Image, text, and pattern: Reconstructing parapegmata

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Introduction

Parapegmata are among the oldest astronomical instruments from the classical world, and are closely related to the earliest astronomical/astrological tradition in Greece, that of stellar astrometeorology.[1] At its most basic, a parapegma is an instrument for keeping track of a temporal cycle or cycles. In an inscriptional parapegma, holes are drilled in a stone or in a wall, and a peg is moved from one hole to the next each day. Astronomical, astrological, calendrical, or other information is inscribed beside each hole and the user simply looks for the peg or pegs to locate themself in the relevant cycle for that day. There are extant parapegmata of different kinds from the fifth century BC through to the Middle Ages. The basic technology of a parapegma was adapted to a range of different uses, often serving as a complement to a calendar, tracking temporal cycles that are not tracked by the local calendar.

In looking at the ways we might reconstruct parapegmata, we are faced with first needing to determine just what kind of information was being tracked by a particular parapegma, and then to look at what kinds of clues are available to us for effecting a reconstruction. These clues fall into three broad classes: internal, comparative, and external. Internal evidence might include fragmentary words or phrases or considerations of physical structure. Comparative evidence is what we can glean from looking at comparable cycles in other parapegmata for clues to what may be missing in a damaged text. What I am calling external evidence includes the use of modern calculations of the stellar phases expected for a given time and place, or the use of modern weather observations for judging the likelihood of a particular meteorological prediction. We shall see that some cycles tracked by parapegmata are easily reconstructed, while others defy our efforts. Paradoxically, I argue that the class of parapegmata that is best attested, astrometeorological parapegmata, turns out to be the least amenable to reconstruction.

Image

Let us begin with a look at an astrological parapegma, the Thermae Traiani Parapegma (see Fig. 2).[2] This parapegma was unearthed in the early 19th century as a graffito in the wall plaster of a Roman house near the baths of Trajan on the Esquiline hill. Two drawings of the parapegma survive. A little-known sketch was made by Piale in 1816, but the usual drawing that is reproduced in the modern literature was made by de Romanis in 1822.[3] The parapegma itself seems to have

1 See Lehoux, 2007, 2006, 2005; Hannah, 2009, 2005; Taub, 2003; Evans and Berggren, 2006; Bitsakis and Jones, 2016; Bevan, Jones, and Lehoux, 2019; Anastasiou *et al.,* 2013; Evans, 1998; Rehm, *Parapegmata, RE.*

2 Figs. 1 and 2 are reproduced from de Romanis, 1822, courtesy of the Thomas Fisher Rare Book Library, University of Toronto. For my classification of parapegmata (astrological, astrometeorological, astronomical, etc.), see Lehoux, 2007.

3 Piale published in Guattani, 1817, pl. XXII, 160-162; de Romanis, 1822.

Instruments – Observations – Theories: Studies in the History of Astronomy in Honor of James Evans, ed. Alexander Jones and Christián Carman, 2020, DOI: 10.5281/zenodo.3928498, pp. 109–131. Chapter DOI: 10.5281/zenodo.3975725.

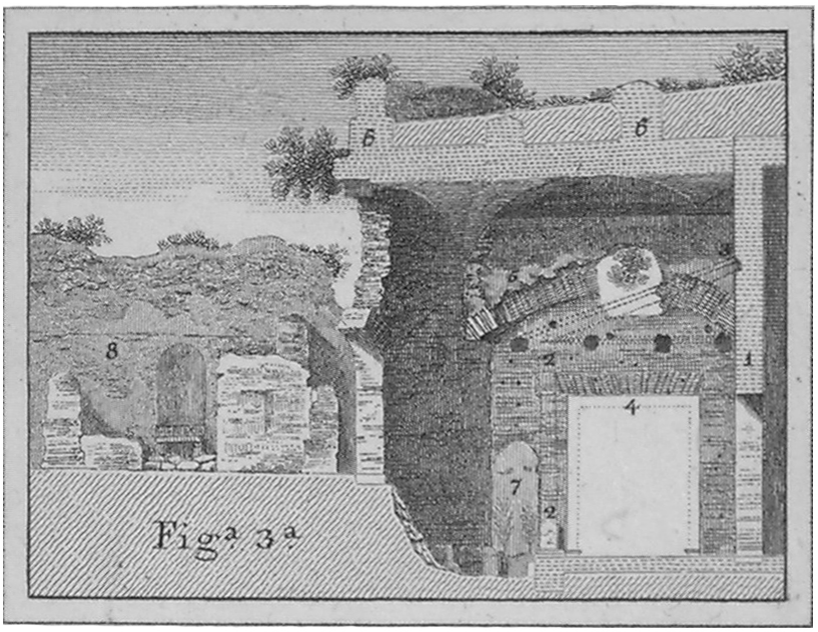


Figure 1. The Thermae Traiani parapegma was inscribed in room 8, on the right-hand wall.

been left exposed to the elements (see Fig. 1) and disappeared shortly thereafter. Further, there is an "improved" terracotta copy, made by a workman named Ruspi in the early 19th century (either from the original or from a drawing), which has turned up at the University of Würzburg. Finally, a plaster cast of the Ruspi copy was found in Rome in the early 1980's,[4] and copies of the Ruspi rendering can now be purchased from the Würzburg museum gift shop.

On the Thermae Traiani parapegma, we find five of the seven deities of the astrological week, reading from left to right. Beginning with a gap (where Saturn should be), we find Sol, Luna, Mars, Mercury, then a blank for Jupiter, and finally Venus, in their traditional order. The numbers from I-XV run vertically down the left side, and from XVI-XXX down the right. In de Romanis' illustration, a hole seems to appear just above and to the right of the hole for XXX.[5] In the middle of the parapegma are the signs of the zodiac, with two holes drilled per sign and running counter-clockwise. A small fragment of a bone peg was found in one of the holes for Gemini.

From simple considerations of functional symmetry and on the basis of the other surviving holes, we can conclude that there must have originally been peg holes beside the numbers I through IV and XXV, and we know the missing deities to be Saturn and Jupiter. Matters of artistic style and iconography defy precise reconstruction, so we can name the missing gods but modern scholars decline to reproduce them pictorially. This point may seem trivial, but Ruspi's Würzburg copy did in fact reconstruct the missing images, and this version is sometimes published in modern accounts without mention of the restorations.[6]

The inscription poses some more difficult problems, specifically in trying to decide what to do with the apparent 31st hole between days XXVIIII and XXX. Is it part of the original parapegma or is it an artifact of the copyist? Is it simply damage incurred by the parapegma at some

4 See Manicoli, 1981.

5 On the significance of this apparent hole see Rehm, 1893-; Erikkson, 1956; Lehoux, 2007.

6 McCluskey, 1998, for example, includes an image of the Ruspi copy. Goessler's, 1928, speculation that Ruspi's copy may have been made before the inscription was damaged is rejected by Stern, 1953, 177 n. 3.

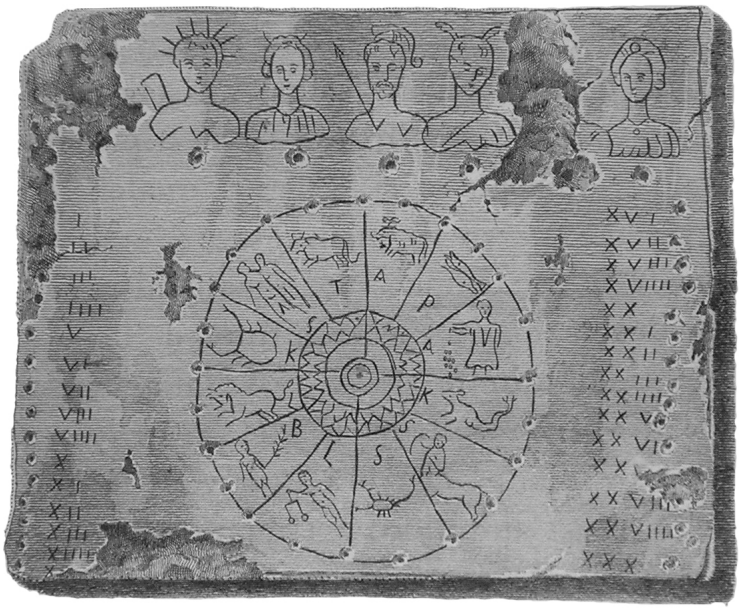


Figure 2. The Thermae Traiani Parapegma: de Romanis' 1822 illustration.

point after excavation? Or perhaps something had been nailed to the wall in antiquity, and so the hole has nothing to do with the parapegma at all.[7] Small as the hole is, the issue is of some consequence in determining the use of the column of numbers, and the use of the parapegma as a whole.

