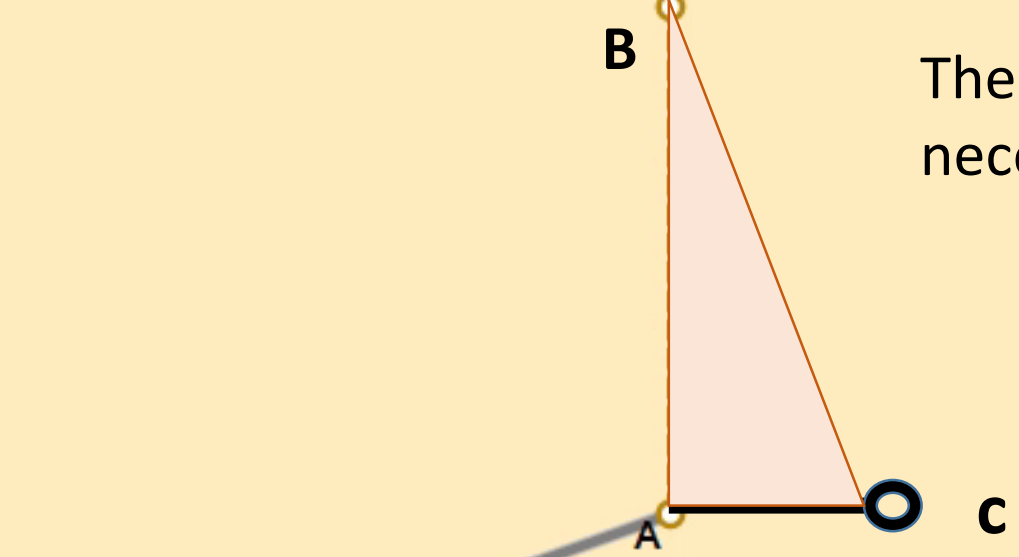
Not so easy again.

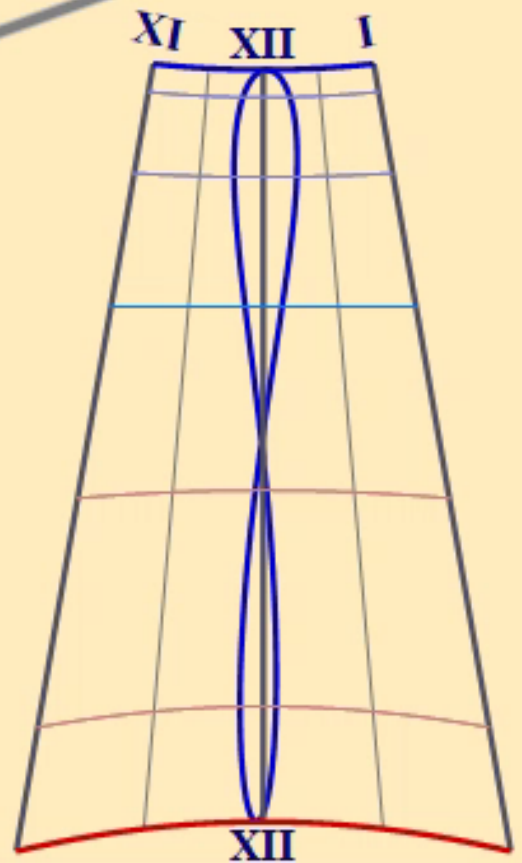
Grandjean de Fouchy got the idea in 1730:
To draw the diagram on the dial table: it is named courbe en 8 ou analemme, on a vertical dial, dates in T and correction in X: the diagram is a flattened 8

