The Obelisk Of Augustus – Part I

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Preliminary - the Greek Science

Scholars generally admit that Antique Greek Science grew out of Assyrian and Egyptian "science". More correctly, it is generally known that the Assyrians and Egyptians developed some form of "science" but that their "science" was rather different from modern Science. Mainly, it dealt with observation, generally with a very simple mathematical speculation. Geometry, as we know it, was invented by Greek mathematicians: but not only ...

Some geometrical-mathematical algorithms such as the "Analemma" and "Stereographical projection" were invented by Greek Scientists: using such mathematical instruments they investigated the deep rules of natural phaenomena (the motion of sun and stars). *Aristarcus of Samos*, *Hipparcus*, *Ptolemy* are only a few of these scientists.

So *Galileo Galilei* many centuries after "...*Philosophy* (Science) *has been written... in this great book of the Universe ...but you cannot read this book if you don't first learn the language the book has been written with...It has been written in a mathematical language ...the letters are Triangles, Circles... if you don't study this language it is impossible to understand it..."(*Il Saggiatore, 1623)

So Greek scientists radically investigated some concealed mathematical-geometrical rules of the "language" of Nature; in fact they did so for the first time in the history of mankind. We should then ask ourselves: did they therefore invent ...Theoretical Physics?

It is important to accept these preliminary considerations if you want to comprehend why in the Mars Field in Rome a very important scientific instrument (a Meridian Line) was built in 9 BCE by Emperor *Augustus* with the seasonal descriptions (zodiacal signs and *parapegmata*[1]) written in greek letters[2].

The assassination of Julius Caesar and an Experiment of Astronomy in the 1st Century BCE

The main task of Theoretical Physics consists in describing natural phenomena with mathematical algorithms and designing experiments whose results could resolve some doubts for scientists.[3] Something similar to such an experiment was realized in Rome in the last decades of the 1st Century BCE.

Gnomonists are perfectly aware that meridian lines have been built in the Middle Ages, Renaissance, and pre-modern years until the 19th century in order to be used as scientific observatories. 100% of them were illuminated, through a hole, by the solar image in a huge "dark chamber" - a big shadowed room inside of a cathedral, public building, or astronomical observatory. Now we shall here make an attempt to demonstrate that a Meridian Line has been realized also in antique times, but in the open space, for scientific-calendrical use.

In order to be told such a story you should come back to the time of the assassination of *Julius Caesar* 44 BCE. Two years earlier, in 46 BCE, *Caesar* had published the well-known decree regarding the new calendar. Everybody knows the content of this calendrical reform: the normal year has 365 days but after

[1] I shall later explain what a *parapegma* is (pl. *parapegmata)*

[2] I spent many years of my life in order to deeply investigate on this item; the result of my research has been published on the Rendiconti of the Pontificia Accademia Romana di Archeologia 2011-2012, 140 pages, 48 illustrations (many of them are technical elaborations); [ALBERI AUBER 2011-2012]. All the arguments cited in the present article have to be considered a concise edition of that study: there you will find 1) many details on the matter and 2) an exhaustive bibliography.

[3] A famous experiment destined to lead science in a certain direction is the Michelson-Morley experiment (1887) regarding the previously supposed existence of an ether.

three "normal" years the fourth one has 366 days, the so-called "bissextile" year. The reform was suggested to *Caesar* by a Greek scientist, whose name has been handed on to us through the centuries: *Sosigenes of Alexandria*. He started from the Egyptian calendar.

The Egyptian year had counted for centuries and millenniums 365 days (without the intercalary year) and this resulted from observations of repetitive astronomical events (*e.g.*: rising of a star). Such a year has a fault: the seasons run-rotate over the year through the centuries. Say if the summer solstice will occur on a certain day of a certain "month", then after 720 years the winter solstice will occur on the same date. The priests were perfectly aware of this fault and a Pharaoh, *Ptolemy 3rd*, in 238 BCE, made an attempt to introduce the intercalary day but somehow his reform failed. Did *Sosigenes* have access to the same sources available to the Pharaoh two centuries earlier? We will never know... but finally he introduced the reform, for the glory of *Julius Caesar*, which still is in use today[4]. This is very important for all of us since in the ancient world the correct length of the tropical year was not universally recognized[5].