If there are thirty-plus-one holes in the parapegma, then that opens up the possibility that the column was meant for counting calendar dates in the Roman calendar, where any given month could have up to 31 days, but not more.[8] Exactly 31 holes, however, would likely rule out the use of these columns for counting the number of days the sun spends in a given zodiacal sign, as on all the classical schemata known to me there is at least one sign in the year in which the sun spends 32 days.

If, on the other hand, there were only 30 holes in the original parapegma, then the most obvious candidate for what is being tracked would be lunar days. Lunar days count from the first day (probably either full or new moon) to the 30th day and then start again. These lunar days are attested as having an astrological significance in many Roman texts, including Virgil's Georgics.[9] Lunar days are also easily equated with the significant lunar phases which were variously lucky and unlucky for a wide range of activities.[10] Finally, in the description of a parapegma in Petronius' Satyricon, we see what sounds like a combination of lunar days and the seven-day week being tracked for good and bad luck.[11] This hypothesis that the numbers I through XXX are meant to track lunar days is greatly strengthened by comparative evidence, since 30-day sequences are

7 As is the case with the Ostia Hebdomadal Deities (see Lehoux, 2007; Becatti, 1954, 116-7; pl. XXXVIII.3).

8 McCluskey, 1998, 57, for example, thinks the numbers track days of the month. See also Degrassi, 1963, vol. XIII.2, 308-309; Rehm, "Parapegma", *RE*, col. 1364; Erikkson, 1956

9 He says that the seventeenth day of the moon is propitious for planting vines, and the ninth day lucky for fugitives and unlucky for thieves. See *Georg.* I.277-8; Pliny, *NH* XVIII.21.

10 See e.g., Columella, *RR* II.x.10, XI.ii.85; Pliny *NH* XVIII.314.

11 See Lehoux, 2007; Petronius, *Sat.* 53.

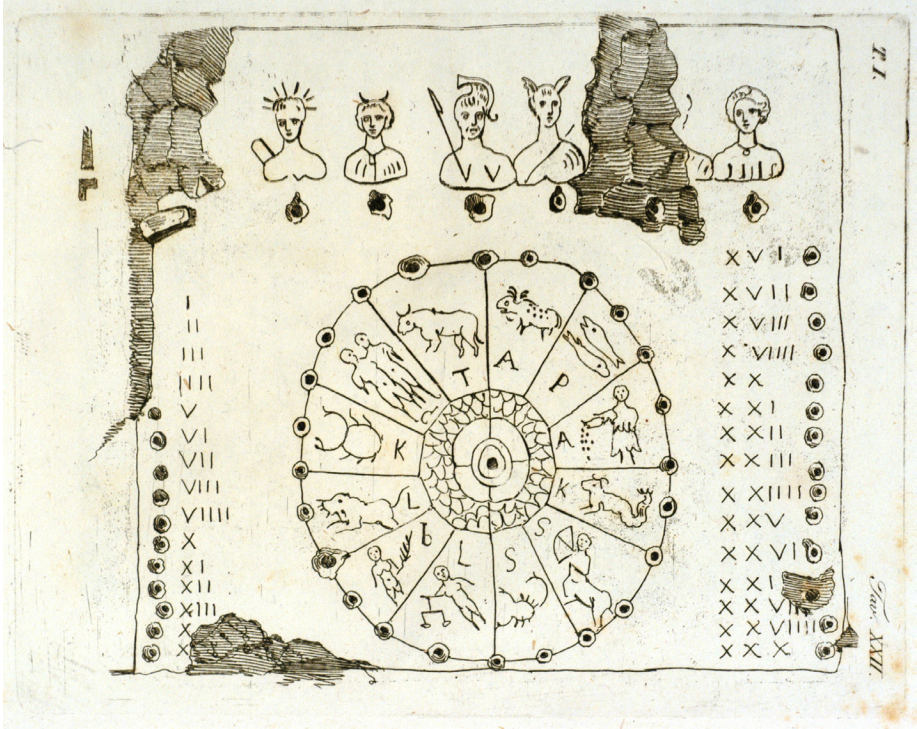


Figure 3. Piale's 1816 illustration of Thermae Traiani. Reproduced from Guattani, 1817. Note the difference in how the "31st hole" is represented.

common in Latin parapegmata, and no parapegma has a sequence that counts upwards to 31. Moreover, in the unique Trier Parapegmatic Mold, meant for casting parapegmata in clay, we see 30 holes inscribed (15 down each side) accompanied by images of changing lunar phases.[12]

A related possibility, but one that still finds a use for a 31st hole, was proposed by Erikkson, following Piale.[13] He agrees that the 30 holes track the lunar cycle, but he speculates that a 31st hole was used to distinguish between full (30-day) and hollow (29-day) months following some schematic rule that would allow the user to determine in advance whether the current lunar cycle was going to be full or hollow. A peg in the 31st hole, situated between day 29 and day 30, would thus act as a stopper, telling the user to skip the 30th hole and go back to day one.

Thus we have three possibilities: (1) there is a 31st hole, either (1a) as part of a calendrical cycle, or (1b) for indicating full or hollow lunar cycles, or (2) there is no 31st hole. As we move on to look at other parapegmata, we will see that only possibility (2), that there is no 31st hole, is supported by comparative evidence. Furthermore neither the Ruspi copy, nor Piale's 1816 illustration[14] (see Fig. 3) of the inscription show a 31st hole. This strongly supports the hypothesis that the hole was damage subsequent to excavation, or else an artifact of de Romanis' copy.

12 The mold is currently in the Rheinisches Landesmuseum Trier.

13 Erikkson, 1956, 24-5; Piale in Guattani, 1817, 161.

14 In Guattani, 1817.

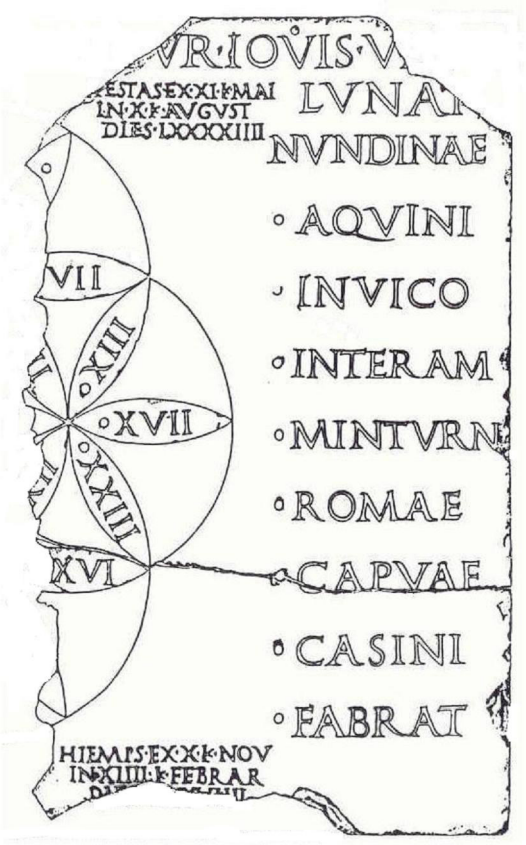


Figure 4. The Latium Parapegma.

Text

Let us turn now to another inscriptional parapegma, the Latium Parapegma (see Fig. 4).[15] At first blush, it is not obvious that this parapegma is at all related to Thermae Traiani. But as we shall see as we work through the reconstruction,[16] there are some familiar details, in spite of the immediately obvious differences.