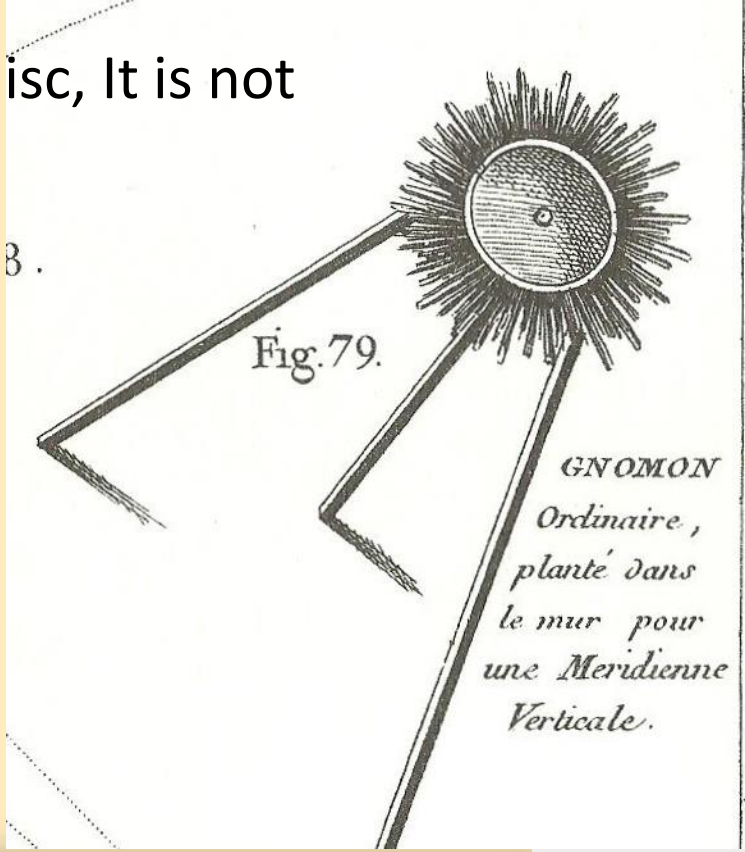


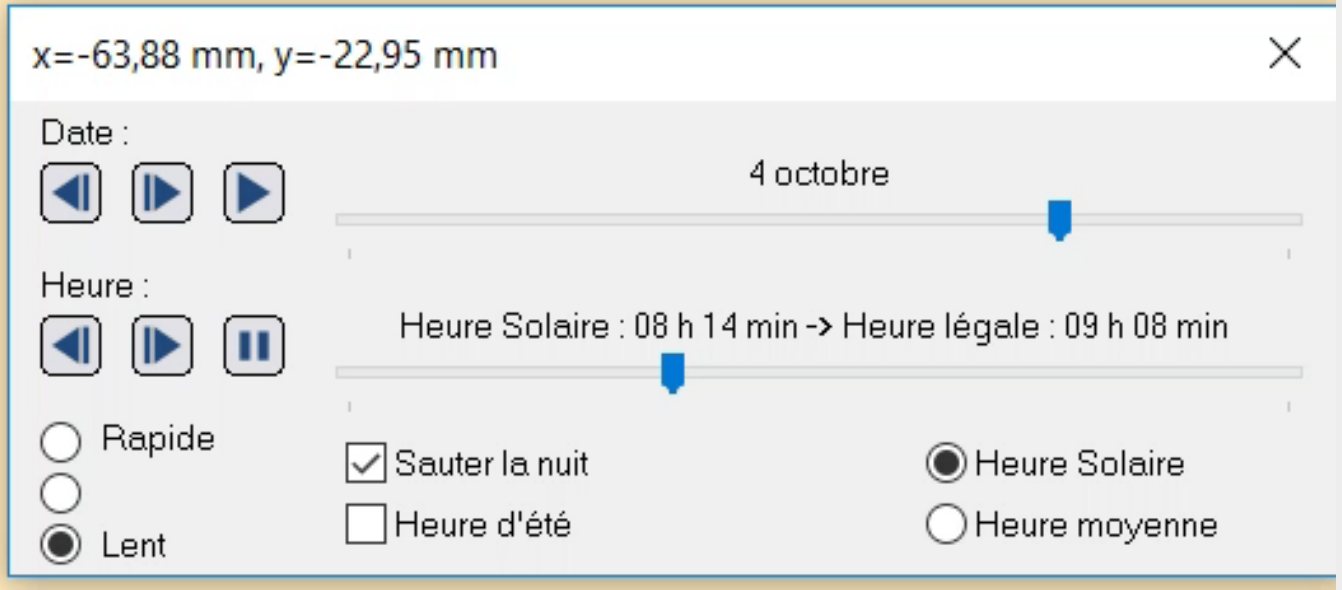
On a vertical noon dial , the winter solstice is at the top and the summer solstice is at the bottom

The useful part of the style is the disc, It is not necesserary to build a full style









This device gives Local noon mean time without any calculation. Many were built after 1730
First one in Hôtel du Petit Luxembourg, Paris by Grandjean de Fouchy , Académie Royale des Sciences member.
 This is only of use between 11 AM and 1 PM., but it is interesting to extend the dial vertically to improve precision.