Now...what is the issue with the assassination of *Julius Caesar*? It is very easy to explain...it happened only two years after the calendrical decree. So,when *Caesar* died, not one Julian calendrical cycle (4 years) had been conducted to its end! At this point of my history I must make a hypothesis: if *Sosigenes,* the Greek scientist, belonged to the staff of scientific collaborators of *Julius Caesar,* you can imagine that, for obvious reasons, he fled abroad. In the absence of *Sosigenes*, was there left in Rome a scientist with a sufficient knowledge of the calendrical problems? Evidently not! In fact, as was reported by the chronicles, Caesar's reform was since then wrongly applied. The intercalary day, was introduced, for many years, after two normal years of 365 days, instead of three. The wrong calendar, if maintained through the centuries, would rotate over the seasons the same way as the Egyptian calendar did, only in the opposite sense.[6]

The wrong calendrical cycle was applied until a year during the reign of *Augustus,* possibly 9 BCE.[7]

At the same time the Egyptian obelisk (the Obelisk of Augustus) was erected in the Field of Mars.

Do these two contemporary events, the correction of *Caesar*'s Calendar and the erection of the Obelisk, have to be connected in some way themselves? A completely ignored passage of *Pliny the Elder* (80 AD) will help us to answer this question.[8]

The Obelisk of Augustus in the Marsfield and the archaeological remains of the Meridian Line.

The Obelisk and the Meridian Line of *Augustus* both excavated in a zone of the Field of Mars constituted an instrument exactly suited to verify the calendrical reform of *Julius Caesar*. The Meridian Line (a part of it) has been found 8 meters under the soil. The credit for this success has to be given to a German archaeologist, Prof. *Edmund Buchner*, who excavated it (1979-80) in the cellar of a building of Via del Campo Marzio, Rome.

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[4] The error corrected by Pope *Gregorio XIII* (1582) was not very important (only 10 days in 16 centuries).

[5] *Censorinus* (3rd Century AD) accepts, for the tropical year, the length of 365¼ days, but he notes that *Sosigenes* was not 100% certain of the length; he reports also other evaluations of the length of the tropical year known in ancient science, at least 8, each different from the other.

[6] Winter solstice would occur in June after 2880 years.

[7] This is the hypothesis that I assumed in my study about the Obelisk of *Augustus* [ALBERI AUBER 2011-2012].

[8] If the correction was applied by the authority of *Augustus*, this was possible only if he was in contact with a Greek scientist. Prior to answering the said question we shall here describe the archaeological remains: in order to recognize them our steps are illuminated by another passage of *Pliny the Elder*; said passage (from the book XXXVI, "the marble") is, on the contrary, very very widely known.

The archaeological find, about 10% of the length (6.65 m) of the whole Meridian Line of *Augustus*, was found at a "wrong" level, at a later archaeological layer (Emperor *Domitian*) but, speaking of said "levels" (augustean, flavian, etc.) coud be nonsense: in fact the Meridian Line could be built since its origin at "any" level (elevated by a hill of gravel) provided it was in agreement with the gnomonic calculations.

My computer rendering of the Buchner excavations (Fig. 1) can be used in order to

1- design a hypothetical reconstruction of the whole Meridian Line
2- calculate the gnomonic height of the shadow- projecting sphere

