

# Parapegmata,

or,

## *Astrology, Weather, and Calendars in the Ancient World,*

*being an examination of the interplay between the  
Heavens and the Earth in the Classical and Near-Eastern  
Cultures of Antiquity, with particular reference to the  
Regulation of Agricultural Practice, and to the*

Signs and Causes of Storms,  
Tempests, &c.

by

**Daryn Rosario Lehoux**

A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy  
Institute for the History and Philosophy of Science and Technology  
University of Toronto

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by Daryn Rosario Lehoux,

Institute for the History and Philosophy of Science and Technology,  
University of Toronto  
2000

## Abstract

I examine a set of texts and instruments, called *parapegmata*, which were used in the classical world for tracking cyclical phenomena such as stellar phases, weather, hebdomadal cycles, lunar cycles, and more. I argue that these texts are primarily astrological rather than astronomical or calendrical. I trace the possible connection between *parapegmata* and calendrical cycles in Greece, Rome, and Babylon, but I maintain a sharp distinction between calendars and *parapegmata*: the *parapegmata* were not used for chronological purposes, but rather for the regulation of various activities, most prominently agriculture. Different types of *parapegmata* were used by the Greeks and Romans for tracking stellar and lunar phenomena, and these distinct phenomena were used by them as signs for the timing of various activities, partly in an attempt to align their actions with sympathetic forces in the Cosmos. In order to understand how the *parapegmata* were used, I devote a chapter to unraveling the modes of predictive signification in the *parapegmata*, showing how these texts and instruments eliminated the need for astronomical observation.

I show that some similar astronomical phenomena were tracked by the Babylonians and Egyptians for similar purposes, although the parallels we find in these cultures show a much closer connection to other, more diverse types of omina than the classical texts do.

The work includes a descriptive catalogue of all the parapegmata known to me.

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## Abbreviations Used in this Work

For Greek and Latin works, I have used the standard abbreviations found in LSJ and Lewis and Short's *A Latin Dictionary*. Other abbreviations are as follows:

ACT	<i>Astronomical Cuneiform Texts</i> (Neugebauer, 1955)
AfO	<i>Archiv für Orientforschung</i>
CCAG	<i>Catalogus Codicum Astrologorum Græcorum</i> (Cumont et al., 1898-)
CIL	<i>Corpus inscriptionum Latinarum</i>
d	day(s)
DSB	<i>The Dictionary of Scientific Biography</i> , New York, 1970-
EAT	<i>Egyptian Astronomical Texts</i> (Neugebauer, 1969)
HAMA	<i>History of Ancient Mathematical Astronomy</i> , (Neugebauer, 1975)
IG	<i>Inscriptiones Græcæ</i> (Berlin, 1863-)
K.	tablets in the Kouyunjik Collection in the British Museum
KAR	<i>Keilschrifttexte aus Assur religiösen Inhalts</i> , (Ebeling, 1915)
LSJ	Liddell and Scott's <i>Greek-English Lexicon</i> .
m	month(s)
MUL.APIN	<i>MUL.APIN: An Astronomical Compendium in Cuneiform</i> , (Hunger and Pingree, 1989)
OCD	<i>The Oxford Classical Dictionary</i> , Oxford, 1996
P. Oxy.	<i>The Oxyrhynchus Papyri</i> , London, 1898-
RE	<i>Paulys Realencyclopädie der classischen Altertumswissenschaft</i> (Stuttgart, 1893-)
τ	tithi(s)
TU	<i>Tablettes d'Uruk</i> , (Thureau-Dangin, 1922)
y	year(s)



## *Preface*

I would like first and foremost to thank my supervisor, Alexander Jones, for making my whole graduate school experience both enjoyable and profitable. I suspect that this dissertation is in some ways not quite what he expected when he first suggested the project to me, but his encouragement has been unfailing, and his assistance untiring.

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Thanks to Jay Foster for tolerating endless hours of me banging my head against some wall or other and helping me sort it out; to Kevin McNamee for coming at everything from an unforeseen direction; to André LeBlanc for really making me pin down the historiography lurking behind this whole thing; to Bob; to all the folk in the *IHPST* Common Room and at *UQAM*; to Bert Hall for all his help; to Leo Depuydt for his helpful comments on chapter 8; to Marcellus Martyr for introducing me *Plato et al.*; to James Hoch and Karljürgen Feuerherm for teaching me so much about language; to my parents, for never suggesting I become an accountant or something; and to Zag and Muna, for everything.

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If I have missed anyone, please forgive me. I plead exhaustion.

## *Chapter One*

# Introduction

This work fills out a chapter in the history of ancient astronomy, one that begins with the earliest classical texts and forms a continuous thread through to the Middle Ages. It looks at the early agricultural, navigational, and medical uses of astronomy to predict changes in the atmosphere, on both a seasonal and a day-to-day basis, from Hesiod through to late antiquity. My starting point is the thesis, first articulated by Bowen and Goldstein, that early Greek astronomy is concerned with a fundamentally different set of problems than later astronomy. Specifically, early Greek astronomy is more interested in the annual phases of the fixed stars than it is with planetary motion. Their thesis finds strong confirmation in this work. But above and beyond their starting point, I show how this fixed-star astronomy persisted in a tradition of weather prediction all through classical antiquity, and this astrometeorology existed side by side with later developments in planetary astronomy and astrology. Moreover, I show how this fixed-star astronomy is not unique to the Greco-Roman world, but has cognates in both Mesopotamia and Egypt. I also look at how the Greek instruments—using this word in a very broad sense—that were used to track the motion of the fixed stars and to predict the weather were later modified by Romans and put to

other uses, such as tracking certain lunar phenomena and the days of the week.

In this work I also address the broader question of how one mode of prediction, cyclical astrological prediction, functioned in the ancient world. I examine a diverse set of texts and instruments collectively known as *parapegmata*. These were used for predicting and tracking such things as astronomical events, day-to-day weather changes, lunar phenomena, and certain types of astrological influences. All the phenomena predicted in the *parapegmata* happen to be inherently cyclical, and this affects the way in which the predictive reasoning works. It also conditions how the predictive logic itself is justified, and (connected to this) how the texts themselves receive their authority.

Now, the reader will notice that I just referred to day-to-day weather changes as 'cyclical', and this may seem strange. Certainly the other phenomena tracked and predicted by the *parapegmata* are easily seen as cyclical: the days of the week, the phases of the moon, and the motions of the sun and stars, for example. But how so the weather? The answer is that, on the ancient understanding (and this was accepted, as we will see, throughout the ancient Mediterranean and Near Eastern world) certain weather phenomena recurred at certain times of the year, or under certain heavenly configurations. Certainly no one today would be shocked by my saying that around the summer solstice the weather is warmer than it was or will be at the winter solstice, or that springtime is rainy. And it is clear that these general weather phenomena are cyclical. If we simply allow an

extension of this logic in the direction of an increased specificity,<sup>1</sup> then we can see how the ancients saw certain types of weather patterns as recurrent at certain times of year: on the day of the setting of the Hyades, for example, rain was predicted. Thus, on the ancient understanding, certain (but not all) weather events were seen as cyclical, and were related to other cyclical (astronomical) events. These astronomical events functioned as *signs* of the coming weather, and sometimes also were seen to be *causes* of that weather.

Because they always treat of cyclical phenomena it is difficult to disentangle the past from the present and the future in the *parapegmata*. Some aspects of them seem only to make sense as predictive (i.e., forecasting events for the future), other aspects as what we might call *stative* (i.e., reporting events that are happening 'today'). These current phenomena are reported because they are either in principle unobservable (say, the current day of the week), circumstantially unobservable (the rising of Arcturus on a cloudy morning), or are completely observable (the rising of Orion on a clear night). In this last case, however, the fact that the *parapegma* tells us that Orion will rise eliminates the need for actual observation: we need only consult the text. In addition to this stative function, *parapegmata* always situate current events in a relative temporal framework, such that past and future events—tomorrow's weather or Sunday's lunar phase, for example—are easily seen.

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<sup>1</sup> I do not offer this as a genealogical account. I make no claims that this is how the idea to predict day-to-day weather developed in the ancient world. I use this illustration rather as a way of bringing the modern reader to the ancient understanding.

An important part of my argument is the contention that these texts should be seen as primarily *astrological* rather than calendrical or even astronomical.<sup>2</sup> The types of events they predict and report cannot be reduced to *astronomy* in the modern sense of the term. While it is true that the ancients did not always draw such a clear distinction between astrology and astronomy as we do now, I think the distinction is one which needs to be made, if only to draw a sharper contrast with previous work on the *parapegmata* by Rehm, van der Waerden, and others, who have treated these texts as though they were primarily astronomical or calendrical.

Because of both the relative obscurity of these texts and the ways they have been interpreted by the few scholars who *have* worked on them, I will need to do some fairly detailed historical work. Accordingly, I begin with a description of what the *parapegmata* are, and how they worked. I then catalogue all the *parapegmata* known to me, as well as any related texts and instruments. This catalogue is meant to supersede Rehm's,<sup>3</sup> and includes or reclassifies many texts of which he was unaware or dismissive.

I go to some length to conceptually disentangle calendars, cycles, and *parapegmata* in chapter four, where I examine a group of speculative interpretations and reconstructions of the *parapegmatic* tradition. I end this chapter by trying to see what positive claims we can make about the early Greek astrometeorological tradition.

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<sup>2</sup> I use the term 'astrological' in its broadest sense. When I need to refer to the casting of personal horoscopes, I use *genethliology*.

<sup>3</sup> Rehm, 'Parapegma', *RE*.

Chapter five aims to establish a framework for speaking of predictive signification. In it I argue that the predictive sign should be understood in a broad sense, and that it should include causative relations as well as synchronous or observational ones. I then address the philological problem of one of the most frequent and poorly understood technical terms in the *parapegmata*: the verb ἐπισημαίνει. I argue that it is an intransitive and impersonal verb which should be taken to mean "there is a change (in the weather)." As in medicine, where its related noun ἐπισημασία is used as a technical term for one phase of a cyclical fever, it has lost all sense of the 'signification' which seems to be implied by its linguistic derivation, and has come instead to refer to an actualized, factual process or event.

From there I go on to look in detail at one of the primary uses of the *parapegmata*: the regulation of agricultural practice. I argue that the events tracked by the *parapegmata* (stellar and lunar phases, for example) were seen to exert a certain *physical* influence, called *sympathy*, with which it was in the farmer's best interests to accord his actions. This agricultural schedule has often been seen as a kind of calendar, but I argue that this reflects too loose an understanding of the idea of a calendar, and that this confusion has led to some questionable (re)constructions of 'lost' calendars.

Chapters seven and eight move us out of the classical world to Babylon and Egypt. We shall see that Egypt developed its own decanal astrometeorological tradition. Babylonian texts, on the other hand, were concerned with a broad range of ominous phenomena.

Astral meteorological omina can be found in the omen series *Enuma Anu Enlil*, and MUL.APIN shows parallels to the classical parapegnatic tradition.

While it is difficult to trace direct influences in meteorological omina from Babylon to Greece or Egypt, we do find calendrical cycles possibly being exported from Babylon and incorporated into the Greek astrometeorological tradition as early as the fifth century B.C. These cycles were used to calibrate the parapegnata, keeping them in line with both the solar year and the lunar calendars of Greece.

The extremely broad scattering of the sources for ancient astrometeorology, ranging from agricultural treatises to calendrics, astrology, astronomy, graffiti, epigraphy, and more, combined with a broad linguistic and cultural diversity, have made this material undeservedly obscure. I hope that by bringing these texts together in one place and showing some of the relations they bear to each other, I will have shed new light on a set of wide-ranging ancient astronomical practices.



## Chapter Two

# What is a Parapegma?

*An' as it blowed an' blowed  
I often looked up at the sky  
an' assed meself the question  
what is the stars, what is the stars?  
-Sean O'Casey*

*I: What is a Parapegma?*

The word *parapegma* (pl.: *parapegmata*) refers to an ancient instrument which was used to keep track of astronomical, astrological or astrometeorological cycles using a moveable peg or pegs. By extension, the word also refers to a group of texts which were derived from these instruments, and which tracked the astrometeorological cycle typically by linking it to a calendar. Broadly speaking, *parapegmata* either (a) correlate and temporally situate weather phenomena and particular kinds of astronomical phenomena (see fig. 1), or (b) correlate and temporally situate lunar days, the seven days of the astrological week (called the hebdomadal days), and often nundinal days<sup>1</sup> (see fig. 2). By *temporally situate* I mean they provided some means for locating the current day in the context of the larger temporal scheme, either by indexing the cycle to a calendar, or by indicating the current day with a peg. I call this process *tracking* a lunar or astrometeorological cycle. In inscriptional

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<sup>1</sup> For an explanation of which, see section *I.ii*, below.

parapegmata, each entry would have a hole drilled beside it to receive a moveable peg. The peg would be shifted on each consecutive day, and thus the inscription beside the peg would contain the information pertaining to the current day.