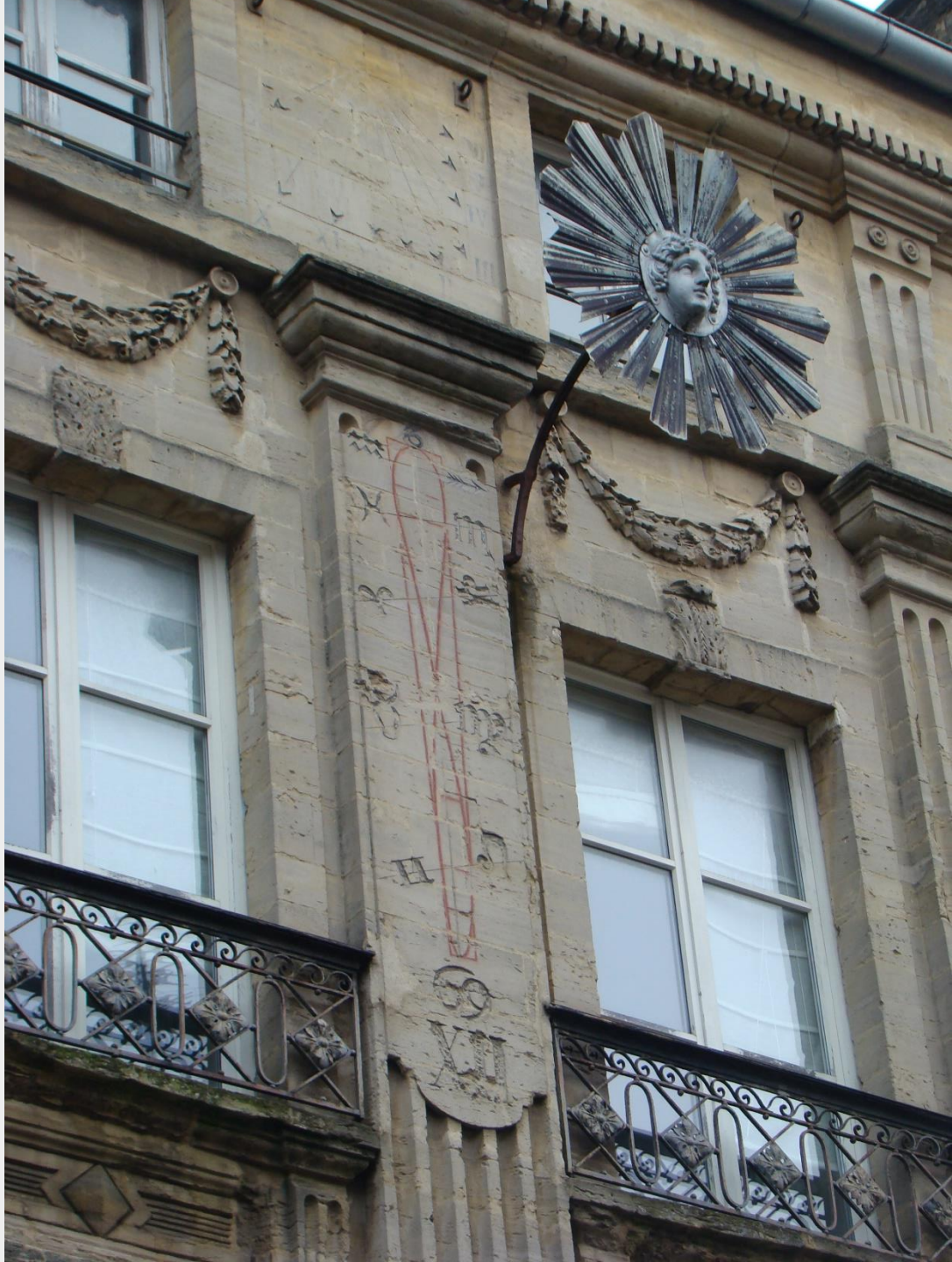
It is Noon local mean time when the shadow of the style crosses over one branch of the diagram
The months or the zodiac to be written beside the diagram to remove the ambiguity between the 2 sides.

This is now a mean time noon dial, a small hollowed disc is set at the end of the style . The annular shadow allows a more accurate observation .

Bayeux

7 rue Saint Martin

1794-96



Rennes Hôtel de Ville
(vers 1760)
(Photo Jean Brissot)

Détail du cadran solaire de l'hôtel de
l'hôtel de ville

Second actor of the Gnomonic saga in Valognes, Jean Charles Richard Dancel (1805-1827)

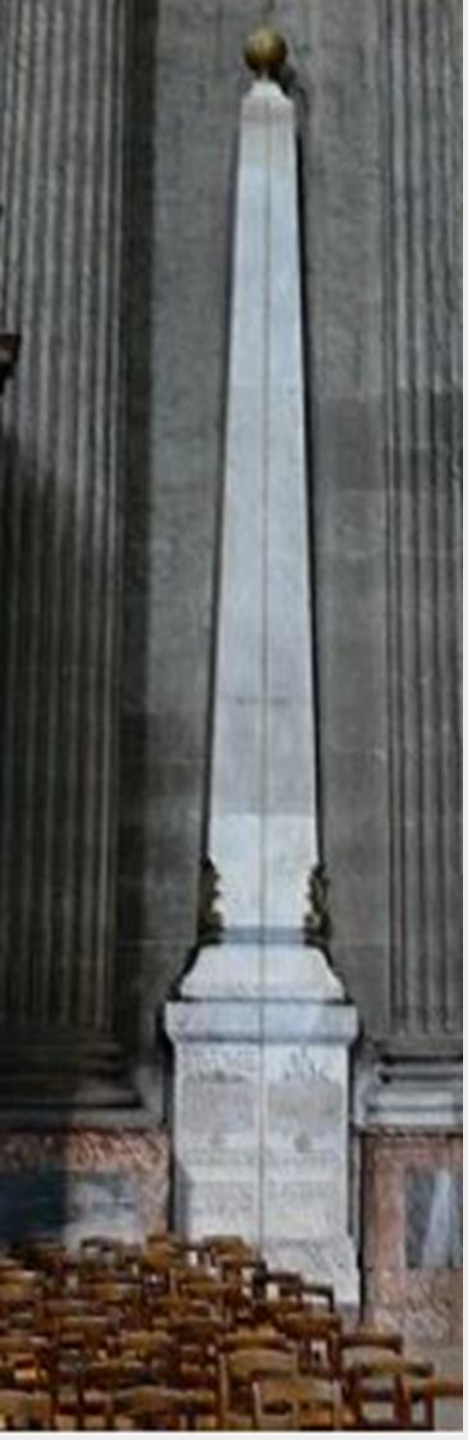
Born 1761 in Cherbourg,
Student in Valognes seminary where Lecoquière was his teacher in Philosophy and Mathématics (1773 -1785); (At that time the multifaced Dial has been built)
Priest, teacher and lecturer in philosophy and mathematics after studying in Sorbonne Paris.