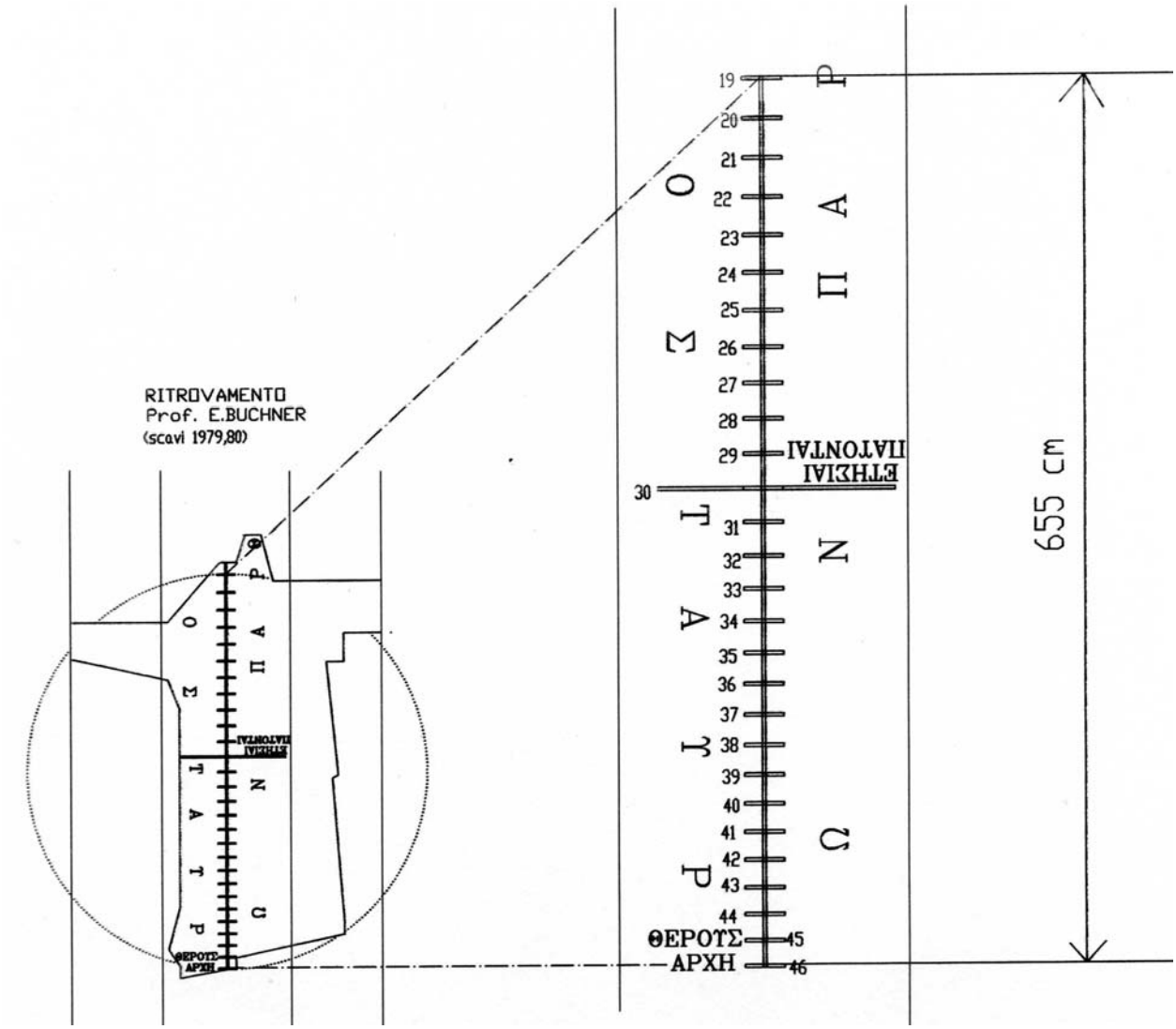

Fig. 1 - A computer rendering of the archaeological find of the Meridian Line of Augustus

This Meridian Line is provided with 1 bronze sign for every one ecliptical degree (approximately one for every day of the year). The diurnal signs found are from 19° Aries until 16° Taurus (15° Leo – 12° Virgo). Along the length of the Meridian Line there are the bronze letters of the names of the zodiacal signs. Partially found are the inscriptions: Krios (Aries), Tauros (Taurus), Leon (Leo), Partenos (Virgo). On the marble of the Meridian Line there are engraved, and filled with bronze letters, some

meteorological-calendrical sentences: they have been recognized by me as fragments of a "*parapegma*".[9] Two *parapegmatic* sentences have been found: "*Ethesian winds cease*" and "*Summer begins*".