There were also non-inscriptional, literary parapegmata in both Greek and Latin. A typical example of these would list the dates of a coming year in, for example, the Roman or Egyptian calendar, and, for particular dates, offer astronomical and weather predictions for that year. In this respect, they are rather like a pared-down version of a more modern *Farmer's Almanac*. These calendars were used in Greece from at least the fifth century B.C., and there are Western European and Byzantine examples dating well into the Middle Ages and beyond.

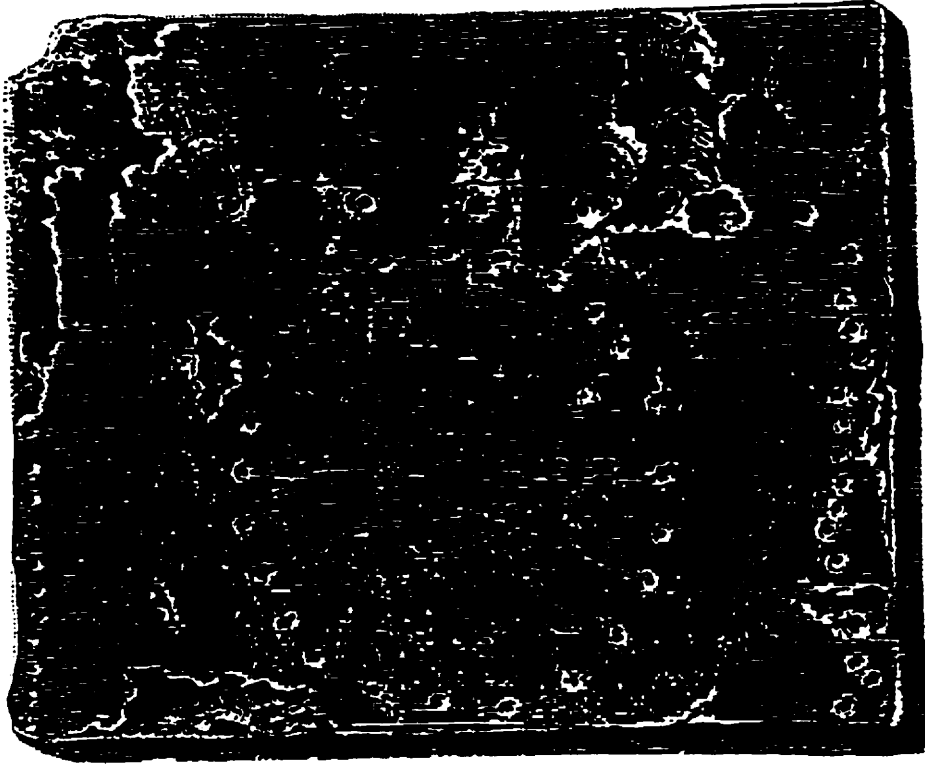
The Romans translated Greek parapegmata into Latin, and they were developing their own versions by the first century B.C., with some interesting modifications. In particular, their inscriptional parapegmata were often used to keep track of lunar days, hebdomadal days and nundinal days. There was also a corresponding Egyptian tradition dating from at least the fourth century B.C., which may or may not be independent from the Greek.

The astronomical phenomena frequently recorded in the parapegmata are the solstices and equinoxes for a given year, and what are called the 'phases' of the more important fixed stars.

30

- The sun is in Aquarius.
- [Leo] begins to set in the morning and the Lyre sets.
- Cygnus begins to set acronychally.
- Andromeda begins to rise in the morning.
- The middle of Aquarius rising.
- Pegasus begins to rise in the morning.
- The whole of the Centaur sets in the morning.
- The whole of Hydra sets in the morning
- Cetus begins to set acronychally.
- Sagitta sets, the season of the west wind accompanying it.
- The whole of Cygnus sets acronychally.
- [Arcturus] ri[ses] acronychally.

*figure 1: part of a pegged astronomical parapegma (Miletus I). The peg was moved from one hole to the next each day, and any important astronomical or astrometeorological phenomena for the day could then be read beside the peg.*



*figure 2: a pegged astrological parapegma (Thermæ Traiani). This type of parapegma used more than one peg to track different cycles. Here there was one peg for the hebdomadal deities (seven holes in the top row under the images of, from left to right, [Saturn], Sol, Luna, Mars, Mercury, [Jupiter], and Venus), another peg for the days of the moon (fifteen numbered holes down the left side and fifteen down the right), and a third peg for the sun's or the moon's position in the zodiac (24 holes around the zodiacal circle in the middle of the parapegma).*

*I.i: The Phases of the Fixed Stars*

We all know that the sun has a motion from east to west, which it repeats every day, moving the 360° around the earth in 24 hours.<sup>2</sup> But the sun also has another, less obvious motion from west to east. This can be observed as follows: go out just at sunset and watch the sky begin to fill with stars as the brightness of the setting sun recedes. You should take special notice of the stars in the general vicinity of the recently-disappeared sun. In particular, remember how far they are from the western horizon a little after sunset. The next day, go out again and observe the same stars. You will notice that they are closer to the horizon than they were at this exact time<sup>3</sup> the day before. The next day they will be closer still, until one day they will vanish entirely in the obscuring brightness of the sun. This vanishing is one of the four important 'phases' of a star, called its '*heliacal setting*', its '*evening setting*', or just its '*setting*'. It is said, in Greek terms, to be due to the slow west-to-east motion of the sun (relative to the fixed stars), which it completes in one (sidereal) year, moving at a rate of approximately 1° per day.<sup>4</sup>

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<sup>2</sup> For the purposes of this work, the earth sits still in the centre of the Cosmos and the sun, stars and planets all move around it.

<sup>3</sup> I say that sunset occurs "at the same time" each day since it is one of the events which defines 'time' in the ancient world. Hours were counted relative to sunset or sunrise in antiquity, rather than from an artificially determined 'midnight' as we do it today.

<sup>4</sup> The measurement of this motion in degrees only began in the second century B.C. in Greece. For that matter, it is not even clear in the earliest sources, such as Hesiod, whether the sun or the stars were thought to be moving.

After about 30 days (assuming the chosen star is on or near the ecliptic) the star will rise from the eastern horizon just before sunrise, thus ending its period of invisibility. This first appearance is the next significant phase of the star, called its '*heliacal rising*', '*morning rising*', or just its '*rising*'.

After this phase, the star will rise earlier and earlier each day until its '*acronychal rising*',<sup>5</sup> or '*evening rising*', when it rises in the east just as the sun sets on the western horizon. A little while later, the star will set on the western horizon just as the sun rises in the east, making its '*acronychal setting*', or '*morning setting*'.

Stars north or south of the ecliptic have some differences in the sequential order of these phases,<sup>6</sup> but the terminology remains the same.

All the phases I have discussed above, the heliacal and acronychal risings and settings, are *apparent* insofar as they are observable phenomena. Some parapegmata, however, distinguish the *true* rising and setting from the observed phase.<sup>7</sup> The true heliacal rising, for example, occurs when the star rises at exactly the same time as the sun rather than (as in the apparent rising) a little before it. Due to the brightness of the sun, the true phase is never

---

<sup>5</sup> 'Acronychal' comes from the Greek ἀκρόνυχος, "at nightfall".

<sup>6</sup> Details can be found in Neugebauer, *HAMA*, p. 760 f.

<sup>7</sup> Bowen and Goldstein, 1988, p. 54 f., disagree, but Ptolemy goes to some length to distinguish true and apparent phases in his introduction to the *Phaséis* (§3), and they offer no convincing account of the occasional distinction in Geminus between a star's '*rising*' and its '*becoming visible*'.

observable, but must be calculated. An example of the distinction between a true and apparent phase can be found in Geminus:<sup>8</sup>

On the 27th (of Cancer): According to Euctemon, Sirius rises: the weather changes....

And four days later, we see:

On the 1st day (of Leo): According to Euctemon, Sirius is visible, it becomes very hot: the weather changes.

Not all cases are so clear, however, and it is often difficult to tell from a given parapegmata whether the true or apparent phases are referred to.

### *I.ii: The Nundinal Days*

The nundinal day is the market-day for a given Italian town, which occurred, from archaic times onward, every ninth day on the Roman reckoning (every eighth day counted as we would do). The local market day was a holiday from agricultural work,<sup>9</sup> and farmers could thus come to town to exchange wares and produce, as well as to keep up on local affairs, politics, laws, etc.<sup>10</sup>

Various *Fasti*<sup>11</sup> have the days of the month labeled consecutively from *A* through *H* (the 'nundinal letters'), where one of these days, would be the local market-day.<sup>12</sup> There are also nundinal

<sup>8</sup> Geminus, p. 212, l. 9-10; 16-17.

<sup>9</sup> Macrobius, *Sat.*, lists the nundinae as *feriae* (I.16.5) but points out that there was a divergence of opinion in antiquity on the matter (see I.16.28-31).

<sup>10</sup> Macrobius, *Sat.*, I.16.34

<sup>11</sup> See Degraffi, 1963, vol. XIII.2; Michels, 1967, p. 23 f.; and especially 187-190.

<sup>12</sup> For a discussion of the problems surrounding which letter represented the local nundinae, see Michels, 1967, p. 27-8.

lists independent of the *Fasti*, which have the names of eight different towns inscribed, indicating that the market day occurred in eight different towns on eight different days, thus the market day in Rome was followed regularly by that in Capua, then Calatia, etc., then it would again be market day in Rome after eight days. Michels sees the *nundinæ* as representing an archaic Roman week which was replaced by the seven-day week beginning in Augustan times, or possibly earlier.<sup>13</sup> She states that "the system of market days had originally been determined by the old count for *nundinæ* and then been transferred to the seven-day week,"<sup>14</sup> based on the *parapegmata* which show both the nundinal days and the hebdomadal days.<sup>15</sup> But her argument cannot account for why *both* the nundinal and hebdomadal days should be on the same *parapegma*. I therefore disagree with her, and think that these texts were meant to keep track of two or more distinct cycles—one nundinal, one hebdomadal, one lunar—such that with one glance at the *parapegma*, anyone could tell what day it was in the local nundinal cycle, what day of the moon it was, and what deity was presiding over the day.

## *II: Where are the Parapegmata Found?*

Until the early twentieth century, the only known *parapegmata* were found in the astronomical or divinatory manuscripts of, for example,

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<sup>13</sup> See Michels, 1967, p. 89, n. 6; p. 192.

<sup>14</sup> Michels, 1967, p. 192

<sup>15</sup> See the class of *Astrological Parapegmata* in chapter 3, below.



Ptolemy, Geminus, and Johannes Lydus. A typical entry from one of these looks like this:

[Θωθ]· α'. ὠρῶν ἰδ L' ὁ ἐπὶ τῆς οὐρᾶς τοῦ Λέοντος ἐπιτέλλει. Ἰππάρχῳ ἐτησαί παύονται. Εὐδόξῳ ὑετία, βρονταί, ἐτησαί παύονται.

[Month of] [Thoth,] (day) 1: (at the latitude where the day is) 14 1/2 hours (long), the (star) on the tail of Leo<sup>16</sup> sets.<sup>17</sup> According to Hipparchus, the Etesian winds stop. According to Eudoxus, rain, thunder, the Etesian winds stop.<sup>18</sup>

Looking at entries such as this, it was unclear why this sort of text was called a παράπηγμα in Greek, which derives from the verb παραπήγνυμι, meaning 'to fix (something) beside (something else)'. The sense of this derivation remained obscure until the discovery of the Miletus parapegmata at the beginning of the twentieth century.<sup>19</sup> These newly discovered parapegmata differed from the literary ones in three respects: They were carved in stone rather than being written down in manuscripts, they contained no calendrical information (i.e., no dates in any civil or religious calendar), and they had holes bored into them beside or near the weather or astronomical entries. These holes corresponded to the number of days between, for example, two phases of a star. An excerpt from *Miletus II* should help to illustrate this.

<sup>16</sup> β Leo. See Toomer, 1984, p. 368.

<sup>17</sup> Here as elsewhere in the parapegmata, 'setting' and 'rising' are abbreviations for heliacal setting and rising, respectively.

<sup>18</sup> Ptolemy, *Phas.*, p. 14.