Emigrate in England 1791 because of French Revolution .
1792-1802 Teacher in philosophy and mathematics St Edmund Collège, Herfordshire. Head teacher 1800-1802.

Incumbent priest in Valognes, 1805-1827
He had one pyramid built in his garden.
Member of Cherbourg Academy as Lecoquière in 1807.
Became 1827 Bishop in Bayeux where he died 1836

Dancel’s « pyramid » in Valognes : An unfinished mean time noon dial.

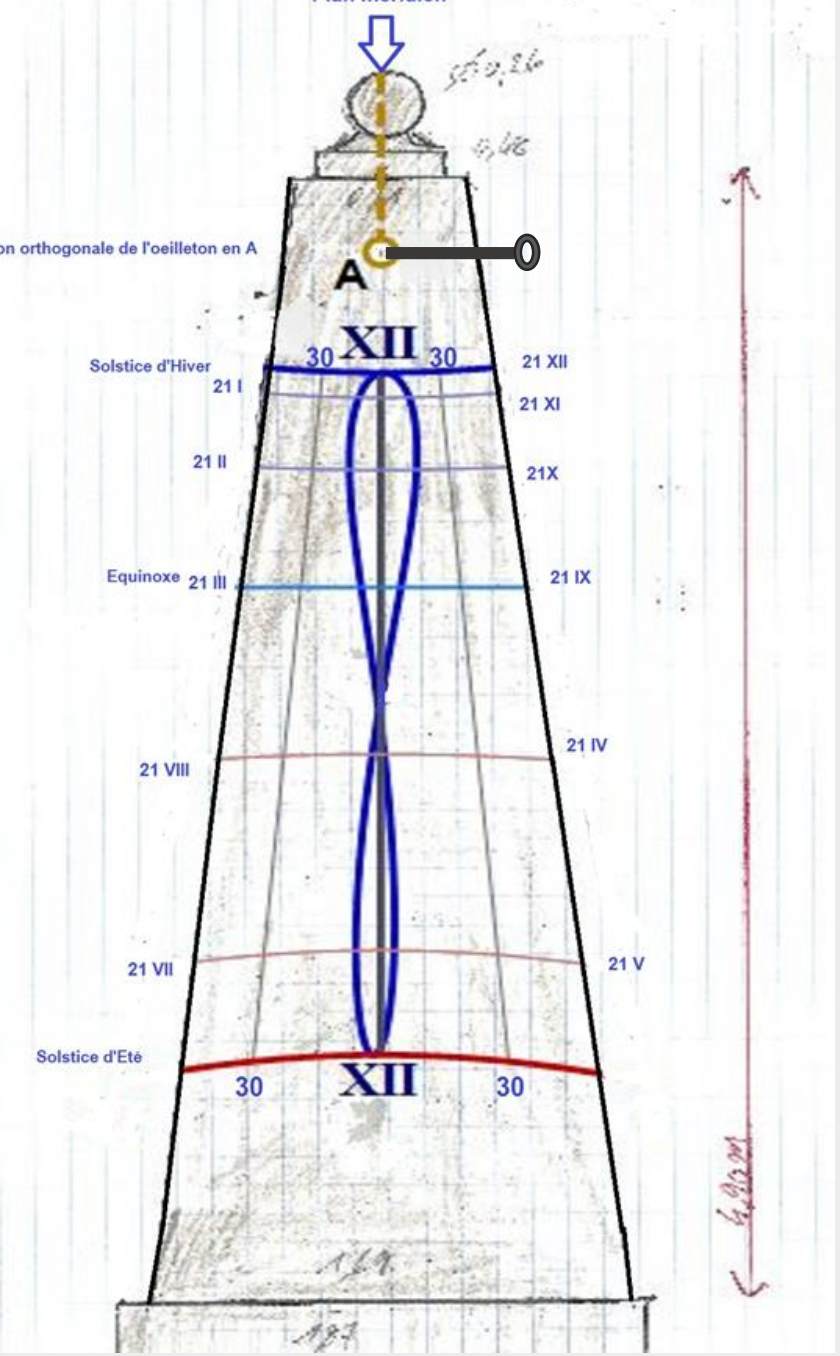
Jardin du Presbytère, rue de l’église , Valognes.



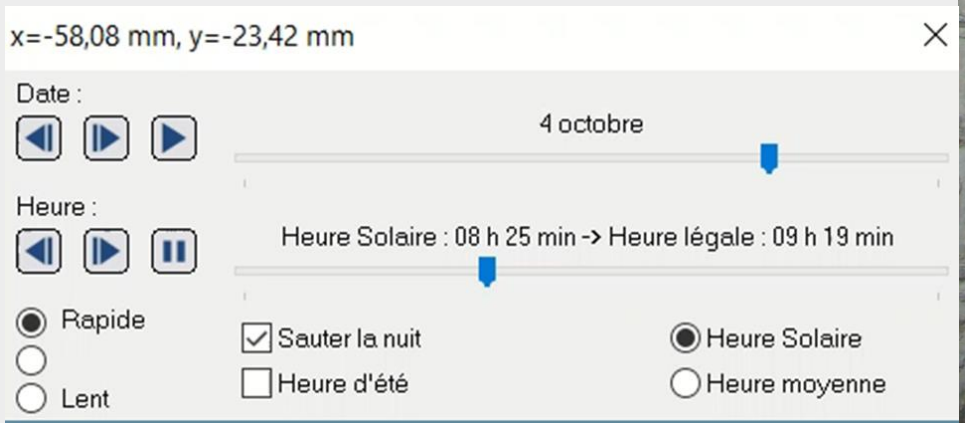
It looks like the large noon dial in St Sulpice church in Paris, where Dancel had been a student and a teacher.