The first difference to note is that this is a much more carefully executed and aesthetically polished inscription than Thermae Traiani. It is carved in marble (approx. 53.5 cm high, 33 cm wide, and 3 cm thick), and quite possibly meant for public display. The second difference lies in how this parapegma is predominantly textual, where Thermae Traiani was iconographic. Like Thermae Traiani, we see some numbers inscribed, and we see at the very top the fragmentary remains of the names of the days of the seven-day (hebdomadal) week: *...]ur · Iovis · V[...* which we can reconstruct as:

15 First Published by Gruterus, 1707. Later by Henzen in *CIL* VI.4.2, no. 32505. More fully reconstructed by Degrassi, 1963. It is currently in the Museo Archeologico Nazionale di Napoli, inv. 2635. Drawings courtesy of the Unione accademica nazionale and reproduced with permission.

16 My reconstruction follows Henzen and Degrassi quite closely, up to a point, but it will be worthwhile to go through all the steps in more detail than they did, to show how different kinds of pattern internal to the text impel us towards the various aspects of the reconstruction. I do not claim that the reasons I give are the same as theirs although it seems likely enough that they were thinking along similar lines.

∘] ∘ [∘

Merc]ur · Iovis · V[eneris

As we look to the rest of this parapegma we notice elements not included in Thermae Traiani, including a complete column of nundinal days, the older Roman eight-day week named after towns in a nominal market itinerary, and some partly damaged dates for the beginning and end of summer and winter, just to the right of the top and bottom of the numbered floral pattern. At the top of the rosette we can read the following:

[A]estas ex XI K. Mai. in X K. August. Dies LXXXXIIII

Summer is from the 11th day before the Kalends of May until the tenth day before the Kalends of August: 94 days.

And at the bottom of the rosette,

Hiemps ex X K. Nov. in XIIII K. Febrar. [Dies LXXXVIIII]

Winter is from the tenth day before the Kalends of November until the 14th day before the Kalends of February: 89 days.

Considerations of symmetry lead us to presume that the two remaining seasons would have originally been on the left of the rosette. In an attempt to reconstruct the lengths and dates of these two seasons, we suppose that the beginning of spring is the day after the end of winter (rather than, say, at some specific time on the same day), and that the beginning of autumn is the day after the end of summer (in Roman agricultural texts seasons regularly have lengths in full rather than partial numbers of days).[17] We thus get

[Ver ex XIII K. Febrar. in XII K. Mai. Dies LXXXXI]

Spring is from the eleventh day before the Kalends of February until the twelfth day before the Kalends of May: 91 days

and

[Autumnus ex IX K. August. in XI K. Nov. Dies LXXXXI]

Autumn is from the ninth day before the Kalends of August until the eleventh day before the Kalends of November: 91 days.

Pattern

A further difference between Latium and Thermae Traiani is that in the Latium Parapegma, we have the numbers inscribed in the middle, in what appears to be a floral pattern. Following Hen-

17 On Roman seasonal dates, see Hannah, 1989.

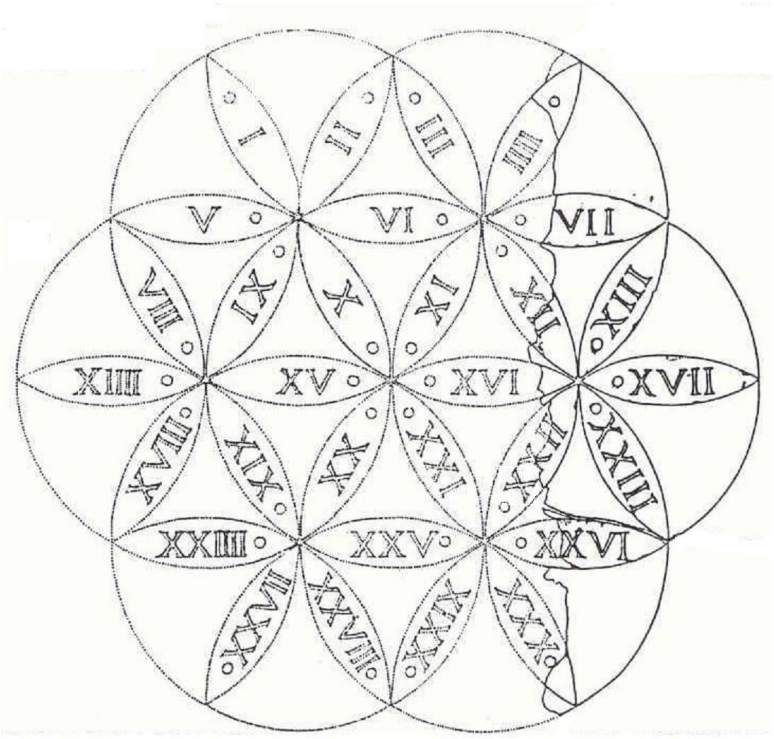


Figure 5. The Reconstructed Latium Rosette.

zen, we can reasonably assume that the rosette is symmetrical, and so it can be reconstructed as in Fig. 5. We should notice here that only the numbers from I-XXX will fit within the rosette itself. This will count against the hypothesis that the numbers are meant to count calendrical dates or zodiacal days. Finally, the very fact that the numbers in the rosette are reckoned upwards from I through XXX, while the calendar in which the seasons are measured is still the traditional Roman one (counting down to the Kalends, Nones, and Ides), is further evidence that these numbers were not used to count calendar dates. This helps to further rule out the possibility that there was an unnumbered peg hole for day 31 in Thermae Traiani.

Some hint of the function of the days numbered in the rosette comes from the word inscribed just above the column of nundinae. Following Degrassi, we suppose that the single word *luna(r)* is grammatically attached to something. Degrassi hypothesizes that the word *dies* originally appeared on the opposite side of the parapegma, to complete the phrase *dies luna(res),* "Lunar Days" as an explanation for what the numbers in the rosette represent. We shall see that comparison with inscriptional dates, and with other parapegmata strongly confirms Degrassi's supposition that the numbers I-XXX are in fact lunar days, and so, I think we have some reason for inserting *dies* on the left side of the parapegma.

Degrassi goes still farther than we have by hypothesizing that down the left side of the parapegma, in what is a conspicuous blank in so symmetrical an inscription as this is turning out to be, there was another set of nundinal days. But here considerations of symmetry may have pushed him too far. There is simply no reason why a single parapegma would need to list more than one set of nundinae, and there is no single inscription, to my knowledge, that has more than one.[18]

18 Although Degrassi thinks the *Allifae Nundinal Lists* were originally part of a single inscription.

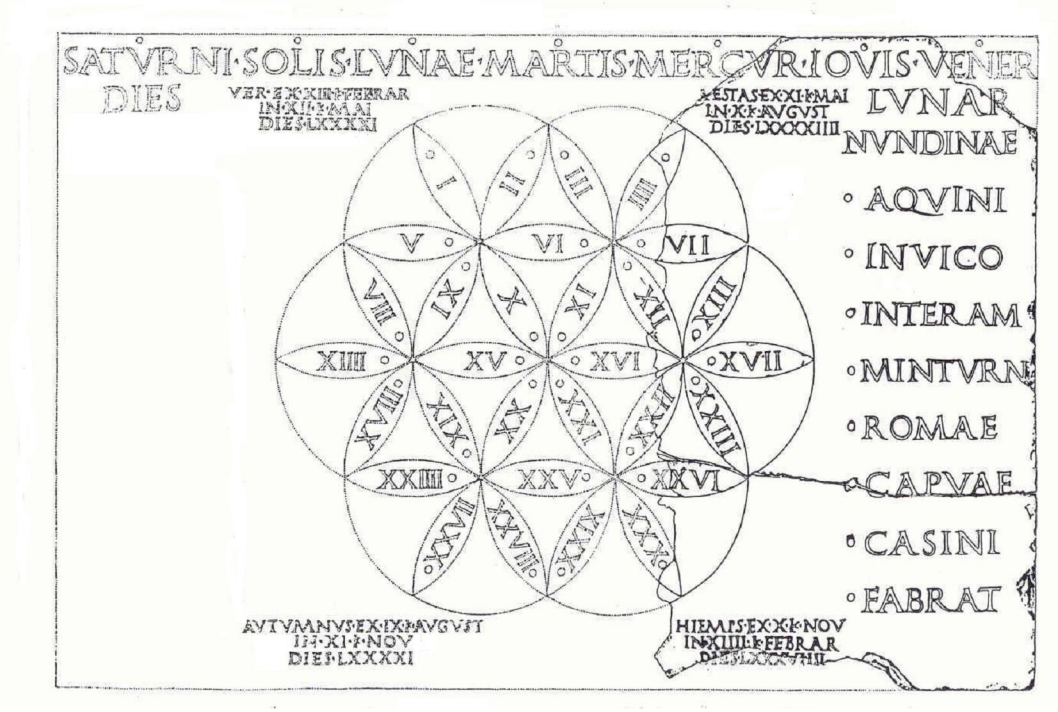


Figure 6. The Reconstructed Latium Parapegma.