<sup>19</sup> Published in Diels and Rehm, 1904, and Rehm, 1904.

- ...] ○
- σκορπίος ἀκρώνυ]χος δύνει  
κατ' Εὐδοξον<sup>20</sup> καὶ Αἰγυπτίους. ○
  - βορέας καὶ νότος πνεῖ κατ' Εὐδοξον  
καὶ Αἰγυπτίους. κατὰ δὲ Ἰνδῶν Καλ-  
λανέ]α σκορπίος δύνει μετὰ βρον-  
τ]ῆς καὶ ἀνέμου.

- ...] ○
- Scorpio] sets [acrony]chally,  
according to Eudoxus a]nd the Egyptians. ○
  - The north a]nd the south wind blow, according to  
Eudoxus [and the Eg]lyptians. According to  
Cal[lane]us of the Indians, Scorpio sets, with  
thun[d]er and wind.

The holes were used for inserting pegs. Rehm thought that these would be used to correlate the parapegma with the local civil or religious calendar(s). Greek civil calendars were lunar, which means that the 12-month 'year' was 354 days long.<sup>21</sup> When needed, a thirteenth month would be added (a 'leap month') to keep the lunar calendar roughly in line with the solar year. These differences in year length meant that the lunar calendar date on which a particular stellar phase occurred could vary by a half month or more from year to year. The stone parapegma could thus be used, as Rehm thought, to determine what date in a given lunar year would see what phases or what corresponding weather patterns. But this would require that the pegs be labeled somehow to indicate calendrical dates.

<sup>20</sup> Eudoxus is Diels and Rehm's suggestion, which seems plausible. Compare Geminus, *Libra* 17 and 19.

<sup>21</sup> See Samuel, 1972.

No complete pegs have ever been found, however. In the *Thermæ Traiani* parapegma the remains of only a single peg were found, not a host of them, as Rehm's theory seems to require.<sup>22</sup> If Rehm is right, then there would have to be at least 30 pegs per calendar, and possibly as many as 384. But in the parapegma described by Petronius, a single peg seems to have been used to keep track of each cycle. Moreover, on Rehm's theory, there would be no need for the peg holes marking eventless days, as in Miletus I. It seems therefore probable that there was only one peg which was moved each day from hole to hole, thus indicating only the current date, and the current astronomical or astrometeorological situation. The empty peg holes would allow one to count the number of days between now and the next significant event.

### *III: What Kinds of Information are in the Parapegmata?*

In some parapegmata, stellar phases are linked with both day-to-day weather phenomena like rain, snow, and storms, and with annual variations in the climate at large, like the 'Etesian winds' which blow over the eastern Mediterranean at the same time each year. Annual events of agricultural interest are also noted, as well as seasonal indicators such as solstices and equinoxes, or the return of the swallows in springtime.

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<sup>22</sup> See Degrassi, 1963, vol. XIII.2, p. 304; The remains of another single peg was found in the *Pausilypum* parapegma, *ibid*, p. 308.

Some astrometeorological parapegmata link particular predictions to particular people. Thus 'rain, according to Democritus,' 'the equinox, according to Eudoxus,' or 'Aries begins to rise, according to Callippus.' *Miletus I*, and the Clodius Tuscus parapegma, on the other hand, simply give the phases or weather with no ascriptions whatsoever, and Ptolemy's *Phaseis* gives his own calculations for risings and settings exclusively, but gives attributions for all of the weather predictions.

Occasionally, predictions offer specific locations (or perhaps applications) to which they are supposed to apply, like 'a storm at sea.' Elsewhere, location may be implied in predictions such as 'wind, according to the Egyptians.'

Other than the astrometeorological parapegmata, there is a large class of astrological parapegmata. It is interesting to note that the astrological parapegmata do not seem to overlap with the astrometeorological ones: there are no parapegmata which clearly contain both weather predictions and either lunar days or hebdomadal deities,<sup>23</sup> although the sun's position in the zodiac does feature in both types. In contrast to the astrometeorological parapegmata, the astrological ones offer no predictions. They are instead tools for keeping track of one or more astrological cycles such as the sun's position in the zodiac, the day of the moon (easily converted to its phase), the planet presiding over the day (the 'hebdomadal deity'), and occasionally also calendrical cycles such as

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<sup>23</sup> With the possible exception of the Puteoli parapegma, *A.tu*, below.

the days of the month or the nundinal days. This combination of calendrical and astrological information is not unique to the parapegmata. It also shows up in inscriptional dates such as the following:

[I]A]NUAR[IVS] D<I>E IOVIS CONS(VLATV) FL(AVII)  
[L]VN(A) PRIM(A)<sup>24</sup>

[In Ja]nuar[y], Thursday, in the Consulship of Flavius,  
first day of the [m]oon.

We see here a combination of consular and calendrical dating, with exactly the kinds of information which the astrological parapegmata were used to keep track of.

#### *IV: Who Wrote the Parapegmata?*

Some parapegmata are *attributive*, that is, they attribute either stellar phases, weather, or both, to some prior authority, such as "rain, according to Euctemon."

We do not know for certain what form the sources for these attributions took. Whether, for example, Democritus had composed a work that looked anything like a parapegma is unanswerable. It is certainly possible that the work from which his predictions were excerpted in the later parapegmata was of an entirely different structure. For all we know it may have read more like Hesiod than Ptolemy. For example, it may have been a text on some other subject containing scattered references to stellar phases and/or weather,

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<sup>24</sup> Dating probably from the fifth century A.D. See Worp, 1991. For other examples, see Eriksson, 1956, p. 28-9.

without dating or ordering them systematically. This fact makes it difficult to know how valuable an exercise it is to excerpt the 'calendrical fragments' of, say, Democritus or Euctemon from the extant parapegmata.<sup>25</sup>

Nonetheless, it will be worthwhile to list the authorities cited in the parapegmata, along with what little we may know about them.

**Barron:** 'the Roman', is mentioned only in Lydus and at the end of Clodius Tuscus.<sup>26</sup> He is otherwise unknown to me.

**Cæsar:** is mentioned in the parapegmata of Ptolemy, Lydus, and Clodius Tuscus. Pliny seems to associate the calendar reform of Julius Cæsar and Sosigenes with the parapegmic tradition,<sup>27</sup> and so I think the Cæsar cited in the parapegmata may well be Julius Cæsar.

**Callaneus of the Indians:** is mentioned only in Miletus I, and is otherwise unknown, although he may be the same person as the gymnosophist Calanus mentioned in the Alexander-history.<sup>28</sup> Pingree argues that Callaneus was using a Greek rather than an Indian method of astrometeorological prediction.<sup>29</sup>

**Callippus:** is known from Aristotle's *Metaphysics* as having improved Eudoxus' concentric spheres model.<sup>30</sup> He also inaugurated the 76-year cycle named for him.<sup>31</sup> He was a contemporary of Aristotle. He is mentioned in Geminus, Pliny, Ptolemy, Lydus, and the Eudoxus Papyrus.<sup>32</sup>

**Chaldæans:** Columella mentions that they observe the winter solstice on *IX K. Jan.*<sup>33</sup> Pliny also mentions them.<sup>34</sup>

**Conon:** fl. second half of the 3rd century B.C. He is mentioned by both Archimedes and Apollonius as a mathematician, and by Seneca, Callimachus and Catullus as an

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<sup>25</sup> As Rehm and van der Waerden have done. See Rehm, 1913, and van der Waerden, 1984a.

<sup>26</sup> Wachsmuth, 1897, p. 158, l. 1, 295, l. 6, *et passim*.

<sup>27</sup> Pliny, *NH*, XVIII.211.

<sup>28</sup> This suggestion was made by Diels and Rehm, 1904, p. 108, n.1.

<sup>29</sup> See Pingree, 1976, p. 143-4.

<sup>30</sup> Aristotle, *Metaph.*  $\Lambda$  8, 1073b32-8.

<sup>31</sup> On which, see below, chapter 4.

<sup>32</sup> For an up-to-date bibliography on Callippus, see Jones, 2000.

<sup>33</sup> Columella, *RR*, XI.ii.94.

<sup>34</sup> See e.g., Pliny, *NH*, XVIII.246.

- astronomer.<sup>35</sup> Ptolemy says he observed in Italy and Sicily.<sup>36</sup> He is also mentioned in Pliny.<sup>37</sup>
- Crito: is mentioned once by Pliny.<sup>38</sup> Rehm suggests he may be the historian Crito of Naxos mentioned in the *Suda*.<sup>39</sup>
- Democritus of Abdera: is the famous fifth-century presocratic philosopher. He is mentioned in the *Geminus*, Pliny, Ptolemy, Clodius Tuscus and Lydus *parapegmata*, as well as in the *Eudoxus Papyrus*.
- Dositheus: pupil of Conon, late 3rd c. B.C. Ptolemy says he observed at Cos. He is also mentioned by *Geminus*, Pliny and Lydus.<sup>40</sup>
- Egyptians: Neugebauer and Rehm thought this referred to Greco-Egyptian observers, but I argue in chapter 8 that it may refer to native Egyptians. They appear in *Miletus II*, Pliny, and Ptolemy.
- Euctemon: is frequently associated with Meton in the ancient sources. Together, they are known for a solstice observation at Athens in 432, and Euctemon is also associated with the 19-year Metonic cycle.<sup>41</sup> He is mentioned in *Miletus II*, *Geminus*, Pliny, Ptolemy, Lydus, and the *Eudoxus Papyrus*.
- Eudoxus of Cnidus: the astronomer, geographer, and mathematician. He lived during the first half of the fourth century B.C. He was the originator of the homocentric spheres model of the Cosmos, and is associated with an eight-year cycle. He shows up in *Miletus II*, *Geminus*, *Columella*, Pliny, Ptolemy, Clodius Tuscus, Lydus, and the *Eudoxus Papyrus*.
- Hipparchus of Rhodes: fl. late second c. B.C., astronomer. Many of his observations are cited in Ptolemy's *Almagest*. Hipparchus discovered the precession of the equinoxes, and was also responsible for incorporating many Babylonian observation reports and numerical parameters into Greek astronomy.<sup>42</sup> He appears in the *Columella*, Ptolemy, Clodius Tuscus, and Lydus *parapegmata*, as well as being mentioned in connection with ἐπισημασίαι in *P. Oxy.* 4475.<sup>43</sup>

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<sup>35</sup> See Neugebauer, *HAMA*, p. 572.

<sup>36</sup> This and the similar entries from this list ("Ptolemy says he observed at x") are all taken from the *Phasels*, p. 67.

<sup>37</sup> For more information, see G. J. Toomer's *OCD* article on him, and I. Bulmer-Thomas's *DSB* article.

<sup>38</sup> Pliny, *NH*, XVIII.312.

<sup>39</sup> See Rehm, 1941, p. 37, n. 1.

<sup>40</sup> For more information, see D. R. Dicks's *DSB* article on Dositheus.

<sup>41</sup> On which, see chapter 4, below.

<sup>42</sup> See G. J. Toomer's detailed *DSB* article on Hipparchus.

<sup>43</sup> See p. 142-143 in vol. LXV of the *P. Oxy.* series.

Meton:<sup>44</sup> fifth century astronomer, frequently associated with Euctemon (see above). He is mentioned in Geminus, Columella, and Ptolemy.

Metrodorus of Chios: pupil of Democritus.<sup>45</sup> Ptolemy tells us he observed in Italy and Sicily. He also turns up in Clodius Tuscus and Lydus.

Parmeniscus: is mentioned once by Pliny,<sup>46</sup> otherwise unknown to me.

Philippus: is probably Philippus of Opus,<sup>47</sup> student of Plato. Ptolemy says he observed in the Hellespont. He appears in Miletus II, Pliny, Ptolemy, and Lydus.

Tubero: is mentioned once by Pliny,<sup>48</sup> otherwise unknown to me.

#### V: *Who Used the Parapegmata?*

From their prominence in Roman agricultural works, we can infer that the parapegmata were used by farmers and estate owners in antiquity for both keeping track of expected weather (useful when planning any outdoor work) and for keeping track of the agricultural 'seasons' which were independent of most ancient calendars. Indeed, it is telling here that Julius Cæsar, the reformer who brought his civil calendar best in line with the agricultural year, may have been a parapegmatist.

When I refer to agricultural seasons, I do not mean the four seasons as defined by the solstices and equinoxes. I mean rather the times for planting, harvesting and tending various crops. A look at

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<sup>44</sup> The best short references are Toomer's *DSB* and *OCD* articles.

<sup>45</sup> Neugebauer, *HAMA*, p. 929, dates him to "possibly the third century".