The Obelisk was provided with a big sphere of golden plated bronze on the top: it was the shadow of said sphere projected on the Meridian Line that allowed the calendrical measures.

The Obelisk was wrecked and broken into several pieces during an earthquake in the 9th century. In the 15th / 16th century the contemporary evidence tells us of many peoples who saw, in cellars, the Obelisk and the Meridian Line. Finally in 1748 Pope *Benedict XIV* charged a very clever priest, father *Angelo M. Bandini*, to study in a very deep way the question of the Obelisk and of the Meridian Line. Father *Bandini* published a very important book which is a precious source of news on the matter [BANDINI 1750]. The wrecked pieces of the obelisk were excavated and positioned in a nearby courtyard. See Fig. 2.

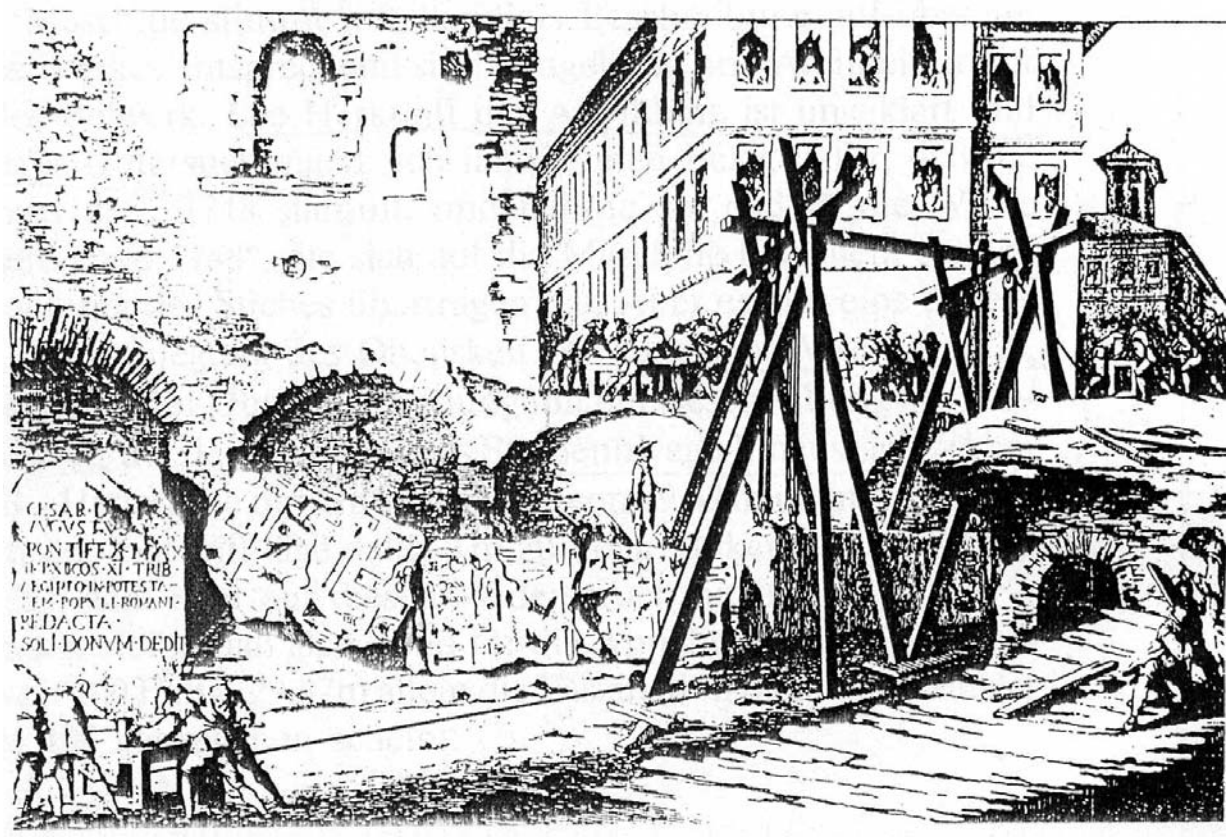

Fig. 2 – The wrecked pieces of the Obelisk excavated by *Pope Benedict XIV* (1748)

After 44 years (1792) Pope *Pius VI* reconstructed the obelisk in the Piazza di Montecitorio in front of the Italian Parliament in a place not far from the original site. See Fig. 3. Every day millions of people in Italy see the rebuilt Obelisk on the television since the political news is usually accompanied with images of the Parliament.