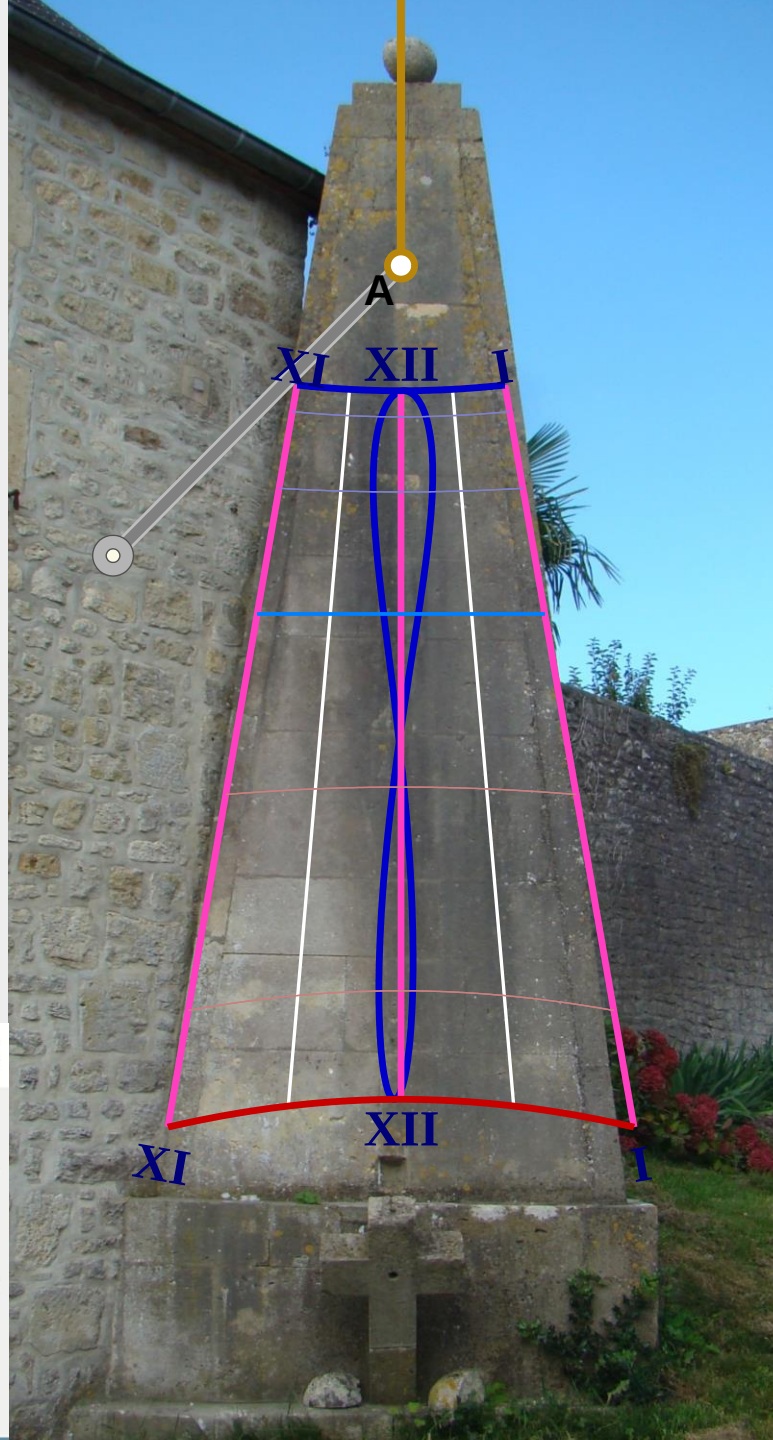
In Valognes, the size, angles, orientation are suitable for a mean time noon dial with a large 8 diagram (About 3 meters on my drawings)