Stopping, then, just short of Degrassi, we are left with a fairly complete parapegma, as we see in Fig. 4, with only the left-hand column still a mystery. One reasonable possibility, following Thermae Traiani, would be a list of the twelve zodiacal signs.

The Dura-Europus Parapegma

A remarkable graffito-parapegma (see Fig. 7), found scratched in a wall in a makeshift Roman barracks at Dura-Europus in Syria shows some of the features of each of the two Latin parapegmata we have seen so far.[19] This is a wonderfully crude rendering, with rough versions, additions and deletions still visible. We see the hebdomadal deities, all at least partly preserved across the top, with a few peg holes still intact. Down the left and right sides we see the heading [L]una, followed by the numbers from I through XXX, with an underscore (lucky for us) under the XXX to indicate that the series is complete. Like Thermae Traiani, this parapegma has a history that complicates its reconstruction. The parapegma was badly damaged during excavation and the plaster crumbled, destroying the inscription almost entirely. The drawing was made from the collective memories of the archaeologists, with the partial aid of one photograph. Thus we cannot be certain of many of the details even of the drawing we have before us.

But the big question that emerges from this text has to do with the column that may be for tracking the local nundinal day. The nundinal day is the nominal market-day for a given Italian town. This was reckoned from archaic times onward every "ninth" day on the Roman style of counting (every eighth day counted as we would do), and this eight-day cycle came to define the earliest Roman version of the week, eventually complemented and later supplanted by the

19 See Rostovtzeff, Bellinger, *et al.,* 1936. Image courtesy of Yale University Press.

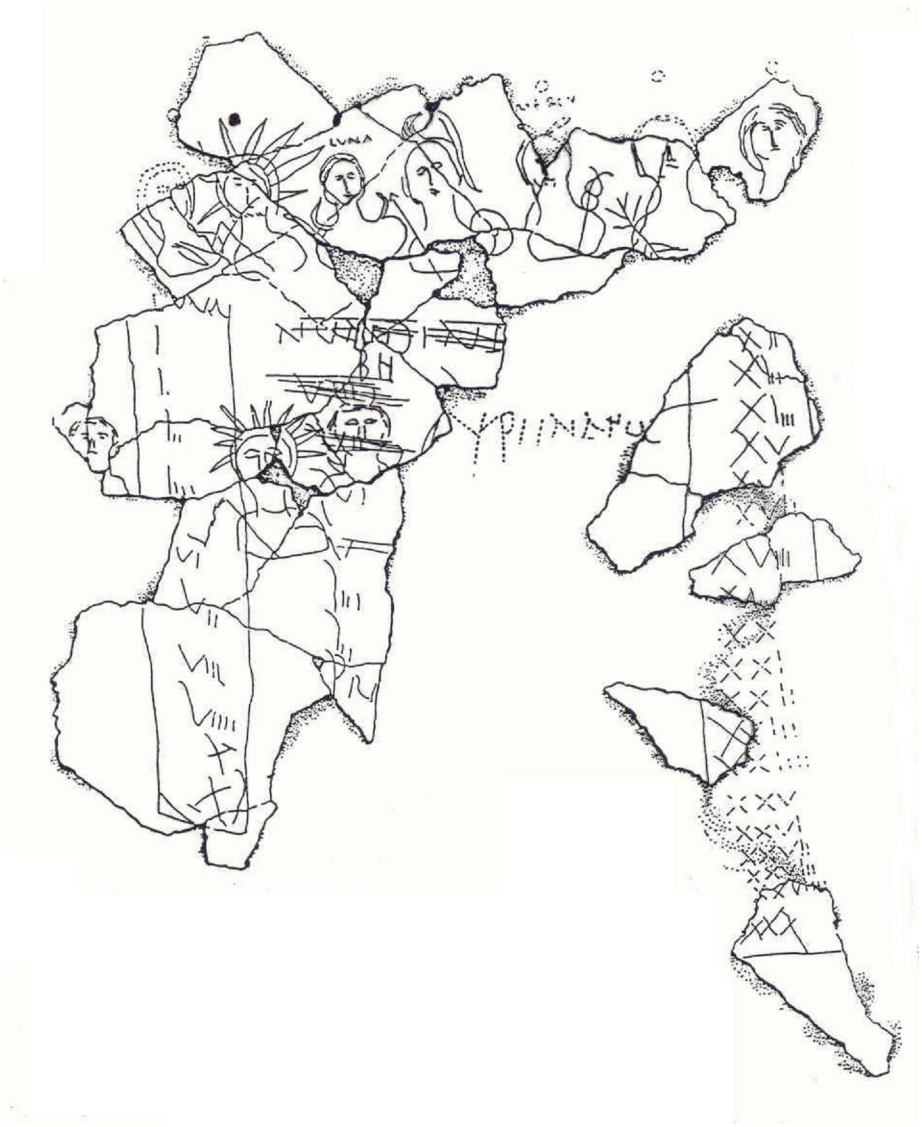


Figure 7. The Dura-Europus Parapegma.

seven-day (astrological) week.[20] The local market day was a holiday from agricultural work, and farmers could come to town to exchange wares and produce, as well as to keep up on local affairs.[21] Various *fasti* have the days of the month labeled consecutively from A through H (called the "nundinal letters"), where one of these days, would be the local market-day.[22] There are also nundinal lists, as we have seen in the Latium Parapegma, which have the names of eight different towns inscribed. This has usually been read as indicating that the market day occurred

20 On the nundinae and nundinal lists generally, see MacMullen, 1970; Deman, 1974; Tibiletti, 1976-7; de Ligt, 1993; Andreau, 2000; Marino, 2000; Rüpke, 1995, 2000; Lo Cascio, 2000; Ker, 2010.

21 Macrobius, *Sat.*, lists the nundinæ as *feriæ* (I.16.5) but points out that there was a divergence of opinion in antiquity on the matter (see I.16.28-31). See also Macrobius, *Sat.* I.16.34

22 On *fasti,* see Degrassi, 1963, vol. XIII.2; Michels, 1967, 23 f.; and especially 187-190; Radke, 1990; Rüpke, 1995. On nundinal letters, see Rüpke, 2000; Michels, 1967.

in eight different towns on eight different days, such that the market day in Rome was at least nominally followed by that in Capua, then Calatia, etc., and then it would be market day in Rome again after eight days.

Looking then at the column headed *nundine* in the Dura-Europus parapegma, if this is indeed a nundinal column, it is reckoned in a new and unique, way. The column seems to read:

~~*NUNDINE*~~
~~*VIII*~~
~~*VII*~~
VI
~~*I*~~
IIII
III
PRI

Snyder argued that this column should be read as counting down to the local nundinal day in a manner analogous to the way in which the Roman calendar counts down to the Kalends, Nones, and Ides.[23] On this reading, the local nundinal day is indicated simply with the word *nundine*, and the rest of the days are counted down ordinally from VIII, ending with *pri(die)* then going back up to *nundine.*

Snyder's reading does fit a story we can provisionally tell. This column would be the only example of a nundinal list found outside of Italy. The author, stuck in a military outpost at the eastern edge of the Roman empire, may have been in a situation where the local market days were not regulated according to the Italian scheme of nundinae, and the names from home would make little sense to use. This is particularly the case since the names of nundinal days in individual Italian towns seem to have been, as we shall see in the next section, unique to each town, and so for the "artificial" community of soldiers in the barracks, any one list would have been unsatisfactory. The author thus resorted to counting down to the local nundinal day in the best way he knew how: by simple analogy to the calendar.