<u>Why did Emperor Augustus order the building of the Meridian Line</u>?

Ignoring the cited passage I discovered in Pliny, we could anyway conclude that there are many signs that help us to examine the possibility that the Meridian Line was built for an astronomical-calendrical reason in order to use the sphere's shadow on the tip of the Obelisk of Augustus:

[9] I shall dedicate a chapter of this article to the antique "parapegmata"

Fig. 3 – The Obelisk of *Augustus* reconstructed by the Pope *Pio VI* (1792) in Piazza di Montecitorio, in front of the Italian Parliament.

-the written testimony of *Pliny the Elder* (80 AD) regarding an Obelisk with a sphere on the tip which projects its shadow on a Meridian Line.[10]

-the archaeological evidence of a Meridian Line which really existed exactly in the place where *Pliny* described it. The 180 bronze signs are typical for a gnomonic instrument dedicated to indicating the 360/365 positions of the shadow, say for a calendrical reason; for the same calendrical reason, the names of the zodiacal signs are explicitly written on the marble of the Meridian Line; the "*parapegmatic*" sentences confirm the extremely specialized task of the gnomonic instrument.

-the temporal coincidence of the correction of the error as applied since the beginning of *Caesar*'s calendrical reform with the date of the construction of the Meridian Line.

-the interest of the Emperor *Augustus* in calendrical questions: the lex Pacuvia (adopted on the same date as the inauguration of the Meridian Line & Obelisk) changed in fact the name of the 6th month (8th for us) to "Augustus".

Said arguments could be only as per themselves considered a valid proof that the unknown Scientist, hired by Augustus in order to confirm Caesar's calendar, was completely right. Said Scientist was surely Greek. The latin name *Facondus Novius* in the (probably) corrupted text of Pliny has to be rejected (see [ALBERI AUBER 2011-2012]).

<u>*A short "gnomonic" phrase of Pliny the Elder, until now completely ignored*</u>

Now regarding the announced phrase of *Pliny the Elder* (80 AD) in his work Naturalis Historia, II (Cosmologia), 35. So *Pliny*:

"*Viene poi il cammino del Sole, che in effetti è ripartito su 360 gradi; ma perchè la sua ombra ritorni al segno di osservazione iniziale sul quadrante, vi si aggiungono cinque giorni, e in più un quarto di giorno,*

[10] Of course we cannot ignore that some scholars have, 30/20 years ago revived an already practically abandoned hypothesis of 400 years ago: they maintained that the shadow projected not only on a Meridian Line but on a huge *Horologium*, 400 m. wide, for all the antique hours. We shall here later discuss this hypothesis.

per ogni anno. Per tale ragione ogni quattro anni si inserisce un giorno intercalare, in modo che il calcolo del tempo concordi con il viaggio del Sole"

and its english translation by H. Rackam (Pliny's Natural History Book II, 35 in the revised and reprinted edition of 1949, page N. 190, Loeb library original issue 1938):

"*Next, the sun's course is divided in 360 parts, but in order that an observation taken of the shadows that it casts may come round to the starting point, five and a quarter days per annum are added; consequently to every fourth year an intercalary day is added to make our chronology tally with the course of the sun".*

Pliny's text is a very clear explanation: therefore no comment is required.

Now, if you want that the shadow's position (of a gnomon) in one day of the year (of course: at midday, for simplicity of observation) should be distinguished from the shadow's position the same day one year later, the ordinary sundials of the antiquity were not fit for this task: in ordinary antique sundials such shadows would be observed as absolutely indistinct one from another. The experiment described by *Pliny* would be successful only if the shadow were projected from a very large gnomon, on a plane surface duly prepared for it - even better if a sign will be engraved with a line on the surface for every day of the year (or: for every ecliptical degree).