<sup>46</sup> Pliny, *NH*, XVIII.312.

<sup>47</sup> See Neugebauer, *HAMA*, p. 740; 574.

<sup>48</sup> Pliny, *NH*, XVIII.235.



Hesiod's *Works and Days* shows quite clearly that the stellar phases played an important role in agricultural practice from an early date.

Πληιάδων Ἀτλαγενέων ἐπιτελλομενάων  
ἀρχεσθ' ἀμήτου, ἀρότοιο δὲ δυσσομενάων.

At the rising of the Atlas-born Pleiades, begin the harvest, and you should plough when they set.<sup>49</sup>

δμῶσι δ' ἐποτρύνειν Δημήτερος ἱερὸν ἀκτὴν  
δινέμεν, εὖτ' ἂν πρῶτα φανῆ σθένος Ὡαρίωνος

Urge the slaves to thresh Demeter's sacred corn when strong Orion would first appear.<sup>50</sup>

But given that their calendars were not synchronized with the sidereal year, the calculation of these phases in advance or even their determination during a cloudy spell would require a little effort for the farmer or estate-manager. The need for simple determination was filled by the *parapegmata*.

Another group for whom stellar phase reckoning was important in antiquity were seafarers. Again from Hesiod:

Ἦματα πεντήκοντα μετὰ τροπᾶς ἡλίου.  
ἔς τέλος ἐλθόντος θέρεος καματώδεος ὥρης.  
ὠραῖος πέλεται θνητοῖς πλόος· ...  
τῆμος δ' εὐκρινέες τ' αὔραι καὶ πόντος ἀπήμων

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.<sup>51</sup>

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<sup>49</sup> Hesiod, *Op.*, 383-4.

<sup>50</sup> Hesiod, *Op.*, 597-8.

<sup>51</sup> Hesiod, *Op.*, 663 f.

Or from Aratus:

καὶ μὲν τις καὶ νηὶ πολυκλύστου χειμῶνος  
 ἐφράσθ' ἢ δεινοῦ μεμνημένος Ἀρκτούροιο  
 ἢ ἑτέων ἄλλων, οἳ τ' ὠκεανοῦ ἀρύονται  
 ἄστέρες ἀμφιλύκης, οἳ τε πρώτης ἔτι νυκτός.

And the man on board ship has seen the wavy storm,  
 remembering dread Arcturus or another star,  
 which draw themselves from the ocean  
 in the morning dusk or at the start of night.<sup>52</sup>

Such advice was important not only to sailors (and travelers) but to merchants as well, who had to arrange for the movement of goods from place to place at various times of year. What sailors and captains learned about the weather from *parapegmata* could affect trade and warfare. This does not apply just to seasonal periods of general stormy weather, but also to predictions like 'a storm at sea' on particular dates as found in the *parapegmata*. Such information would have helped sailors decide when to venture out onto the open sea.

Lastly, from the appearance of *parapegmata* in medical writers such as Aëtius, from references to astrometeorology in Stephanus of Athens and Galen,<sup>53</sup> and from the medical prescriptions in the Quintilius *parapegma*, we can surmise that physicians in antiquity sometimes consulted *parapegmata*. But this should not be surprising, since it fits in quite well with the ancient medical concern with climate, weather, and seasons as seen for example in

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<sup>52</sup> Aratus, *Phæn.*, 744-7

<sup>53</sup> See, e.g., Galen, *In Hipp. lib. prim. eptd.*, vol. XVIIa, p. 15, l. 8; *De diebus decretoriis*, vol. IX, p. 914, l. 15.

the Hippocratean *Epidemics*, and such works as *On Airs* and *On Regimen*.

#### VI: *Towards a History of Parapegmata*

I have pointed out that there are several kinds of parapegmata, each adapted to a different purpose. I take the Miletus II parapegma as paradigmatic, since it is the earliest parapegma which shares at least some features with all the others. Miletus II is a Greek inscriptional astrometeorological parapegma, and thus shares morphology with the inscriptional astrological, astronomical, and astrometeorological parapegmata, and function with the literary astrometeorological parapegmata. On the other hand, the older parapegmata, *P. Hibeh 27* and the Ceramicus Parapegma, for example, are less generalizable.

I see the development of the various types of parapegmata as the instantiation of two types of change: on the one hand, morphological change (a change in form), and on the other hand, functional change. Conversely, morphologically different parapegmata show functional continuity, and functionally different parapegmata show morphological continuity.

Using this model, and taking Miletus II as our starting point, we can see that the Roman astrological parapegmata are morphologically similar, but functionally quite different from the Greek inscriptional astrometeorological parapegmata. While they are physically comparable, insofar as they have holes for a moveable peg which is used for tracking some cyclic phenomena, they are

functionally distinct, insofar as they seem not to have been astrometeorological. The literary parapegmata, on the other hand, are functionally similar to Miletus II (they are astrometeorological), but morphologically different, insofar as they are textual, and typically index the astrometeorological information to a calendar rather than to a moveable peg.

This is not, however, to say that Miletus II necessarily represents the earliest type of parapegma. There is no denying that the Ceramicus Parapegma is much older, and seems to represent some functionally different type of parapegma, since no other known inscriptional parapegma before the Roman ones indexed a series of sequential numbers to a peg. So also, the morphologically different *P. Hibeh 27* and Aratus' *Phænomena* both predate Miletus II. The type of parapegma represented by Miletus II might thus stand as a fusion of two distinct traditions: a textual astrometeorological tradition, and a technological tradition represented by the Ceramicus parapegma. We can date this inscriptional astrometeorological tradition to 109 B.C. (Miletus II) or earlier. On the current archeological evidence, then, I hypothesize that the Miletus II type came into being as a combination of the function of astrometeorological texts like *P. Hibeh 27*, and the morphology of parapegmata of the Ceramicus type. Further functional change took place after this time, which led to the morphologically-derived Roman astrometeorological and calendrical parapegmata.

In clearer terms: the oldest known parapegma is inscriptional, but of unknown use. Apparently unrelated to it is a textual

astrometeorological tradition dating as far back as Hesiod. This tradition came to use the morphology of the Ceramicus type of parapegma to track astrometeorological cycles, which resulted in the Miletus II type of parapegma. Alongside of the occasional production of inscriptional astrometeorological parapegmata, literary *P. Hibeh*-type parapegmata were still being produced and used right up into the Middle Ages. From either the Ceramicus or the Miletus-type parapegmata, however, another tradition developed in the Roman world which used the shape and operation of these inscribed instruments to track a new set of phenomena with a peg: lunar, hebdomadal, and nundinal cycles. One example of a calendrical adaptation of this type of inscriptional parapegma is extant, the Guidizzolo Fasti, which uses a peg to track the Roman calendar. From this tradition (or possibly before it?) derived the inscriptional-graffiti-type of parapegmata, which consisted of the writing out of a cycle on a wall, for tracking lunar, hebdomadal, nundinal, and calendrical cycles without the help of pegs.

As we find and catalogue more parapegmata in future, or as we come to better understand the current ones, we may change this picture, but on the currently available evidence, this seems to be the best explanation of the development of the Greek and Latin parapegmata.

### Chapter Three

## What are the Extant Parapegmata?

I have divided the extant parapegmata into seven classes as follows:

*A) Astrometeorological Parapegmata* are those which relate astronomical phenomena with weather. *B) Astrological Parapegmata* are those which were used to keep track of astrological cycles such as the days of the moon, the zodiacal sign of the sun, and the hebdomadal deities. Some of these include civil calendrical information and nundinal days as well. The presence of the nundinal days in the astrological parapegmata may at first seem anomalous, but these were an important part of the Roman calendar, and so may have been incorporated for this reason. I doubt they had any astrological significance. *C) Astronomical Parapegmata* are those which simply provided a means to keep track of the phases of the fixed stars, with, so far as we can tell, little or no accompanying meteorological or astrological information. *D) Other Parapegmata* are those which are either too fragmentary to determine their use, or which do not fit my other classes. *E) Reports of Parapegmata* are ancient accounts or descriptions of parapegmata. *F) Related Texts and Instruments* are those which pertain to the dates of, or date-differences between, the phases of the fixed stars and/or seasonal weather patterns. They are much more general than the parapegmata, but it seems likely to me that they are related to

them either in function or derivation. Lastly *G) Dubia* is where I list any calendars, inscriptions, etc. which seem not to be parapegmata, but have been claimed to be so by previous authors. I give my reasons in each case for not counting them as parapegmata.

I do not distinguish in this classification system between inscriptional and literary parapegmata, apart from noting the difference in my description. The calendars are undated unless otherwise indicated.

It will be noticed that my classification differs greatly from Rehm's.<sup>1</sup> In the first place, he distinguishes primarily between inscriptional and literary parapegmata, whereas I have chosen to class them according to their use, rather than their morphology. Secondly, and more importantly, Rehm lists many of the parapegmata that I include as genuine, under the heading of '*Inauthentic (uneigentliche) Parapegmata*' (his class III). His reason for this seems to be that he was working under the assumption that the literary parapegmata, most of which are astrometeorological, were paradigmatic, and therefore only those inscriptional parapegmata which were astrometeorological were counted as genuine. The Ceramicus parapegma squeezed in on Rehm's questionable assumption that it was used to count days in a zodiacal month, and was therefore related to the Geminus parapegma.<sup>2</sup>

I have chosen instead to treat all inscriptional parapegmata as genuine, and I class the literary ones relative to these. My reasons for

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<sup>1</sup> Rehm, 'Parapegma', *RE*.

<sup>2</sup> I argue in chapter 4, below, that Geminus does not use a zodiacal month.

doing so are twofold: first, the very word *parapegma* implies a pegged inscription (the Greek παραπήγνυμι means 'to put a peg beside something'). Second, I think the differences between the astrometeorological and astrological *parapegmata* are less pronounced than Rehm did. Both are tools for tracking extra-calendrical cycles, and their different functions even get combined in the later ephemerides. Thus I see any instrument which uses moveable pegs to keep track of astronomical, meteorological, or astrological information as a real *parapegma*. I classify related texts and inscriptions according to their similar uses.



*A: Astrometeorological Parapegmata*

**A.i) P. Hibeh 27<sup>3</sup>** is a Greek parapegma from the Saïte Nome of Egypt and dated in the Egyptian calendar. It probably dates from the reign of Ptolemy Euergetes (early third century B.C.). Smyly argued, based on equinoctial dates, and comparison with the Eudoxan phases in Geminus, that it was probably the work of one of Eudoxus' followers. This is, I suppose, possible, but, as Grenfell and Hunt note, the text is "much disfigured ... by frequent blunders"<sup>4</sup> and so one wonders how flexible we need to be in our understanding of "follower" and what value the text has for Eudoxan scholarship generally. Neugebauer is very sceptical of a Eudoxan influence.<sup>5</sup>

The text itself consists of a brief letter from the compiler to a student, followed by the calendar itself. Part of this letter is word-for-word the same as part of *P. Par. 1* (see parapegma *F.vii*, below). The calendar is not attributive, but simply lists risings and settings, the lengths of days and nights, some weather and, uniquely, Nile-depth forecasts and Egyptian religious festivals.

**A.ii) Aratus' *Phænomena*** is a third-century Greek poem, very popular in antiquity, which describes the constellations and various weather signs,<sup>6</sup> including atmospheric signs, such as the appearance

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<sup>3</sup> In Grenfell and Hunt, 1906, p. 138-157.

<sup>4</sup> Grenfell and Hunt, 1906, p. 143.

<sup>5</sup> See Neugebauer, *HAMA*, p. 687 f.

<sup>6</sup> The section on weather signs is at Aratus, *Phæn.*, 733-1154.

of the moon or sun, and animal signs (as in Theophrastus' περι σημείων).<sup>7</sup> In the astronomical parts of the poem, Aratus includes some astrometeorological information, such as that the Etesian winds begin just after the rising of Sirius, that Capella heralds storms,<sup>8</sup> or that the north wind is associated with Pisces.<sup>9</sup>

**A.iii) Miletus II**,<sup>10</sup> was found, like Miletus I (parapegma C.ii, below), at the theatre in Miletus in the winter of 1902/1903 by a crew working under the direction of T. Wiegand. Unlike Miletus I, it is attributive for both stellar phases and weather predictions. Like Miletus I, it is inscribed in Greek, is fragmentary, and has holes drilled for keeping track of days. It is the only known source which mentions the "Indian Callaneus," to whom several predictions are ascribed. In his *RE* article, Rehm links a fragment of introductory material (inv. no. 456 C) to the parapegma fragments (inv. no. 456 A, 456 D and 'N'),<sup>11</sup> although in his original publication the introductory fragment had been linked with Miletus I, (no. 456 B). He changed his mind for "epigraphical" reasons.<sup>12</sup> The introductory fragment has the name [Ep]icrates Pylo[rou] written across the top, who was an ephor in 89/88 B.C.