This is certainly a possibility, though I would not conclude from this that, even if it is correct, counting down to the local nundinal day was common anywhere outside these barracks.[24]

Problems Reconstructing Nundinal Lists

There are a number of parapegmata with complete or fragmentary lists of the hebdomadal days, and there are also some parapegmata with only nundinal days listed. Where it is a simple matter to reconstruct any missing hebdomadal days,[25] we are not so lucky with the nundinal days. It turns out that it is very difficult to get our extant nundinal lists to agree with each other.

A fragmentary parapegma from Pausilipum (transcribed in Fig. 8) has partial lists of both hebdomadal days and nundinae. It is a straightforward matter to complete the hebdomadal row with *[Mercur · Iovis · Veneris],* but if we look at the comparative evidence for the nundinal row, we find that evidence to be terribly conflicted.

23 See Snyder, 1936.

24 Snyder, 1936, for example, argues that this was the normal way of counting nundinae.

25 With the exception of the Mithraic hebdomadal deities, the ordering of the seven-day week is standard in antiquity just as it is today. Espérandieu thinks he has found one case of an alternate ordering from Gaul, but I have argued against this. See Lehoux, 2007, 177-8.

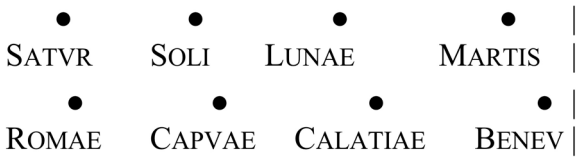


Figure 8. The Pausilipum parapegma.

Beginning with two of the best preserved nundinal lists extant, the Pompeii Calendar and the Latium Parapegma, we find the following nundinae:

Pompeii Calendar	*Latium Parapegma*
Pompeis	*Aquini*
Nuceria	*In vico*
Atella	*Interam(na)*
Nola	*Minturn(ae)*
Cumis	*Romae*
Putiolos	*Capuae*
Roma	*Casini*
Capua	*Fabrat(eria)*

The ordering of the last two entries in Pompeii (Roma followed directly by Capua), agrees with two of the entries in the Latium Parapegma. We can compare details of these and other nundinal lists by reordering the lists to emphasize overlap where possible and counting the nundinal days from there,[26] as follows:

Pompeii	*Latium*	*Pausilipum*	*Allifae I*	*Allifae II*	*Suessula*
Rome	Rome	Rome	Interamn[a]	[Ca]les	Cales
Capua	Capua	Capua	Telesia	[Sues]sula	[.....]
Pompeii	Casinum	Calatia	Saepinum	[Sin]uessa	[.....]
Nuceria	Fabrateria	Benev[entum]	Puteoli	[Ta]tinie	Campania
Atella	Aquinum	[.....]	Atella	[...]en[...]	Atella
Nola	*in vico*	[.....]	Cumae	Nucer[ia]	Suessula
Cumae	Interamna	[.....]	Nola	[L]uceria	Nola
Puteoli	Minturnae	[.....]	Altinati	[S]uessa	Cumae

What we find is that no two nundinal lists are identical, each containing a different subset of towns. More significantly, no two lists agree on the relative order of more than just two towns. We find Rome followed by Capua in every list that includes either place, but none of those lists has any of the same days thereafter (although the Pausilipum list is admittedly missing four days). If we look at the three lists that include Atella, Nola, and Cumae, plus one that includes a different overlapping subset, and concentrate only on days that actually overlap, we find:

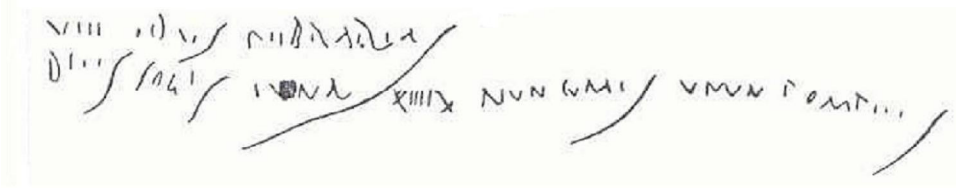
26 This does not change the relative ordering of the days in the list.

Pompeii:	*Nuceria*	Atella	Nola	Cumae	Puteoli		
Allifae I:	Puteoli	Atella	Cumae	Nola			
Suessula:		Atella	*Suessula*	Nola	Cumae	*Cales*	
Allifae II:			*Nuceria*			*Cales*	*Suessula*

Thus we find Atella, Nola, Cumae in the first list, but Cumae and Nola reversed in the second. These two lists also disagree on where Puteoli should be relative to the three, one first putting it after the set, the second before. The Suessula list agrees with neither, putting Suessula in between Atella and Nola, three days before Cales, where Allifae II puts Suessula the day after Cales. There is simply no way to reconcile these differences.[27]

Part of the reason for the discrepancies in the order of the nundinal days as preserved in different inscriptions may just be that for the readers of any one inscription in a particular locality like Pompeii, only the local nundinal day would matter. So long as there are seven other days in between, marked by seven other towns, no discrepancy with the actual nundinal days of these towns (or with other lists from still other towns) will be immediately apparent or even particularly significant. The usefulness for someone in Pompeii of knowing the actual nundinal day in Rome would be marginal. Of course, itinerant traders are attested in numerous inscriptions,[28] but the distances between the nundinal towns on any given list, and the often nonsensical back-and-forth orderings, show that the lists are probably not meant to be read as regular "circuits" even for these merchants.[29]

There is evidence that the nundinal day had some significance in dating formulae. Look at the date formula in the following graffito from Pompeii:[30]



VIII Idus Febrarias
dies Solis, Luna XIIIIX, nun(dinae) Cumis. V (Idus Febrarias?) nun(dinae) Pompeis.

VIII Ides February
Sunday, 16th day of the moon, nundinal day of Cumae. V (Ides February?) nundinal day of Pompeii.

27 Although attempts have been made. Deman, 1974, argues that the *Suessula* and *Pompeii* lists "concordent parfaitement", but I am unconvinced. He claims (based on comparison of the different *Allifae* lists) that Atella and Suessula are interchangeable, as are Puteoli and Cales. He then assumes that *Suessula's* "Atella, Suessula, Nola..." should be read as if it were "Atella *and* Suessula (together on one day), Nola (the next day)..." He does, however, concede that there is a lot a disaccord elsewhere. Tibiletti, 1976-7, tries to reconcile several lists, but his attempt forces him to see a seven-day nundinal cycle in the Latium parapegma, forcing him to ignore one of the eight peg holes.

28 See MacMullen, 1970.

29 See de Ligt, 1993, 115, although he thinks the Suessula list may be an exception; see also MacMullen, 1970, 340.

30 From *CIL* IV, Suppl. 2, no. 4182. Snyder, 1936, reads this text quite differently. Image courtesy of the *Corpus inscriptionum latinarum.*

On the usual reading of this inscription, we see calendar dates for the beginning and end of a three-day period. Corresponding to the VIII Ides of February, the day of the hebdomadal week (Sunday), the lunar day (XIIIIX), and a nundinal day *(nun. Cumis)* are given. Snyder has proposed a different reading such that the second date would be *V nun(dinas) Pompeis,* which is to say as implying that the nundinal day *Cumis* equals the fifth day before the nundinal day of Pompeii. I think it makes more sense here to follow the editors of the CIL in reading the entry as a second date, three days later, which was *nun. Pompeis.*[31] The abbreviation of the second date to just a numeral is possible because of the proximity of the full date formula *(VIII Idus Febrarias)* just before it.[32] In two dates mentioned back to back like this we need not expect the full rendering of the date both times. Compare Petronius: *hoc habebat inscriptum: "III. et pridie Kalendas Ianuarias..."*

Calendrical Columns

One text closely related to these parapegmata has columns for tracking calendrical cycles, in addition to columns for hebdomadal days and nundinae. Fig. 9 reproduces a drawing of the so-called Pompeii calendar.[33] Here we see well preserved, labeled columns for the hebdomadal days, the nundinal days, three columns for a calendrical cycle (notice the PRI(die) and K(alends) in the fourth column, and the Non(es) and Ides in the fifth), and lastly, three columns for the numbers I through XXX, as we saw in both Latium and Thermae Traiani.