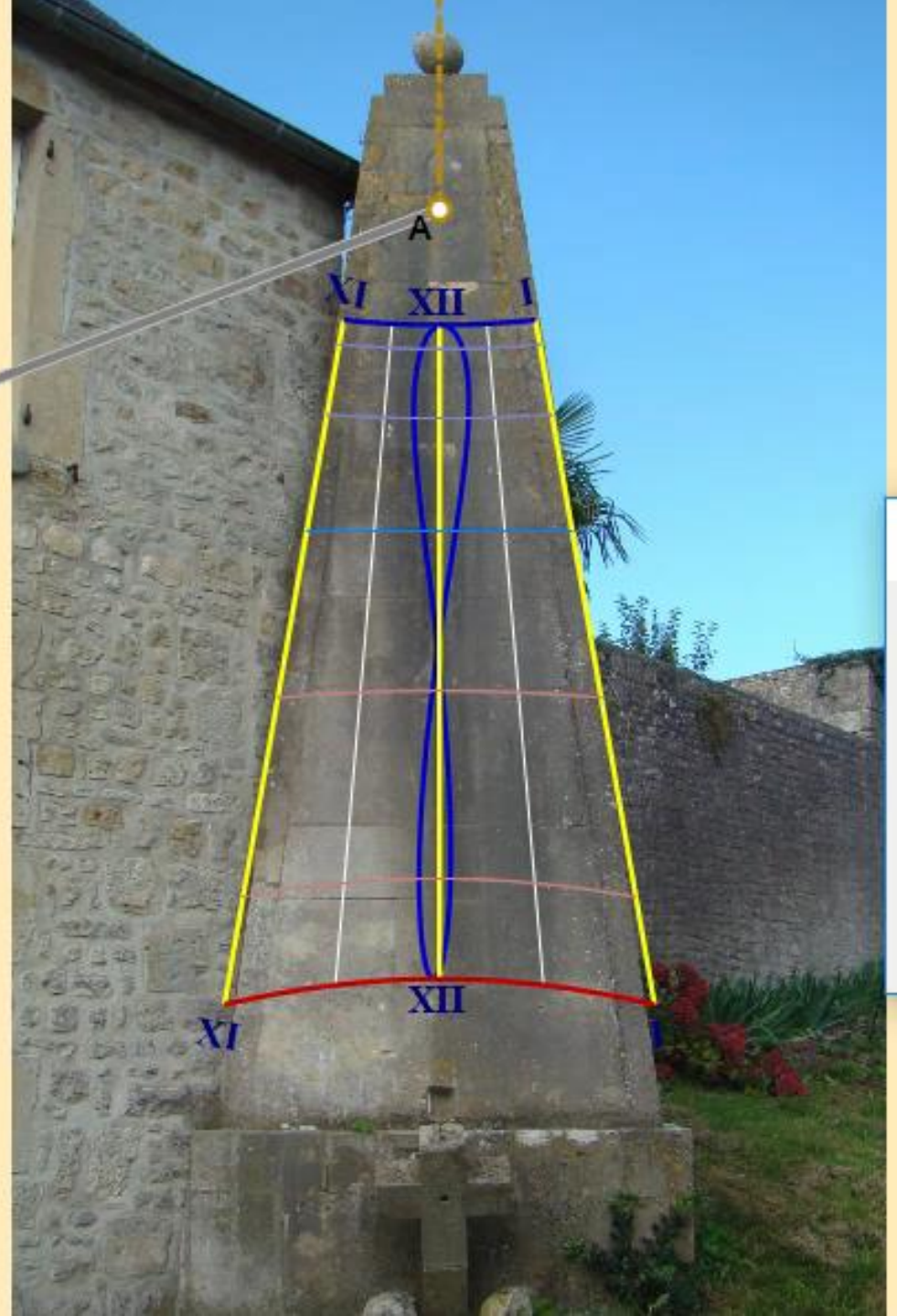
This was not engraved, but I think Dancel had intended to offer this improvement to the city. This being an accurate mean time noon dial where the clock makers, vergers and citizens could check their watches and clocks; and ring the bells at the same time.



This is what the Dancel’smeridian of time would have looked like:







Virtual reconstitution October 4Th:

It is noon mean time when the disc is over the right side of the 8 curve

x=-58,08 mm, y=-23,42 mm

Date :

4 octobre

Heure :

Heure Solaire : 08 h 25 min -> Heure légale : 09 h 19 min

Rapide

Lent

Sauter la nuit

Heure d'été

Heure Solaire

Heure moyenne

Click here

He was said to be a tough royalist and a local legend was that he had a firecracker lit by the sun on top of the pyramid at every anniversary of King Louis XVI 's beheading

Paris : Musée des Arts et Métierses
réalisé par Rousseau - fin XVIII^{ème}

No clue of this to be found now, but Sundial cannons were trendy C19 and I guess the firecracker was a sundial cannon.

Sundial gun, noon cannon or meridian cannon, also noonday gun is a device consisting of a sundial incorporating a cannon with a fuse that is lit by an overhanging lens, concentrating the rays of the sun, and causing the cannon to fire at noon, when properly oriented along a north-south axis.

You may find them now in museum and antiques shops.

From 1786 to 1914, such a sundial gun was fired by the sun at noon in Jardin du Palais Royal, Paris and was a popular attraction

Small reclining cross in Valognes

Cross dial

What about this stone cross
Could it be a cross dial ?