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<sup>7</sup> Theophrastus, *De sig.*

<sup>8</sup> Aratus, *Phæn.*, 148 f.

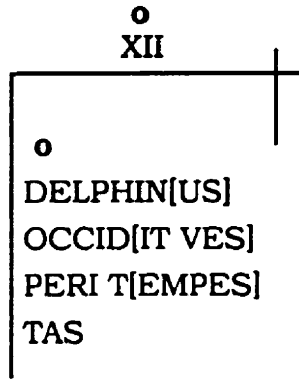
<sup>9</sup> Aratus, *Phæn.*, 240, f.

<sup>10</sup> Published in Diels and Rehm, 1904; see also Rehm, 1904.

<sup>11</sup> 456 C is in Diels and Rehm, 1904, p. 102, and 456 A and D are on p. 107-110. 'N' is published in Rehm, 1904.

<sup>12</sup> Rehm, 'Parapegma', *RE*, col. 1299.

**A.iv)** The *Puteoli Parapegma*<sup>13</sup> is a marble fragment 14.5 cm high x 8.5 cm wide, bearing a numeral (*XII*) and a partly destroyed Latin inscription correlating the evening setting of Delphinus with a storm. Both the date and the weather prediction have peg holes. It reads:



The *XII* may represent a lunar day, as in the astrological parapegmata (class B, below),<sup>14</sup> a zodiacal day (i.e., *XII Scorpionis*), or a calendar date (i.e., *XII ante kalendas*). Rehm argues<sup>15</sup> that since the setting of the Dolphin here follows what he assumes is the calendrical entry *XII*, then its setting must have been on the *XIII*. Since this phase does not happen on the 13th of any known or reconstructed solar or zodiacal calendar, then we must have before us a unique post-Julian example of the Greek lunar calendar, in Italy, in Latin. But this rests on the assumptions that the two entries are in immediate sequence

<sup>13</sup> Degrassi, 1963, vol. XIII.2, p. 310; For a clearer drawing of the fragment, see Mingazzini, 1928, p. 203.

<sup>14</sup> I offer this possibility hesitantly, since, if correct, this would be the only combination astrological and astrometeorological inscribed parapegma. I note, however, that Pliny combines lunar days with astrometeorology in his parapegma (e.g., Pliny, *NH*, XVIII.228).

<sup>15</sup> Rehm, 'Parapegma', *RE*, col. 1302.

(which is not demonstrable), and that the XII must be calendrical, which, again, is uncertain.

**A.v)** The *Geminus Parapegma*<sup>16</sup> is sometimes called the *Pseudo-Geminus Parapegma*, since it is often thought not to have been written by Geminus, although it appears appended to the end of all MSS of his *Isagoge*. Although the *Isagoge* dates from the first century B.C.,<sup>17</sup> the parapegma does not cite any authors after Dositheus (late third century). Specifically, Hipparchus, whose work shows up in the *Isagoge*, is notably absent from the parapegma.<sup>18</sup> The absence of Hipparchus indicates to me that the parapegma probably predates the late second century B.C., but I do not think this implies that it must have been appended to the *Isagoge* by someone other than Geminus. As for Böckh's other arguments, that the season lengths of the parapegma do not agree with those of the *Isagoge*, and that Geminus argues against astrometeorology in book XVII, I would point out the following: (1) if he *did* append an older parapegma to his book, there is no reason to expect Geminus to have corrected the season lengths; he may have been simply letting the text stand as he found it; and (2) his argument in book XVII is not against astrometeorology *per se*, but against a stellar *influence* on the earth. He nowhere says that parapegmata do not work. What he does say is that the associations

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<sup>16</sup> Geminus, p. 210 f.

<sup>17</sup> For a discussion of this date, see Jones, 1999b.

<sup>18</sup> For the original arguments against its authenticity, see Böckh, 1863, p. 22 f. Aujac, 1975 (p. 157) treats it as genuine.

of stars and weather are based on repeated observations, but this is *not* an argument against astrometeorology.

The parapegma is complete for the whole of a year (although it does not list all dates for the year, it does list all *significant* dates, and covers the entire year). The year begins with the summer solstice. It is attributive, both for phases and weather. It correlates phases and weather with zodiacal days, i.e., 'the first day of Cancer, the second day of Cancer,' and so on. In chapter 4, I argue *contra* Rehm and others that this parapegma does not use a zodiacal calendar.

**A.vi) Ovid's *Fasti*** (early first century A.D.) includes the dates of some stellar phases, often with weather predictions. Only one entry has a weather prediction with no stellar phase accompanying:

XVIII Kal. Mai.:  
Luce secutura tutos pete, navita, portus:  
ventus ab occasu grandine mixtus erit.<sup>19</sup>

The days of the nundinal week (A through H) are included throughout, as are the designations of *dies fasti*, *nefasti*, or *comitales*.

**A.vii) Columella's *Parapegma***<sup>20</sup> is included as part of his treatise on agriculture, dating to the mid-first century A.D. It is a long literary parapegma, annotated with agricultural instructions. It correlates dates in the Julian calendar with stellar phases, weather, and seasonal indicators such as the migratory patterns of birds. For

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<sup>19</sup> Ovid, *Fasti*, IV.625-6.

<sup>20</sup> Columella, *RR*, XI.2.4, f.

further commentary on this calendar and its role in Roman agricultural practice, see below, ch. 6.

**A.viii) Pliny's *Parapegma*,**<sup>21</sup> in book XVIII of his *Natural History* (first century A.D) shows up first as a short excerpt of seasonal indicators, combined with stellar phases, Julian dates, weather, and agricultural instructions (many attributed to previous authors), as well as lunar days and other information. It is a complex intertwining of many different sources, as we should expect from Pliny.

**A.ix) Ptolemy's *Phaseis***<sup>22</sup> is a detailed parapegma from the second century A.D. listing dates in the Egyptian calendar, and connecting these with their corresponding stellar phases for different climata. It is the only known parapegma which offers different rising and setting dates for various latitudes. Weather predictions are attributed to a host of astronomers.

**A.x) The *Polemios Silvius Fasti***<sup>23</sup> is a fifth-century codex-calendar written in Latin and organized according to the Julian calendar. It includes meteorological predictions for the year, which were largely taken from of Columella.<sup>24</sup> The only astronomical entries are the

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<sup>21</sup> Pliny, *NH*, XVIII.202 f. Rehm lists this as two parapegmata, his B 6 and B 20. I see no reason to do so.

<sup>22</sup> Ptolemy, *Phas*.

<sup>23</sup> Degrassi, 1963, vol. XIII.2, p. 263-276

<sup>24</sup> See Degrassi, 1963, vol. XIII.2, p. 263.

solstices and equinoxes, which do not have weather associated with them. All meteorological entries are tied solely to calendar dates, but the fact that these weather predictions seem to have been excerpted from Columella, who does correlate stellar phases with these weather phenomena on the same dates as Polemius Silvius, leads me to class this calendar as astrometeorological.

**A.xi)** The *Antiochus Parapegma*<sup>25</sup> is a short calendar correlating stellar phases with changes in the weather (έπισημασ(α)<sup>26</sup> and occasionally with specific predictions such as "July 14: The whole of Orion rises at the same time as the sun; it causes rain and wind." All dates are in the modified Julian calendar,<sup>27</sup> which seems to have begun to be used in the fourth century A.D. rather than the sixth, as Mommsen thought.<sup>28</sup>

**A.xii)** The *Parapegma of Clodius Tuscus*,<sup>29</sup> is quoted in its entirety in Lydus' *De ostentiis*, and referred to there as *Ephemeris for the Whole Year, from Claudius Tuscus, Translated into (our) Language* (i.e., into Greek from Latin). The calendar it uses is a unique combination of the traditional and modified Julian calendars, such that entries read:

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<sup>25</sup> Boll, 1910a.

<sup>26</sup> On the meaning of this word, see chapter 5, below.

<sup>27</sup> I.e., dates are given as July 1, July 2, etc. rather than by the traditional method of counting down to the Kalends, Nones and Ides.

<sup>28</sup> For this argument, see Ferrua, 1985.

<sup>29</sup> Lydus, *De ost.* p. 117; for publication of further MSS of this parapegma, one of which is attributed to Hermes Trismegistus, see Bianchi, 1914, p. 3-48. Unlike Bianchi, however, I find one of his MSS (*Paristnus gr. 2419*) to be sufficiently different from the others to warrant counting it as a distinct parapegma, A.xxi, below.

α'. Καλένδαις...  
 β'. τῆ πρό δ' νωνῶν Ἰανουαρίων...  
 γ'. τῆ πρό γ' νωνῶν...

and so on. Every date has an entry. It correlates these dates with stellar phases, weather, the sun's entry into the zodiacal signs, the beginnings of the seasons,<sup>30</sup> and some bird behaviours. The entry for April first tells us that on that date, "the sun moves one degree." On July 27th, we are told that "grapes are beginning to ripen," and on the 30th, "fruits begin to ripen." Another peculiarity of this calendar is some entries that are tempting to interpret as observational reports: In addition to frequent entries which read ἄστρον κρυπτόν, or κρύφιον ἄστρον ("the stars are hidden"),<sup>31</sup> we find τὸν δὲ ὀιστόν φασι δύεσθαι ("They say that Sagitta sets").<sup>32</sup> Even more unusual, however, is the entry on Sept. 24th: ἐκλειψις σεληνιακή ("A lunar eclipse"), which obviously could only apply to one particular year, rather than being a generalizable prediction or observation. This is the only entry in any parapegma pertaining to an eclipse.

I am also puzzled by entries such as ὁ δελφίν δύνεσθαι μελετᾶ ("Delphinus tends to set")<sup>33</sup> and δύεται καθόλου ἡ ὑάς ("the Hyades generally set").<sup>34</sup>

<sup>30</sup> The seasons are sometimes associated with zodiacal signs and sometimes not. Compare, for example, Aug. 17, ἀρχὴ φθινοπώρου with Sept. 16, τὸ δωδεκατημόριον ἀρχεται τοῦ μετοπώρου. I am unclear, however, on why this latter entry should fall three days before ὁ ἥλιος ἐν ζυγῷ (Sept. 19), which is two days before ἡ μετοπωρινὴ ἡμερῖα (Sept. 21). Compare also Nov. 9 and 10. I am likewise puzzled by the 7-day difference between "the sun is in Sagittarius" (Nov. 18) and "the sun is at the first degree of Sagittarius" (Nov. 25).

<sup>31</sup> e.g., Jan. 14, Feb. 1, Feb. 9, Apr. 14, July 2, Aug. 15, Dec. 11, and Dec. 18.

<sup>32</sup> Feb. 19.

<sup>33</sup> Jan. 29.

<sup>34</sup> Apr. 26.



**A.xiii)** The *P. Iriarte Parapegma*<sup>35</sup> is a Greek calendar correlating some stellar phases with weather predictions and dates in the modified Julian calendar. It also predicts the behavior of birds, such as χελιδόνες παίζουσι. Bianchi dates it to 300 or 400 years after Clodius Tuscus, although the preserved MS (*Matritensis gr. CX*) dates from the late fifteenth century. It is related to the Aëtius parapegma, below, but is much more complete. The year begins with the month of March, and entries are in the reformed Julian calendar.

**A.xiv)** The *De mensibus Parapegma*<sup>36</sup> is a collection of dated astronomical and astrometeorological predictions excerpted from Johannes Lydus' sixth-century *De mensibus* by Wachsmuth. Dates are in the Roman calendar, and sources such as Democritus, Cæsar, and Eudoxus are cited for both stellar phases and weather predictions.

**A.xv)** The *Aëtius Parapegma*<sup>37</sup> appears as a chapter titled περί ἐπισημασιῶν ἀστέρων in Aëtius of Amida's sixth-century medical work, the *Tetrabiblos*. The calendar includes stellar phases, weather predictions, and some medical information directly associated with the weather. Aëtius explains this by saying that τῶν ὑγιαίνοντων τὰ σώματα καὶ πολλῶ μᾶλλον τῶν νοσοῦντων ἀλλοιοῦται πρὸς τὴν τοῦ

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<sup>35</sup> Published by Bianchi, 1914, p. 49 f.

<sup>36</sup> In Wachsmuth, 1897, p. 295-299.

<sup>37</sup> Published in Wachsmuth, 1897, p. 289-293.