This is exactly what happens on the Meridian Line of Augustus, excavated by Prof. *E.Buchner* in 1979/80.

In fact I calculated the declination of the sun in the years from 11 AD to 15 AD (detail in Appendix 3 of [ALBERI AUBER 2011-2012] and on this basis I was able to draw a prospect of the shadows along the Julian cycle: see Fig. 4. The drawing of Fig.4 has been made for a declination of the Sun near to zero. I also made the calculations and drawings for the declination of the first days of February, that would be near the supposed (from the historians) date of inauguration of the Obelisk, but the shadow of a sphere of 70 cm seems to me, for this season, rather small.[11]

One could ask: why was this description of *Pliny* collected into the 2nd book (Cosmology) and not in the 36th (The marble) where the description of the Obelisk is to be found? We can answer this question by noting that the question of the shadows which have to return to the signs is an exquisitely astronomical-gnomonic-calendrical question which typically belongs to Cosmology.

In any case as demonstrated in Fig. 4, near the equinoxes, the shadow of one day in a normal year is distant from the shadow of the same day one normal year later only by 10 cm, but it happens only if the gnomon is very high, say, for example, 100 roman feet (29.6 meters). On the horizontal sundial of Thamugadi,[12] which is unique in antiquity for its dimensions, the gnomon (about 3 m high) was only one tenth as high as the Obelisk of *Augustus*, so the difference between one year to the next would be very tiny - say 1 cm - unacceptable for *Pliny's* experiment. In fact, since the shadow blurs into a fringe, the "observatio umbrarum" of *Pliny*, by the "big" sundial of Thamugadi would be very problematic...we could say practically impossible. And on an ordinary sundial? An ordinary antique sundial with a gnomon of a few centimetres as was usual on the sundials of Antiquity? The answer is obvious.

The conclusion? As seen after our considerations of the previous chapter there would be left a quota of uncertainty regarding the Obelisk of *Augustus* to be recognized as the instrument used by the unknown

[11] This is due notoriously to the solar rays coming from a non-point source. This would be a good argument for investigating on this matter: was the "gold-plated sphere" ("aurata pila" of *Plinius*) bigger than 70 cm?

[12] Studied by *Ali Guerbabi* [GUERBABI 1992] ; the sundial (fragments) of about 100 AD were discovered in the Agorà of the abandoned roman city of Thamugadi (Today: Timgad, an inner place of modern Algeria).

Greek scientist charged by *Augustus* with the task of solving the problem of the intercalary day. Now if we correctly examine the completely ignored text of *Pliny the Elder*, that we have now reported and commented on, we are obliged to conclude that the only gnomonic instrument of Antiquity fit to investigate the necessary correction of *Caesar*'s calendar was the gnomonic complex constituted by

- the Obelisk, as described by *Pliny*, erected by Emperor *Augustus* and excavated by Pope *Benedetto XIV*
- the Meridian Line built by *Augustus,* described by *Pliny* too*,* and excavated by Prof. *Buchner.*