The final group of columns shows some damage at line 2 of its middle column, but restoration is simply a matter of completing the numerical series to get *XV, [X]VI, XVII ....* Things get a little more interesting, however, in the calendrical columns. In the reproduction here, we see some damage indicated between the first and second column, from the top down to the level of line 6. The leftmost column can be restored just by counting up from the first complete number, *XV,* such that the column should be read *X[VIIII], X[VIII], XV[II], XV[I], XV, XIV, ...* But something strange happens in the middle calendrical column. Reading down from the top, we have: *VIII, VII,*

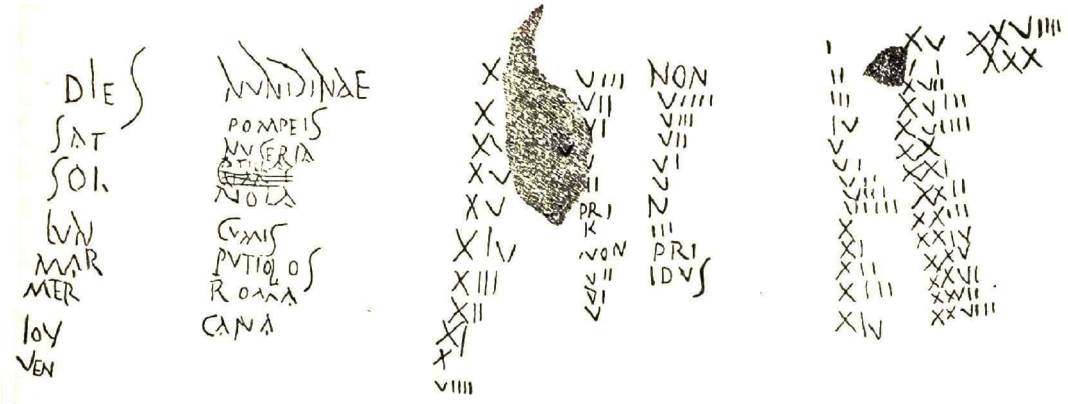


Figure 9. The Pompeii Calendar.

31 I note, for what it is worth, that this ordering disagrees with the Pompeii calendar, where *nun. Pompeis* is four days after *nun. Cumis.*

32 Another possibility (if a remote one) for reading this text is that the author is simply confused. Deman has argued that *dies solis* seems to be a mistake, since, given the consular year higher up in the inscription, the VIII Ides Feb. should be a *dies Mercurii.* Could the *V* be an abbreviation for *vel?*

33 Published in CIL IV, no. 8863. Image courtesy of the *Corpus inscriptionum latinarum.*

VI, [V], [I]V, [I]II, PRI, K, then an unclear entry, followed by *VII, VI, V.* The leftmost column and most of the middle one are clearly for the reckoning of dates in the Roman style, counting down from *XVIIII K.* to *III K., Pridie,* and the Kalends.

If we look to the right-hand calendrical column, we see that it also counts down from the Nones to the Ides, as follows: *Non, VIIII, VIII, VII, VI, V, IV, III, Pri, Idus.* But something funny has happened between the Kalends and the Nones in this list. Although no damage to the wall is indicated in the CIL drawing, we must surmise, for the sake of consistency, that three lines are missing from the bottom of the middle column, in order for it to properly count down to the Nones, thus we restore: *VII, VI, V, [IV, III, Pri]* in the middle column. Degrassi tries to solve this problem differently, supposing instead that the *VII, VI, V* are mistakes for *IV, III, Pri,* but this strikes me as implausible, given that the lack of a *Pridie Non.* should have been immediately obvious to the author, and also because *IV, III, Pri* would only be useable for a short month, not a 31-day month, whose Nones counted down from *VI,* not *IV.*

Perhaps the most troublesome line is the entry immediately after the Kalends. It looks to read something like *IVON,* and has been read as a month name by both Della Corte and Degrassi: *NOV* by Della Corte, and *IAN* by Degrassi. On either interpretation, the list is being interpreted as a calendar for the dates around the Kalends *of a particular month,* beginning with *XVIIII K.* and ending with the Ides. But this does not fit the general nature of the document as a whole, which is, like other parapegmata, a listing of four kinds of cycles (hebdomadal, nundinal, calendrical, and lunar) in their entirety. If it was meant for a particular month, then what would be the point of having four separate cycles of differing periodicities written out just once each, and each starting from their beginnings? Why is each cycle listed from its beginning, and not *in media res,* as we should expect if it were a particular month and its weeks and lunar cycle being tracked? (The odds of all these cycles beginning on the same day are less than one in 50,000.)

Taking it as a perpetual calendar, I propose to read the line after the Kalends as part of the numerical sequence counting down to the Nones, that is, as *VIII* rather than as a month name, and this would make the calendar section agree with the spirit of the rest of the document. I thus reconstruct it as follows:

DIES	NUNDINAE	X[VIIII]	VIII	NON	I	XV	XXVIIII
SAT	POMPEIS	X[VIII]	VII	VIIII	II	[X]VI	XXX
SOL	NUCERIA	XV[II]	VI	VIII	III	XVII	
LUN	~~CUMI~~ ATILLA	XV[I]	V	VII	IV	XVIII	
MAR	NOLA	XV	[I]V	VI	V	XVIIII	
MER	CUMIS	XIV	[I]II	V	VI	XX	
IOV	PUTIOLOS	XIII	PRI	IV	VII	XXI	
VEN	ROMA	XII	K	III	VIII	XXII	
	CAPUA	XI	VIII	PRI	VIIII	XXIII	
		X	VII	IDUS	X	XXIV	
		VIIII	VI		XI	XXV	
			V		XII	XXVI	
			[IV]		XIII	XXVII	
			[III]		XIV	XXVIII	
			[PRI]				

Astrometeorological Parapegmata

The final class of parapegmata is in many ways the most interesting and the best attested. These are the astrometeorological parapegmata, used for correlating annual stellar appearances and

disappearances with weather predictions. Such correlations form the core of the earliest attested astronomy in Greece, dating to as early as Hesiod's Works and Days. For example, Hesiod tells us:

> Fifty days after the solstice, at the arrival of the end of the season of weary heat, that is the time for mortals to sail. ... Then are the winds orderly and the sea propitious.[34]

Parapegmata for tracking astrometeorological phenomena were very useful in Greece, where the lunar calendar wandered in and out of the seasons. In this class of parapegmata the vast majority of examples are attested in literary sources rather than inscriptions. In these literary parapegmata, where there was no peg to indicate the current day, some kind of calendar or other temporal tracking device was used to help the reader situate the current day in the cycle. Look at this excerpt from Columella's parapegma:

> V Kal. Febr. Auster aut Africus, hiemat, pluvius dies.
> III Kal. Febr. Delphinus incipit occidere, item Fidicula occidere, significat.
> Pridie Kal. Febr. eorum, quae supra, siderum occasus tempestatem facit, interdum tantummodo significat.
> Kal. Febr. Fidis incipit occidere, ventus Eurinus et interdum Auster cum grandine est.
> III Non. Febr. Fidis tota et Leo medius occidit....

> V K. Feb. south wind or south-west wind; it is wintry; rainy day.
> III K. Feb. Delphinus begins to set, likewise Lyra (begins) to set; there is a change in the weather.[35]
> Pri. K. Feb. The setting of those stars, mentioned above, causes a storm, sometimes there is only a change in the weather.
> K. Feb. Lyra begins to set;[36] there is an east wind and sometimes a south wind with hail.
> III Non. Feb. All of Lyra and the middle of Leo set....

Here the reader is expected to find the current date and read off the astrometeorological situation.[37] But, in spite of the number of examples we have of literary parapegmata, we shall see that they so frequently disagree as to be all but useless as evidence for reconstructing inscriptional or other fragmentary parapegmata.

Some of the main problems that we encounter in trying to reconstruct astrometeorological parapegmata can best be seen by considering one of our most fragmentary examples, coincidentally the only inscriptional astrometeorological parapegma extant in Latin, the Puteoli Parapegma (Fig. 10).[38] Here we see in the main section a partly preserved phrase that we can reconstruct by comparison with Columella: *Delphin[us] occid[it ves]peri, t[empes]tas,* "Delphinus sets in the evening, (there is) a storm." Columella has *Delphinus incipit occidere,* and *siderum occasus tempestatem facit,* "Delphinus begins to set," and "the stars' setting causes a storm" on two con-

34 Hesiod, *Op.,* 663 f.

35 For this translation of *significat,* see Lehoux, 2004a.

36 It is unclear why this entry gets repeated, but this entry is preserved in all MSS. There may be some technical distinction between *Fidicula* and *Fidis* that is unique to Columella, or else one of the two entries is an interpolation.