ἀέρος κατάστασιν. More specifically, he says: μηνὶ τῷ αὐτῷ (sc. Σεπτεμβρίῳ) κέ' ἰσημερία φθινοπωρινή· καὶ γίνεται μεγίστη ταραχὴ τοῦ ἀέρος πρὸ τριῶν ἡμερῶν· διὸ παραφυλάττεσθαι χρὴ μηδὲ φλεβοτομεῖν μηδὲ καθαίρειν μηδ' ἄλλως τὸ σῶμα κινεῖν σφοδρᾶ κινήσει. I note also that this entry, like many others in this parapegma, associates the phase of a star with the weather *several days before the occurrence of the phase*. The dates are listed in a schematic combination of the Syromacedonian calendar and the Julian calendar, where Syromacedonian months are straightforwardly equated with Roman ones, both beginning on the same day, rather than with the true 16-20 day lag.<sup>38</sup> Unlike the Quintilius parapegma, Roman dates are listed in the new manner, as, for example, *February 26*, rather than *IV Kal. Mar.*

**A.xvi)** The *Quintilius Parapegma*<sup>39</sup> appears appended to part of the *Geoponica* in Vat. gr. 216 (fourteenth century). It begins with an unattributed passage lifted from Aëtius (the whole introduction to his *περὶ ἐπισημασιῶν ἀστέρων*), followed by the heading *ἀστέρων ἐπιτολαὶ καὶ δύσεις κατὰ Κυντίλλιον*. The parapegma shows similarities to that of Aëtius, with his medical prescription, quoted above, presented almost word-for-word, although instead of forbidding phlebotomy for only 3 days, Quintilius forbids it for 9. As in Aëtius, the dates are listed in a combination of the Syromacedonian and Roman Calendars, but Quintilius has a better correspondence between the

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<sup>38</sup> Compare this with the Quintilius parapegma, below.

<sup>39</sup> Edited in Boll, 1910b

two calendars,<sup>40</sup> and it mostly uses the traditional Roman dating system, although occasionally dates such as July 3 or September 7 do creep in. The impossible IX Nones Oct. also occurs.

**A.xvii)** The *Iudicia Parapegma*<sup>41</sup> appears, incomplete, appended to one twelfth-century manuscript<sup>42</sup> of Pseudo-Ptolemy's *Iudicia*, and then turns up again, complete, in the P. Liechtenstein 1509 printing of the *Iudicia*. It seems, as Burnett has argued, to be largely (or even wholly) based on ancient parapegmata, quite probably sharing a source or sources with the Aëtius Parapegma (though lacking its medical information). It may also derive some of its information from Pliny, either directly or by way of astronomical Scholia. The text is very corrupt, and information shared with Aëtius is crudely translated. For example, some active verbs in Greek have been rendered passive. Where Aëtius has μηνὶ τῷ αὐτῷ (sc. Σεπτεμβίῳ) ἰδ' ἀρκτοῦρος ἐπιτέλλει καὶ ἀλλοιοῖ τῇ ἐξῆς ἡμέρα <τὸν ἀέρα>, the *Iudicia* has *Quarta decima die eiusdem* (sc. *mensis septembris*) *Arcturus - id est Septemtrion - apparet cum Solis ortu. Mutatur aer in crastinum*. This parapegma is unique in that a few weather predictions specify the duration of the weather phenomena in hours: *Prima die mensis septembris, Icarus custos plaustrum apparet cum Solis ortu, et mutatur aer in .vii. horis, hoc fit inter diem et noctem*. Or: *Vicesima septa die (Aprilis)*

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<sup>40</sup> See Boll, 1910b, p. 24 f.

<sup>41</sup> Published with commentary in Burnett, 1993.

<sup>42</sup> Burnett, following Krchnák, 1963, p. 176-7, dates it to before 1160, although Lehmann, 1930 dates it to between the thirteenth and fifteenth centuries.

*Orion vespertinus ponet, et mutatur aer usque in 9 die<i> horas.*<sup>43</sup> And lastly: *Die 9 (Iunii) vespertinus apparet Delphinus et mutatur aer in 10 hora<m> diei.* I note that, like Aëtius, the dates are in the modified Roman calendar.

**A.xviii)** The *Florentinus Parapegma*<sup>44</sup> is a short list in the *Geoponica* which correlates the beginnings of the prominent winds and seasons with dates in the Roman calendar, and the sun's position in the zodiac (sometimes in degrees). It also dates the rising and setting of the Pleiades to IV Ides January and IV Nones November, respectively.

**A.xix)** The *al-Bīrūnī Parapegma*, called *On the Days of the Greek Calendar* is an eleventh-century summary of Sinān ibn Thābit's tenth-century work *Kīṭāb al-anwāʿ*, a now-lost work on meteorology. It is a compendium of the Greek parapegmata known to Sinān (Ptolemy, Geminus and Johannes Lydus), with the addition of Arabic weather traditions and other Greek sources such as Hippocrates. It includes some dietary and medical advice for certain dates, the dates of festivals among different peoples, and the risings of the Euphrates and the Nile. There are also ritual prescriptions, such as the admonition that on the 16th of *Hazīrān* one is best "to rise in the

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<sup>43</sup> Burnett does not explain the switch to Arabic numerals in the later part of his edition of the calendar (beginning on the 19 April). It may possibly reflect the usage of the 1509 edition, versus the earlier incomplete MS version, although Burnett does mention "oriental forms of Arabic numerals beginning on fol. 69<sup>r</sup>" in the MS.

<sup>44</sup> *Geoponica*, I.1; also published in Wachsmuth, 1897, p. 320-321.

morning from sleep on the left side, and to fumigate with saffron before speaking."<sup>45</sup>

It mentions but a few astronomical phenomena, and those only in passing. This stems from Sinān's argument that the weather phenomena are tied to particular dates rather than to stellar phases:

Regarding the cause of these *anwā'*,<sup>46</sup> scholars do not agree among each other. Some derive them from the rising and the setting of the fixed stars, among them the Arabs. ... Others again from the days themselves, maintaining that they are peculiarities of them, that such is their nature, at least, on an average, and that besides they are increased or diminished by other causes.<sup>47</sup>

The exact relation between this calendar and other Arabic astrometeorological calendars is still unclear.<sup>48</sup>

**A.xx)** The *C. Marcianus 335 Parapegma* is preserved in a fifteenth-century Byzantine codex and published in the CCAG.<sup>49</sup> It seems to be quite a late text, and is unusual in discussing mostly storms at sea. I include it here for only the sake of completeness, because Rehm lists it as a parapegma.

<sup>45</sup> al-Bīrūnī, *Chronology*, p. 258.39-40.

<sup>46</sup> *anwā'* is the plural of the noun *naw'*, which is used in the singular throughout this calendar to translate the Greek verb (I) ἐπισημαίνει. I think *anwā'* is being used here in the same general sense as ἐπισημασία is used in Ptolemy's introduction and conclusion to the *Phaseis*: i.e., to mean 'weather changes'. I note that *anwā'* cannot here mean "influence of a lunar mansion", since the *anwā'* being effects of the heavens is explicitly ruled out by the 'other authors,' who we are later told include Sinān. For further arguments on the issue of the date vs. the phase, see al-Bīrūnī, *Chronology*, p. 261.33 f.

<sup>47</sup> al-Bīrūnī, *Chronology*, p. 231.15-25.

<sup>48</sup> See, for example, Dozy, 1961; Pellat, 1986.

<sup>49</sup> Cumont, CCAG, II.214.

**A.xxi)** Bianchi published the fifteenth-century MS *Par. gr. 2419* claiming it to be a MS of the Clodius Tuscus parapegma,<sup>50</sup> but it is sufficiently different, I think, to list it separately here. While a comparison with the Clodius Tuscus parapegma does reveal a number of similarities, particularly in the dating and wording of meteorological predictions, the stellar phases are often quite different from Clodius Tuscus. Entries are indexed to the reformed Julian calendar.

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<sup>50</sup> Bianchi, 1914, p. 22-48.

*B: Astrological Parapegmata*

**B.i)** The *Thermæ Traiani Parapegma* was found in Rome in a house at the baths of Trajan. It disappeared sometime in the nineteenth century. A copy of a sketch of the more-or-less complete parapegma can be found in Degrassi's *Inscriptiones Italiae*.<sup>51</sup> It consists of pictures of the gods presiding over the days of the week inscribed horizontally across the top, with their corresponding holes bored just beneath them. The days of the moon from *I-XV* run vertically down the left side, and from *XVI-XXX* down the right. A hole appears just above and to the right of the hole for *XXX*, but it does not seem to be for an unnumbered day *XXXI*, as has been speculated.<sup>52</sup> Eriksson argues that this hole was used to mark either full or hollow months, but his argument is unconvincing.<sup>53</sup> I think comparison with other, similar parapegmata (see especially Dura-Europus, Latium, Ostia, and Pompeii, below) reveals this mysterious 31st hole to be most likely the result of either accidental damage to the inscription itself, or else an artifact of the original copyist.

In the middle of the calendar is a circle divided into twelve sections, with each division bearing the picture and initial (Latin)

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<sup>51</sup> Degrassi, 1963, vol. XIII.2, p. 308-9. There is also a terracotta copy made from the original in the Kunstgeschichtlichen Museum der Universität Würzburg, although this copy has been "improved" by the restoration of Saturn and Jupiter. It does not have the 31st hole between days *XXVIII* and *XXX*. A plaster cast of this copy can also be found in the Museo della Civiltà Romana. See Manicoll, 1981.

<sup>52</sup> See Rehm, 'Parapegma', *RE*, col. 1364; Eriksson, 1956.

<sup>53</sup> Eriksson, 1956, p. 24-5.

letter of successive zodiacal signs running counter-clockwise. There are two holes drilled per sign, representing the beginning and middle of each sign. A fragment of a bone peg was found in one of Gemini's holes. This circle seems to have been used to keep track of the movement of either the sun or the moon through the zodiac.

Erikkson speculates that the peg was lunar and was moved each day for six days, and then it rested on the seventh day.<sup>54</sup> But this would still leave a deficit of one day every three lunar months, or about four days a year. I suspect that such inaccuracies would have been intolerable, and that either (a) some more complicated system of movement was used, or (b) the motion of the peg, whether representing solar or lunar phenomena, was dictated by observation or by some external text. In any case, such reconstructions are unprovable, and the other parapegmata do not shed any light on the matter.

**B.ii)** The *Dura-Europus Parapegma*<sup>55</sup> is a graffito found scratched into a plastered wall in a Syrian house which served as a military barracks during the Roman occupation. The inscription therefore dates from between 165 and 257 A.D.<sup>56</sup> Much of the inscription was destroyed during excavation, but the remainder is now at Yale. This parapegma is similar in many respects to that of the *Thermæ Traiani*

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<sup>54</sup> Erikkson, 1956, p. 25.

<sup>55</sup> A reproduction based on a partial tracing, a partial photograph, and a "careful description" is published in Rostovtzeff, Bellinger et al., 1936, p. 42; also in Snyder, 1936, p. 15.

<sup>56</sup> For these dates, see Drower, Gray et al., 1996



in that it has the gods of the hebdomadal days pictographically represented across the top, possibly with holes drilled into the plaster above them for a moveable peg. The word *LUNA* appears just above the head of that goddess. The numbers from *I* to *XXX* are inscribed vertically down the two sides of the calendar beneath the heading *LUNA*, but do not seem to have had peg holes beside them. Just to the left of the middle is a column reading *NUNDINE, VIII, VII, VI, V, IIII, III, PRI[DIE]*, again, without peg holes. As Snyder pointed out this is interesting as it is the only example of a nundinal list found outside of Italy. Snyder argues (I think plausibly) that this column should be read as counting down (in the manner peculiar to the Roman calendar) to the nundinal day, which may have had some ceremonial or military significance for the local Roman population.<sup>57</sup> I would, however, add a note of caution with regard to this parapegma: the published drawing and description were both executed *after* the parapegma itself had been badly damaged by rain. The drawing was made largely from memory aided by a photograph.

**B.iii)** The *Latium Parapegma*<sup>58</sup> is a marble fragment 53.5 cm high, 33 cm wide, and 3 cm thick, comprising probably the right-hand 2/5 of the original. It has the names of the days of the week (with their corresponding holes) written horizontally across the top, the nundinal days (with holes) written vertically down the right-hand side, and the remains of the numbers *I-XXX* (i.e., days of the lunar

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<sup>57</sup> See Snyder, 1936.