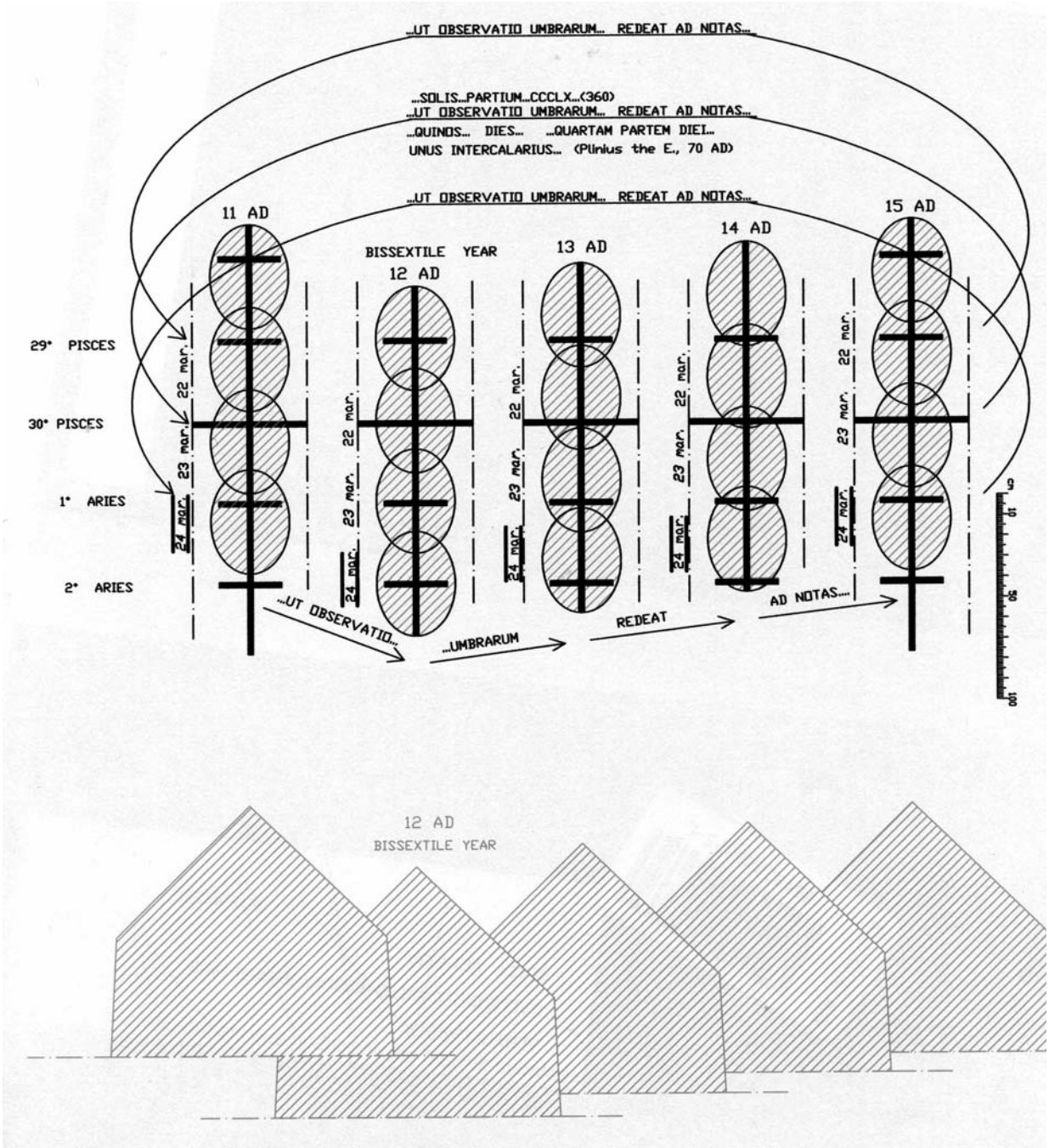

Fig. 4 –A sphere projected on the dial the ellipses of shadow as on the drawing: it happened some days of March in the years 11 to 15 AD. The gnomon, as generally accepted, was a sphere with a diameter of 70 cm.

Other problems

Once we have cleared up why the Meridian Line was built, there are some other questions left unresolved:

1- What is a correct interpretation of Pliny's text as he cites the function of measuring the lengths of days and nights (...*dierumque ac noctium ita magnitudines*...)?

2- Is it possible to determine the complete profile of the Obelisk with the correct position of the projecting sphere? In particular the basement of the Obelisk on the Field of Mars?

3- Is it possible to determine the still hidden remaining part of the Meridian Line? What role could the *parapegmata* of antiquity play in such a reconstruction?

4- How is it that the bizarre hypothesis of a huge sundial for all the hours, which never existed, has been occasionally considered with seriousness during 4 centuries?

5- Is it possible to imagine a graphical reconstruction of Obelisk and Meridian Line, in particular if linked with nearby monuments (*Ara Pacis*)?

We shall provide answers to these questions in the second part of this article.

Bibliography – Part I

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