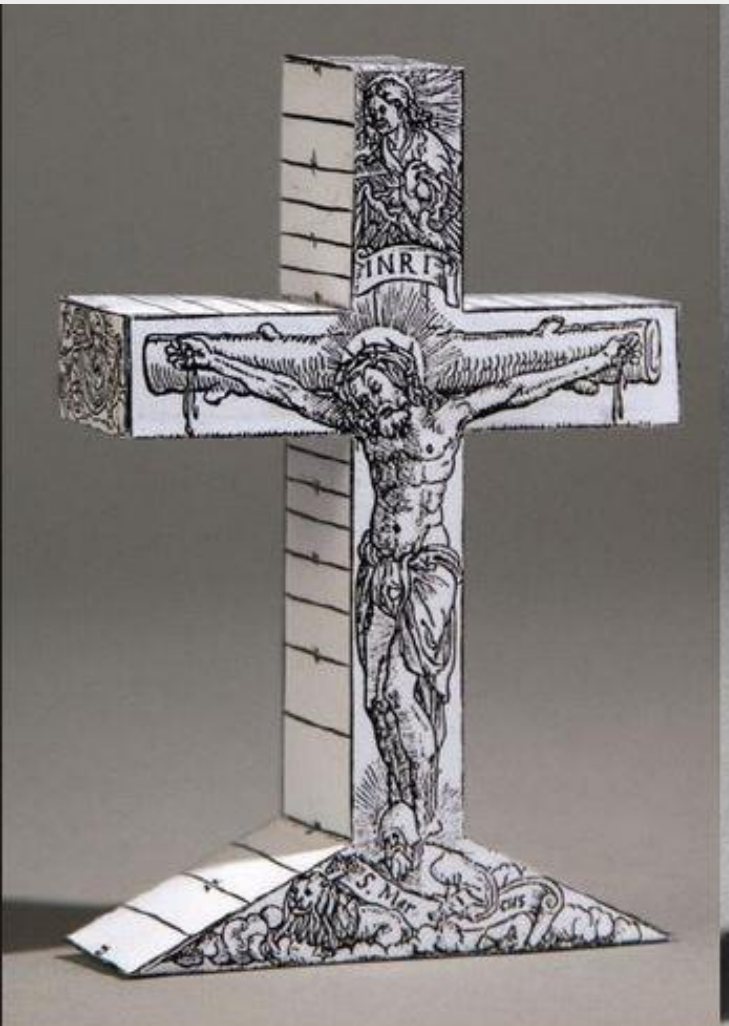
A cross dial is a multi-faced equatorial sun dial, with 6 polar tables

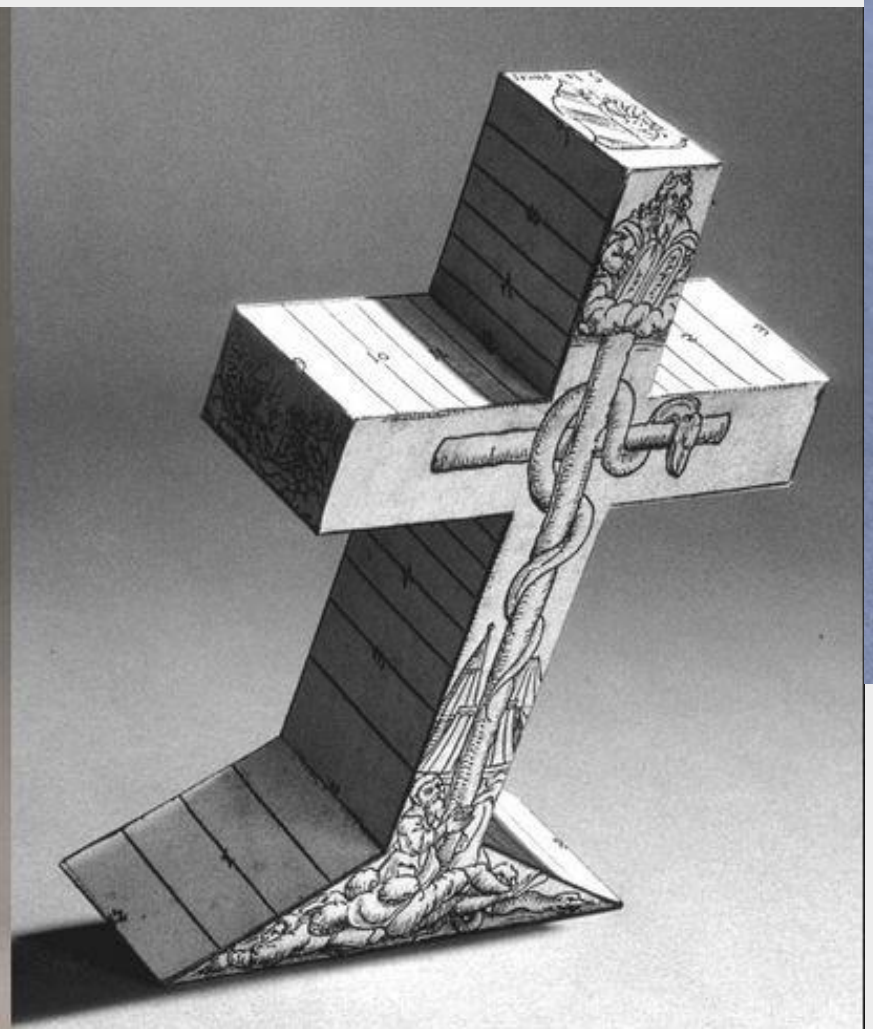
But the small cross is not parallel to equator.

Is it a mason’s mistake, or Dancel’s mistake ?