<sup>58</sup> For a drawing and reconstruction, see Degrassi, 1963, vol. XIII.2, p. 300-1.

month) with their peg holes arranged in a unique floral design in the middle. The inscription *LUNAR* appears in the upper right corner, and Degrassi has speculated that the calendar originally had [*DIES*] *LUNAR[ES]*. The preserved fragment also includes the dates and lengths for two seasons as follows: *Ajestas ex XI k. Mai. in X k. August. Dies LXXXXIII*, and *Hiemps ex X k. Nov. in XIII k. Febrar. Die[s] LXX]XVIII*. Based on the preserved fragment, we cannot be certain whether or not this parapegma originally contained either a column for the zodiacal signs, or even possibly for weather predictions. Degrassi's speculation that there was another column of nundinal days down the left side is based only on an assumption of symmetry, and I think it unlikely. What purpose could a second column of nundinae possibly have?

**B.iv) The Veleia Inscription**<sup>59</sup> was found in 1762 in Veleia in northern Italy. It is a group of marble fragments from the upper left corner of a larger inscription, with two smaller bits from elsewhere in the calendar found later. It has drawings of a few five- and six-pointed stars and a crescent moon on the top part. The numbers *III-X[VII]* and *[XV]III-XX[I]* are extant, written horizontally beneath the pictures. These presumably represent lunar days. The number *XV* is written twice; the second time it is circled (perhaps as a deletion mark?). Below the row of numbers are more pictures, with at least a small lunar crescent visible. I believe these may be parts of images for

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<sup>59</sup> *CIL*, vol. XI, no. 1194; Degrassi, 1963, vol. XIII.2, p. 313.

the hebdomadal days of the Moon and Mercury, as in the Dura-Europus and Thermæ Traiani parapegmata. No peg holes are mentioned by the editors, although there are small holes, probably just decorative indentations, apparent in centre of each star in Degrassi's photograph.

**B.v)** *Neapolitan Museum 4072*<sup>60</sup> is a marble fragment of uncertain origin measuring 41 cm high, 41 cm wide, and 2.5 cm thick. It contains a partial list of dates (*XVI-X[IX]*) with the word *DIES* partially preserved above them, and the days of the hebdomadal week (*MERCU]RI, IOVIS, VENERIS [...]* below. The named days and the numbers have corresponding peg holes drilled above them.

**B.vi)** The *Ostia Inscription*<sup>61</sup> is a partially preserved graffito found in a third century private house. It reads:

*LUNE [...*  
*] II III IIII V VI VII VIII VIII X XI XII XIII XIII XV XVI XVII XVIII XVIII XX*  
*XXI XXII XXIII XXIII XXV XXVI XXVII XXVIII XXVIII XXX [...*  
*VI GAL*  
*] IIII*  
*VMINIVS M*  
*...]IVS*

Lanciani sees a partial *V* at the end of the third line, after the *XXX*. He does not mention holes near the numbers. The inscription seems to be for the purpose of correlating lunar days with hebdomadal days.

<sup>60</sup> Degrassi, 1963, vol. XIII.2, p. 307.

<sup>61</sup> Lanciani, 1878; Degrassi, 1963 vol. XIII.2, p. 312.

**B.vii)** The *Pompeii Calendar*<sup>62</sup> was found in 1927 written on a shop's wall with a narrow stylus. It consists of the names of the hebdomadal days of the week in Latin, the nundinal days, the dates of a calendar month, and the lunar days *I-XXX* written in successive vertical columns. There are no holes for pegs. It reads:

<i>DIES</i>	<i>NVNDINAE</i>	<i>X[VIII]</i>	<i>VIII</i>	<i>NON</i>	<i>I</i>	<i>XV</i>	<i>XXVIII</i>
<i>SAT</i>	<i>POMPEIS</i>	<i>X[VIII]</i>	<i>VII</i>	<i>VIII</i>	<i>II</i>	<i>[X]VI</i>	<i>XXX</i>
<i>SOL</i>	<i>NVCERIA</i>	<i>X[VII]</i>	<i>VI</i>	<i>VIII</i>	<i>III</i>	<i>XVII</i>	
<i>LUN</i>	<i>ATELLA</i>	<i>XV[I]</i>	<i>[V]</i>	<i>VII</i>	<i>IV</i>	<i>XVIII</i>	
<i>MAR</i>	<i>NOLA</i>	<i>XV</i>	<i>[I]V</i>	<i>VI</i>	<i>V</i>	<i>XVIII</i>	
<i>MERC</i>	<i>CVMIS</i>	<i>XIV</i>	<i>[I]II</i>	<i>V</i>	<i>VI</i>	<i>XX</i>	
<i>IOV</i>	<i>PVTIOLOS</i>	<i>XIII</i>	<i>PRI</i>	<i>IV</i>	<i>VII</i>	<i>XXI</i>	
<i>VEN</i>	<i>ROMA</i>	<i>XII</i>	<i>K</i>	<i>III</i>	<i>VIII</i>	<i>XXII</i>	
	<i>CAPVA</i>	<i>XI</i>	<i>VIII</i>	<i>PRI</i>	<i>VIII</i>	<i>XXIII</i>	
		<i>X</i>	<i>VII</i>	<i>IDUS</i>	<i>X</i>	<i>XXIV</i>	
		<i>VIII</i>	<i>VI</i>		<i>XI</i>	<i>XXV</i>	
			<i>V</i>		<i>XII</i>	<i>XXVI</i>	
			<i>[IV]</i>		<i>XIII</i>	<i>XXVII</i>	
			<i>[III]</i>		<i>XIV</i>	<i>XXVIII</i>	
			<i>[PRI]</i>				

In the drawing reproduced in Degrassi,<sup>63</sup> there is damage to the wall at the top of the inscription between columns 3 and 4, and in a small part of column 7. Curiously, no obvious damage is indicated below the *V* in column 4, but some dates are nonetheless not visible. They may have been erased in antiquity, or else the reproduction is faulty. The *VIII* in column 4, just below the *K* (for *kalendæ*) is read as a month name by both Della Corte and Degrassi: *NOV* by Della Corte, and *IAN* by Degrassi. But I think neither of these suggestions is really plausible. Degrassi sees the entries beneath this, the *VII*, *VI*, *V*, as mistakes for *IV*, *III*, *PRI*, but I doubt this very much.

<sup>62</sup> Drawing in Degrassi, 1963, vol. XIII.2, p. 305; originally published by Della Corte, 1927, p. 98.

<sup>63</sup> Originally published in the *CIL*, vol. IV, no. 8863.

Instead, I think it fair to assume, from its similarity to other calendrical and astrological parapegmata, that this inscription was meant as a kind of perpetual calendar, and that the dates are meant to be used for any month, not just a particular month. Moreover, *VIII* follows the pattern throughout the rest of this particular calendar nicely, where the dates begin counting down immediately after the feast day, and the next entry is clearly *VII*, followed by *VI* and *V*. This is an idealized month.

But even so, this calendar has a peculiarity not pointed out by either Degrassi or Della Corte: *it contains impossible dates*. In no month of the Roman calendar is there an *ante diem XVIII Kalendas*, nor an *ante diem VIII* or *VII Nonas*, nor an *ante diem VIII Idus*. I can offer no suggestion to account for this strange feature.

**B.viii)** The *Pausilypum Parapegma*<sup>64</sup> is a marble fragment measuring 26 cm high and 59 cm long, which lists the names of the days of the week, with their corresponding holes, and the nundinal days below these. It reads:

○	○	○	○	[...]
SATVR	SOLIS	LVNAE	MARTIS	[ ...
○	○	○	○	[...]
ROMAE	CAPVAE	CALATIAE	BENEV[ENTI ...	

Maaß dates it to the first century B.C.<sup>65</sup>

<sup>64</sup> Degrassi, 1963, vol. XIII.2, p. 304.

<sup>65</sup> Maaß, 1902, p. 265.

**B.ix)** The *Trier Hebdomadal Parapegma*<sup>66</sup> is a clay fragment found in Trier in 1930, consisting of the images of the first five hebdomadal deities, from left to right beginning with Saturn, each above its own peg-hole.

**B.x)** The *Trier Parapegmatic Mould*<sup>67</sup> is an unique find from a pottery site in Germany. It is a mould meant to impress on wet clay the image of a hebdomadal parapegma, with the personified images of the four seasons below, and the thirty holes for the days of the moon down the two sides (fifteen per side; not noted by Rehm). So far as I know no impressions from this particular mould have been found. It seems to indicate some scale of production for parapegmata, and therefore a corresponding local demand.

**B.xi)** The *Soulosse Hebdomadal Parapegma*<sup>68</sup> is a fragmentary limestone relief, 16 cm high by 27 cm long, showing images of four of the hebdomadal deities, from left to right: Mars, Mercury, Jupiter, and Venus. Under each is a peg-hole.

**B.xii)** The *Arlon Hebdomadal Parapegma*<sup>69</sup> is a stone fragment of unknown provenance measuring 20 cm by 19 cm, and 12 cm thick. It seems to be the leftmost part of a bas-relief. On the left is an image described by Espérandieu as a veiled goddess which he presumes to be

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<sup>66</sup> Dölger, 1950.

<sup>67</sup> For a photograph, see Dölger, 1950, pl. 5.

<sup>68</sup> Espérandieu, 1907, vol. VII, no. 4857.

<sup>69</sup> Espérandieu, 1907, vol. V, no. 4016.

the moon, (although notably lacking her usual lunar crescent) and to the right is an image of the Sun. The stone breaks off to the right of the sun. There are peg holes beneath both of the images.

Espérandieu suggests that the relief depicts the hebdomadal deities, but is meant to be read from right to left, and that it began with Mars rather than the more usual Saturn. Duval notes that among the representations of hebdomadal deities from Roman Gaul, this one would be unique in both respects.<sup>70</sup> Given its state of preservation,<sup>71</sup> I do not think we can rule out the "veiled goddess" being Saturn, who has a similar headdress in the Dura-Europus and Trier parapegmata, as well as the Alésia disk.<sup>72</sup> Indeed Saturn, lacking obvious characteristics such as the Sun's rays, Luna's crescent, or Mars' helmet, must be deduced by Dölger as the first god in the Trier fragment.<sup>73</sup> The cowl typically worn by Saturn in Roman iconography can be quite subtle.<sup>74</sup> Moreover, the Moon is usually accompanied in pictures with a lunar crescent sitting prominently either on her head or on her shoulders,<sup>75</sup> a feature which is conspicuous by its absence in this image. I think it safe to say, then, that the Arlon relief probably begins with Saturn on the left, with the Sun to its right, followed (in the lost part) by the Moon, etc. as would be expected.

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<sup>70</sup> Duval, 1953, p. 287.

<sup>71</sup> See the photograph in Espérandieu, 1907, vol. V, no. 4016.

<sup>72</sup> See also the photographs of the hebdomadal deities from Mainz in Dölger, 1950.

<sup>73</sup> Dölger, 1950, p. 202.

<sup>74</sup> See e.g., Espérandieu, 1933, p. 384.

<sup>75</sup> Although in the earliest representation of the hebdomadal deities, the Pompell calendar medallions, she has an almost full moon behind her head, looking rather more like a halo than a moon. See Long, 1992.

**B.xiii)** The *Rottweil Parapegma*<sup>76</sup> consists of a fragment showing Jupiter and Venus with peg holes beneath each. There is an incomplete series of holes beneath these, but it is unclear what information they were used to keep track of. From comparison with other parapegma, I do not think it unlikely that these were for counting lunar days. Another fragment shows part of the image of Capricorn.

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<sup>76</sup> See Goessler, 1928; Duval, 1953, p. 287.



**C: Astronomical parapegmata:**

**C.1) P. Rylands 589,**<sup>77</sup> a second-century B.C. papyrus from Egypt, originally included what the text itself describes as a parapegma, although most of it has been lost. The introduction to it says:

παράπ(ηγμα τ]ων κατ[ὰ σ]ελήνην νομηνιαῶ[ν ὡς εἰσι  
κ]ατὰ [τὰς ἡ]μέρας τῶ[ν] κατ' Αἴγυπ[τίους δωδε]καμή[νων]  
τεταγμένοι. οὐ ἐστὶν ἡ π[ερ]ι[οδ]ος ἔ]τη μὲν εἰκ[ο]σι πέντε.  
μῆνες δ[ὲ] σ]ὺν ἐμβ[ο]λιμ[ο]ις τριακόσιοι ἐννέα. ἡμέρ[αι] δὲ  
ἐν[ακ]ισχ[ί]λια ἑκατὸν εἰκ[ο]σι πέντε. [σ]ημαί[νε]ι δὲ καὶ  
τοὺς κατὰ σελήνην μῆνας καὶ τούτων τίνες ἦσι πλήρη[ς]  
κ[αὶ] τίνες κοῖλ[οι] καὶ π[ο]ῖο[ι] αὐτῶν ἐμβόλιμοι κα[ὶ] ἐν τίνι  
ζω[ιδί]ωι ἡλι[ο]ς καθ' ἕκαστον μῆνα στή[σεται]. ὅ[ταν]  
διέλθει τὰ εἴκοσι πέ[ν]τε ἔ[τη] πάλιν ἐπι[τ]ήν αὐτὴν ἀρχὴν  
ἤξει καὶ τὸ[ν] αὐτὸν τρόπ[ο]ν ἀλ[λάξ]εται.