37 See Lehoux, 2004b.

38 See Lehoux, 2006.

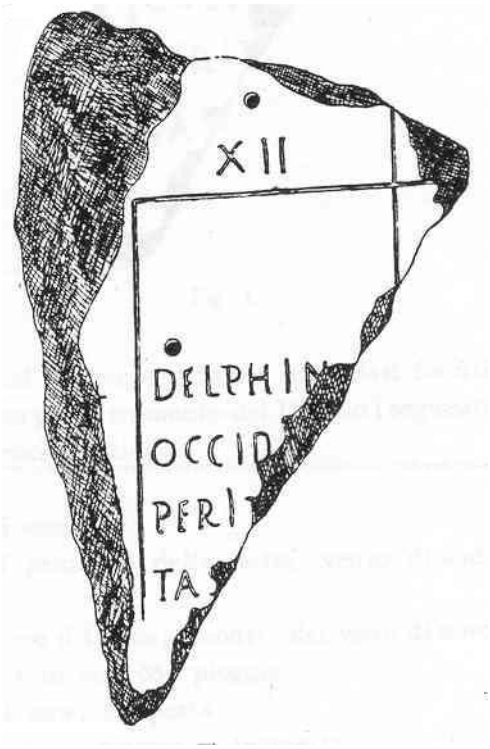


Figure 10. The Puteoli Parapegma.

secutive days. Such discrepancies in day counts, it turns out, are endemic to all but a few small clusters of closely related parapegmata. Given the fragmentary nature of the Puteoli parapegma, it is impossible to tell whether it belongs to such a cluster.

The XII in the top line does not help matters, as there is nothing like it in any other astrometeorological parapegma. Moreover, its hole is considerably smaller than that of the entry for Delphinus below it (2.5 mm versus 4 mm), indicating that the XII is part of a different cycle from Delphinus, probably either calendrical or lunar, tracked with a different-sized peg, as we find in some other Latin inscriptional parapegmata with multiple cycles. We have already seen several parapegmata that track some subset of hebdomadal, nundinal, lunar, and calendric cycles, but this would be the only one to combine an astrometeorological cycle with any other, making it a unique kind of hybrid for which direct comparative evidence is lacking.

If we look to how other parapegmata handle the one astrometeorological entry on the Puteoli fragment, we see just how much variation there generally is in this class of parapegmata, and just how much uncertainty we have in trying to reconstruct any fragmentary parapegma based on such comparative evidence.

All these different parapegmata have different phases listed as significant, and the ordering of entries they do share often differs markedly in ways not explainable simply by differences in latitude (Fig. 11). In only a few cases can we see patterns emerging that show us that some two or three parapegmata are related to each other,[39] and in such cases comparative evidence may be of more use than it is for other examples, but for the most part clear relationships are lacking between astrometeorological parapegmata, just as we have seen with nundinal lists.

39 As with Columella and Polemius Silvius, for example. See Degrassi, 1963, vol. XIII.2, 263.

Puteoli Parapegma	*Columella*	*Ovid*	*Pliny*	*Clodius Tuscus*	*Ptolemy*
	Star in the breast of the Lion sets.				
	S or SW wind, wintry, rainy.				
	Delphinus and Lyra begin to set, change in weather.	Lyra sets, Leo is invisible.		Stormy winds with snow.	Bright star of Lyra sets in the evening. S or NW wind.
Delphinus sets in the evening, Storm.	Storm from evening setting of Delphinus and Lyra.	Delphinus sets in the evening.	Delphinus sets in the evening.	Delphinus tends to set.	
	Lyra begins to set, E wind or S wind with hail.			Part of Lyra begins to set in the first watch of the night, and clouds and a strong N wind with thunder.	
	All of Lyra and the middle of Leo set.	Half of Aquarius is visible.		Rain mixed with snow.	
				S and E wind, and Lyra begins to set.	
	Middle of Aquarius rises, windy.			Stormy air and W wind.	Star on heart of Leo sets in the morning.
				The middle of Leo sets with Lyra.	
			/... a gap of 11 days.../		
			Star in breast of the Lion sets in morning.		
			/... a gap of 8 days.../		
			Lyra sets in the evening.		

Figure 11. Comparison of astrometeorological data.

"Miletus II"

More complete than Puteoli, but not much more reconstructable, is a parapegma from Miletus, known as Miletus II. The main difference here from what we have seen so far is that this parapegma is attributive, that is, the predictions are ascribed to various authorities such as Meton, Euctemon, Eudoxus, and others. There are three fragments preserving parapegmatic data (IMilet inv. 456D, 456A, and 456N, see Figs. 12-14), and additionally a fragment with part of an introductory text and slight remains of the left edge of a column of parapegma (456C).[40] Here we see both weather predictions and astronomical information attributed. Some days, it should be noted, have no astrometeorological information associated with them, and are represented just by place-holding peg holes.

Like the Puteoli Parapegma, Miletus II does not compare well enough with other parapegmata to warrant reconstruction beyond what can be achieved on internal evidence alone. Some attempts have been made to reconstruct the missing stellar phases by a comparison with both astronomical data (for the true sequence of phases at Miletus), but this assumes that the parapegma was observationally derived, which cannot be shown.[41] And comparative evidence in other parapegmata is only useful if a close resemblance between one parapegma and another can be shown, which is not the case here.

But there is a further temptation that raises its head with attributive parapegmata like this one. By comparing this text with other attributive parapegmata, and extracting the predictions ascribed to individual authors, some scholars have tried to reconstruct the lost ur-parapegmata from which the attributions were taken. Thus we get Rehm's and Pritchett and van der Waerden's *Parapegma of Euctemon,* and van der Waerden's *Parapegma of Dionysius.*

On Not Reconstructing Lost Parapegmata

The "Euctemon Parapegma"[42] is a modern reconstruction by Rehm of the presumed fourth century BC calendar from which later parapegmatists are supposed to have excerpted their Euctemon citations. The problem here is that we cannot be sure that the text or texts from which the citations were taken looked anything like the reconstruction (it may have looked more like Hesiod or Aratus), nor—and this is a very important point—that it was written in the same calendar.

Rehm has attributed to Euctemon a list of the date-differences between various stellar phases, specifically, the very one found in *C. Vind. Gr. philos. 108,* fol. 282v-283r.[43] His reasoning relies on the close similarity between some of the timings of phases listed in this text and the dates of phases attributed to Euctemon in Geminus and Ptolemy. But the correspondence between *C. Vind.* and the attributions to Euctemon in Geminus and Ptolemy are not a perfect match and in some instances differ quite markedly. Even a quick glance at Rehm's table where he sets

40 The texts given here are slightly revised from those in Lehoux, 2004b. In particular Rehm's transcription of the currently untraceable 456N has been checked against a photograph in the *Inscriptiones Graecae* archives in Berlin, which is probably the same photograph that Rehm himself used; a scan is available at https://archive.nyu.edu/handle/2451/44434/ . On 456C see now Bevan, Jones, and Lehoux, 2019.

41 See Lehoux, 2004b.

42 Rehm, 1913. See also Pritchett and can der Waerden, 1961; Wenskus, 1990; Hannah, 2002, 2005, 2009; Lehoux, 2007.

43 See Cumont, *CCAG*, VI, 13.

1	[	• [ ]
	[...]ẠTA	ΚẠ[...]
	[...] *vac.*	*vac.* [...]
	[...] •	• ὡρίω[ν ...]
5	[• ... ἀκρώνυ]χος δύνει	κατὰ [...]
	[κατὰ ...] ϙαὶ Αἰγυπτίους. •	• ὑάδε[ς ...]
	[• ...] νότος πνεῖ κατ᾽ Εὔδοξον	κατὰ .[... ... καὶ]
	[καὶ Αἰγ]ῠπτίους, κατὰ δὲ ᾽Ινδῶν Καλ-	λύρα Ε[...]
	[λανέ]α σκο̣[ρ]πίος δύνει μετὰ βρον-	κατὰ [...]
10	[τ]ῆς καὶ ἀν]έμου	• ὑάδε[ς ...]
	[•] •	σφόδ[ρα ...]
	[• ...]ẸΣ ἀκρώνυχοι ἐπιτ̣ἐλλουσιν	• χειμ[αίνει ...]
	[κατ᾽ Εὔ]δ̣οξον κα̣ὶ Αἰ̣[γυπτί]ους.	• ὑάδ[ες ...]
	[... ἐσπ]ἑ̣ριαὶ ἐ̣π̣[ι]τ[έ]λ̣λουσιν	χειμ[αίνει ...]
15	[...]	• [...]