C16 portable cross dials

Musée de Nuremberg
Georg Hartmann 1529



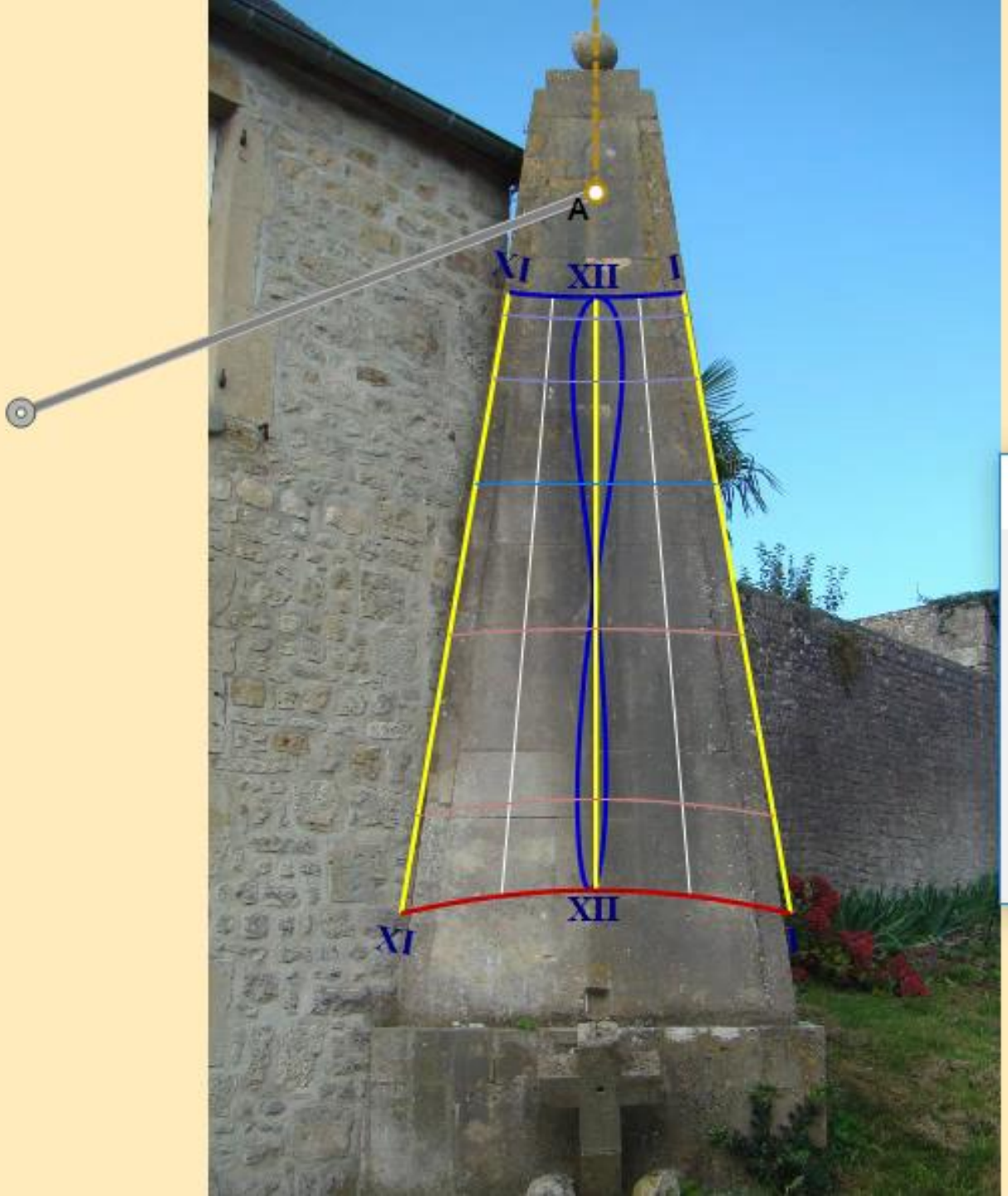


British Museum
Melchior Reichle 1569

British Museum

Chronologie (Eléments tirés de *Histoire de l'heure en France*, Jacques Gapaillard 2011) et épilogue

Date	Evénement
2éme siècle	Claude Ptolémée calculated time equation
C13	First clock in Europ
1372	First public clock in Paris (Charles V)
C16	First portable clocks
1735	Mean time noon dial of Grandjean de Fouchy
1760	Dom Bedos de Celles' treatise «La gnomonique pratique ou l'art de tracer les cadrans solaires »
1773/1782	Lecoquière built Valognes monumental dial
1805/ 1827	Dancel built the « pyramide » in Valognes rectory
1826	Paris shifted from true time to mean time
1839	French post-office shifted to mean time
1851	East France railway company shifted to mean time
1891	Paris mean time inforce by law in France and Algeria
1892	World wide creation of time zones
1910	First radio wave time signals transmitted from Eiffel tower
1911	Legal time in France to be Greenwich mean time, time zone +1



x=-58,08 mm, y=-23,42 mm

Date :

4 octobre

Heure :

Heure Solaire : 08 h 25 min -> Heure légale : 09 h 19 min

Rapide

Lent

Sauter la nuit

Heure d'été

Heure Solaire

Heure moyenne