1	[	• [ ]
	[...]A	KA[...]
	[...]	[...]
	[...]•	• Orio[n ...]
5	[• ...] sets [acrony]chally	according to [...]
	[according to ...] and the Egyptians. •	• The Hyade[s ...]
	[• ...] the south wind blows according to	according to [... ... and]
	Eudoxus [and the Eg]yptians; and	Lyra E[...]
	according to the Indian Cal[laneus,]	according to [...]
10	Scorpio sets with thunder and wind.	• The Hyade[s ...]
	[•] •	very mu[ch ...]
	[• ...]ΕΣ rise acronychally	• It is stor[my ...]
	[according to Eu]doxus and the E[gypti]ans.	• The Hyade[s ...]
	[...] r[is]es in the [eve]ning.	It is stor[my ...]
15	[...]	• [...]

Figure 12. IMilet inv. 456D.

1	[...	...]ẹ̣ι ἑσπ̣έρας κ̣α̣[...]
	[...]	[κ]α̣τ̣᾽ Εὐκτήμονα. •
	[...]	• αἴξ ἀκρώνυχος δύνει κα̣[τὰ]
	[...] *vac.*	καὶ Φίλιππ̣ον καὶ Αἰγυπτί[ους.]
5	[... ο]υ̣σιν κατ᾽ ΕΥ-	• αἴξ ἑσπερία δύνει κατὰ ᾽Ινδῷ̣[ν]
	[... κατὰ ᾽Ι]νδῶν Καλλανέα	Καλλανέα. •
	[• ... ἑσ]π̣έριαι δύνουσιν	• αἐτὸς ἐπιτέλλει ἑσπέ̣ρας
	[... ἐπι]σ̣ημαίνει, χαλάζηι	κατ᾽ Εὐκτήμονα.
	[κατὰ ...] • • •	• ἀρκτ̣ο̣ῦρος δύεται ἕωθεν καὶ ἐ[πιση-]
10	[...]Α̣Σ κρύπτεται ἑσπέρας, χάλαζαι	μαίνει κατ᾽ Εὐκτήμονα. τῆ̣ι δ᾽ α[ε-]
	[...]γ̣οντα̣[ι] καὶ ζέφυρος ἐπιπνεῖ	τὸς ἐπιτέλλει ἑσπέρας καὶ κα̣[τὰ]
	[...] ̣ΜΟ̣[̣] ̣ κατὰ δὲ ᾽Ινδῶν	Φίλιππον.
	[Καλλανέα ...] *vac.*	

1	[	...] evening [...]
	[	[accordi]ng to Euctemon. •
	[	• Capella sets acronychally ac[cording]
	[	to both Philippus and the Egypti[ans.]
5	[...]s according to Eu-	• Capella sets in the evening according
	[... according to the I]ndian Callaneus	to the Ind[ian] Callaneus. •
	[• ...] sets i the [eve]ning	• Aquila rises in the evening
	[... there is a ch]ange in the weather	according to Euctemon.
	[ ] with hail, [according to ...] • • •	• Arcturus sets in the morning accord-
10	[...]Α̣Σ disappears in the evening. It hails	ing to Euctemon. On this day [Aqu-
	[...]γ̣οντα[ι] and Zephyrus blows.	ila rises in the evening also, ac[cor-]
	[...] ̣ΜΟ̣[̣] ̣ and according to the Indian	[ding to] Philippus.
	[Callaneus ...]	

Figure 13. IMilet inv. 456A.

Geminus and Ptolemy alongside *C. Vind.*[44] will reveal just how unconvincing the correspondence is between *C. Vind.* and our known sources for Euctemon. Of the thirty-eight day-counts that are listed by *C. Vind.,* eleven match the timings in Geminus' Eudoxus exactly, and four more are within a day or two. Due to textual corruption, nine more entries are impossible to compare. This leaves us with fourteen entries—40% of the text—that are not a good fit between the two texts. In many instances the fit is in fact better between these entries and other parapegmata, and/or material attributed to other authorities in Geminus. Moreover, in Geminus, all the Euctemon entries are wedded to weather predictions, which are lacking in *C. Vind.* All of this leads me to the conclusion that both Geminus and *C. Vind.* were working from multiple sources, not just some single text attributable to a single author. It is therefore not possible to cite the list we find in *C. Vind.* as "the parapegma of Euctemon."

44 Rehm, 1913, 14-26; 30; see also the analysis in Lehoux, 2007, 181-187.

1 [...]Ạ.Ị ἐπιση-
[μαίνει ...]Ị κατ᾽ Εὐκτήμονα. τῆι δ᾽ ΑϒΞ- •
[... κατὰ Φ]ίλιππον. ἀρκτοῦρος δύ̣ε̣-
[ται ...]Ṇ καὶ ἐπισημαίνει
5 [...] ἐ̣πιτέλλουσιν ἕωθε̣ν̣ [...]
[...]Ṇ.ΕΙ αὐταῖς κατὰ Φίλιππ[ον ...]
[... κ]ατ᾽ Εὔδοξον πλει̣ὰ̣[δες]
[ἐπιτέ]λ̣λουσιν.
[...]Ị.Ạ.Ι ἐπιτέλ[λουσιν ...]
10 [κατ᾽ Ἰνδῶ]ν Καλλα̣[νέα ...]

1 [...]Ạ.Ị there is a change
[in the weather ...]Ị according to Euctemon, and at the ΑϒΞ- •
[... according to Ph]ilippus. And Arcturus se-
[ts ...]Ṇ and there is a change in the weather.
5 [(pl.) ...] rise i the morni[ng ...]
[...]Ṇ.ΕΙ for the same ones, according to Philipp[us ...]
[... acc]ording to Eudoxus. The Pleiades
[ri]se.
[...]Ị.Ạ.Ι ris[e ...]
10 [According to the Indian] Calla[neus ...]

Figure 14. IMilet inv. 456N.

Conclusion

My general stance has been cautious with respect to reconstructing parapegmata, paying particular attention to the problems posed by comparative evidence in certain classes of these texts. Because of the regularity and simplicity of the lunar and hebdomadal sequences found in some parapegmata, they are easily reconstructed. For nundinal and astrometeorological sequences, however, comparative evidence turns out to be useful for reconstruction in only a few cases, but very few of these texts agree with each other at even a basic level. The degree of variance shown by the different texts is, I think, sufficiently high that we must presume variance to be largely endemic to these cycles. This has the greatest impact on the large body of astrometeorological parapegmata. Reconstructions and editions that try to minimize or correct for their variance are doing these texts an injustice. I would thus caution against the temptation to fix repetitions, mistakes, and omissions in these texts through comparison with other parapegmata, and instead to treat the texts as they have come down to us, flaws and all.[45]

45 I would like to thank Alexander Jones and the anonymous referee for their valuable comments on earlier drafts of this paper.

Abbreviations

CCAG = Cumont, F., et al., ed. *Catalogus codicum astrologorum graecorum*, Brussels, 1898-1953.
CIL = Corpus inscriptionum latinarum, Berlin, 1863-.
Georg. = Vergil, *Georgics*.
NH = Pliny, *Naturalis historiae.*
Op. = Hesiod, *Works and Days.*
RE = Paulys Realencyclopädie der classischen Altertumswissenschaft, Stuttgart, 1893-.
RR = Columella, *De re rustica*.
Sat. = Petronius Arbiter, *Satyricon*, or Macrobius, *Saturnalia.*

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