Of the parapegma itself, only bits remain, including a table equating Egyptian months with the sun's position in the zodiacal signs for one year, the Egyptian dates of νομηνιαί for four months of one year and nine months of another, and some mention of what may be religious festivals.

It is interesting to note that this text seems to have been used only to fix the motions of the sun and moon in terms of Egyptian calendar dates in a 25-year cycle. It is unclear from the text if this would have primarily had astrological or calendrical significance. Another possibility is that the cycle was used to correlate parapegmata (which we know were being indexed to zodiacal signs in Greece by the late second-century B.C.)<sup>78</sup> with the Egyptian calendar.

<sup>77</sup> Turner and Neugebauer, 1949.

<sup>78</sup> See my comments on the Geminus parapegma and Miletus I in chapter 4, below.

The  $\nu\omicron\mu\eta\nu\acute{\iota}\alpha\iota$  dates may have been used to count lunar days, as in the astrological parapegmata, above, or may have reflected a local or cult calendar.

**C.ii) *Miletus I*** is a fragmentary inscriptional Greek parapegma published by Diels and Rehm in 1904.<sup>79</sup> There is an introduction on a separate fragment, linked to the parapegma by Rehm<sup>80</sup> based on epigraphic similarity, which dates it to the year 110/109 B.C. The parapegma itself has stellar phases listed, and holes for moveable pegs around them. The phases are organized by the sun's position in the zodiac.<sup>81</sup> There is almost no weather information in the preserved fragment. The only meteorological entry is: "Cygnus sets, the season of the west wind (Zephyrus) accompanying." I interpret this as a seasonal marker rather than a strictly meteorological prediction. Since it is the only such entry surviving in what appears to be an otherwise strictly astronomical parapegma, I choose not to class this parapegma as astrometeorological. It should serve, however, to remind us just how artificial these modern classes are when it comes to grouping and sorting such a diverse set of texts.

An excerpt from the sign of Aquarius can be seen in chapter 2, fig. 1, above.

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<sup>79</sup> Diels and Rehm, 1904; Dessau, 1904.

<sup>80</sup> Rehm, 'Parapegma', *RE*, col. 1299-1230. He had originally linked a different introduction to it. See Diels and Rehm, 1904, p. 102.

<sup>81</sup> On this, see chapter 4, below.

Rehm's theory that Miletus I was meant to be used alongside something like Miletus II<sup>82</sup> assumes that a strictly astronomical parapegma would have been unthinkable. I do not agree. If we assume that the people using the parapegmata know certain rules of thumb, then the correlations of phases and weather do not need to be explicitly stated in the calendar: to take a modern example, I do not need to buy a special calendar that tells me to plant my annuals (in Southern Ontario) on the weekend of the 24th of May. I only need to know which weekend is the 24th and I trust my memory for the rest.

**C.iii) The *Antikythera Mechanism*<sup>83</sup>** is a remarkable geared astronomical computer pulled from a first-century B.C. shipwreck by sponge divers. It seems to have been used to show the relative motions of the sun and the moon according to the Metonic cycle and the Egyptian calendar. It includes an astronomical parapegma. One of the geared dials on the front of this unique calendrical/astronomical instrument is divided into graduated zodiacal signs. Part of Virgo, all of Libra, and the very beginning of Scorpio are preserved. There are 30 graduated divisions in Libra, which Price reasonably interprets as degrees. Above the first degree of Libra the letter A is clearly marked. Price also thinks (but is not certain) that he can see a B above Libra 11, a Γ above Libra 14, a Δ above Libra 16, a E above Scorpio 1, and (most of the way around the

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<sup>82</sup> Rehm, 'Parapegma', *RE*, col. 1300.

<sup>83</sup> Published by Price, 1974; compare also the sixth-century A.D. device published by Field and Wright, 1985.

dial, an  $\omega$  above Virgo 18. Price proposes (I think correctly) that these letters are keyed to the "parapegma inscription" just below the dial. The largest preserved fragment of this inscription reads:

Z	I{...	
H	OP{...	
Θ	{...	
I	{...	
[K		e]veni[ng.
[Λ	The Hya[des set] in the e]v[e]ni[ng.	
M	Taurus [bel]gins to r]is[e.	
[N	Vega rises in the e[v]ening.	
[Ξ	The Plei]ades ri[s]e in the morning.	
O	The Hyades rise in the morning.	
Π	Gemini begins to ri]se.	
P	Aquila rises in the even[ing.	
Σ	Arcturus sets in the m[orning.	

It appears that the Greek letters (in the left column of the inscription) were meant to correspond to the letters inscribed over particular degrees of the zodiac on the parapegma dial itself, and the stellar phase corresponding to each letter on the dial could thus be read off from the inscription.

Much of the inscription following the letters  $\Lambda$  through  $N$  has now been unfortunately destroyed by efforts to study and preserve the instrument, but notes taken by Rehm have allowed Price to reconstruct it with some certainty. Price tentatively reconstructs the remainder of the inscription by comparing it with Geminus, but this is misguided, since even the preserved fragment cannot be made to fit well with Geminus.<sup>84</sup> By counting day-differences from the autumnal equinox ( $A$  on the Antikythera dial) to the other letters (if indeed they are secure) and comparing this to the day-differences in other

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<sup>84</sup> See Price's table 4, p. 46, and his comments on the problems with it on p. 49.

parapegmata, I have found closer correspondence to stellar phases in the following parapegmata (the equinox is italicized):

- (a) Columella: Sept. 11, 24, Oct. 4, 8 (one day late), 10, 13 (one day late), and 28;
- (b) Ptolemy, for the clima where the day is 14 hours long: (no entry), *Thoth* 28, Phaophi 7 (one day early), 11, 12 (one day early), and 26 (two days early);
- (c) Ptolemy, for the clima where the day is 14 1/2 hours long: Thoth 17 (two days late), 28, Phaophi 8, 10 (one day early), (no entry), (no entry), 27 (one day early);
- (d) Parisinus gr. 2419: Sept. 6, 19, 29, Oct. 3 (one day late), 5 (one day late), 20 (one day late).

Since so many different possibilities are attested, and since most of the letters on the dial are insecure, I think any reconstruction of the entries for A through E, and  $\omega$ , would be doubtful. Moreover, there is no guarantee that all of the letters on the dial represented purely astronomical phenomena. They may have included important seasonal markers such as winds (compare Miletus I, above).

**C.iv)** The *Venusia Fasti*<sup>85</sup> is a fragmentary Latin calendar dating from the first century B.C. It is complete from the Kalends of May through to XII K. July. Apart from listing the nundinal letters and the *dies fasti*, *nefasti* and *comitales*, it has four astronomical entries:

G<sup>86</sup> NON[AE] (sc. *maiae*) F(ASTUS). VERGILI(AE)  
 EXORI(VNTUR)  
 B XV (sc. *K. Iuniae*) C(OMITALIS). SOL IN GEMIN(IS)  
 B XIII (sc. *K. Iuliae*) C(OMITALIS). SOL IN CANCRO  
 A VI (sc. *K. Iuliae*) C(OMITALIS). SOLSTITIVM  
 CONFECTIVM)

<sup>85</sup> Degrassi, 1963, vol. XIII.2, p. 55-62.

<sup>86</sup> The leftmost column is for the nundinal letters, A through G.

Unlike the *Menologia Rustica*,<sup>87</sup> which I do not include as parapegmata, the *Venusia Fasti* contains the date of a stellar phase, and the dates of the sun's entry into the signs of Gemini and Cancer are given precisely. In the *Menologia*, the sun's position in the zodiac is listed only roughly, such that each sign is equated with a particular month.

**C.v)** The *Geoponica Phase List*,<sup>88</sup> attributed to Quintilius, simply lists the rising and setting dates of certain prominent fixed stars and constellations (Arcturus, the Pleiades, Orion, etc.), but does include a mention of the Etesian winds. Dates are given in the modified Roman calendar. Most of it seems to have been excerpted from the Quintilius parapegma, although there is one entry missing from Quintilius: τῆ ἰγ' τοῦ Ἰουλίου. προκύων ἐξῶς ἐπιτέλλει which occurs in the *Geoponica* phase list at a point corresponding with a corruption in Quintilius.<sup>89</sup> Dates in this phase list can be displaced by one or more days from those in Quintilius, although sometimes they do not differ.

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<sup>87</sup> See Degrassi, 1963, vol. XIII.2, p. 286 f.; Broughton, 1936.

<sup>88</sup> *Geoponica*, I.9.

<sup>89</sup> See from IV Nones July to IX Kal. August in Boll, 1910b, p. 7.

### D) Other Parapegmata

**D.i)** The oldest known parapegma, the *Ceramicus Parapegma*,<sup>90</sup> is represented by only a small fragment found in the Ceramicus district of Athens, dated by Brückner to the fifth century B.C. It simply has the ordinal numbers 'fifth' through 'ninth' inscribed in Greek beside holes into which pegs could be inserted:<sup>91</sup>

○ πέμπτη ○  
 ○ ἕκτη ○  
 ○ ἑβδόμη ○  
 ○] ὄγδοη ○  
 ○ ἐν]ά[τ]η {

Rehm's theory that this parapegma was meant to correlate civil lunar dates inscribed on the pegs, with zodiacal dates (i.e., 'fifth [day of Virgo...])' inscribed on the stone itself, is unlikely.<sup>92</sup> It appears much more likely that a single peg was moved from hole to hole, rather than the entire set of holes being occupied by a set of labeled pegs.

Since this fragment is so small, we cannot rule out the possibility that the Ceramicus Parapegma was solely calendrical, or even that it served some other function, completely different from any known later parapegma.

<sup>90</sup> Published by Brückner, 1931, p. 23-4, with photograph.

<sup>91</sup> The column of holes after the numbers is difficult to make out in the photograph published by Brückner, but shows up clearly in the drawing published in *IG 2<sup>2</sup>* 2782.

<sup>92</sup> Rehm, 'Parapegma', *RE*, col. 1301; see my arguments against multiple pegs in chapter 2, above.

**D.ii) The *Guidizzolo Fasti*<sup>93</sup>** is a fragmentary stone parapegma measuring 16.5 cm by 16 cm by 4 cm thick, dating from sometime after 8 B.C. It is a unique parapegma insofar as it seems to be strictly calendrical, with only dates and feasts listed. Holes are drilled beside each entry, and the preserved fragment is as follows:

[o] XIII	o X[V]	o [III] ID[V]S I[V]LIAS
[o] XII	o XIII	APOLLI[NARIA]
[o] XI	o XIII	o X K AVG[VSTIS]
[o] X]	o XII	NEPTVN[ALIA]
o VIII	o XI	o IDIBVS AV[GVSTIS]
o VII	o X	DIANA(E)
o VI	o VIII	o X K SEPTEM[BRES]
o V	o VIII	VOLKANALIA
o III	o VII	o III IDVS DECEM[BRES]
o III	o VI	SEPTIMONTIV[M]
o PR[IDIE]	o V	o XVI K IANVAR[IAS]
	o III	SATVRNALIA
	o III	o XV K IA[N]VA[RIAS]
	o PRID[IE]	EPON(A)E

The first two columns may well represent November and December, as Degrassi supposed, assuming the fasti were written at the end of the calendar section. It seems clear that this parapegma was meant to keep track of the calendar year and its various fasti, such that a peg would have been moved for each day of the calendar month. A separate peg seems to have been used from time to time to mark the particular fasti, but this kind of intermittent column (i.e., lacking holes for the *dies nefasti* between the fasti) is unique, and I am not sure what to make of it. There may have been a single hole marked *DIES NEFASTVS*, so that a feast-marking peg was either there or in one of the fixed (or moveable?) fasti on any given day. It is also

<sup>93</sup> Degrassi, 1963, vol. XIII.2, p. 234-5.



possible (though less likely) that the peg was moved from the calendar section over to the feast section for the feast days only, and then moved back to mark normal days.

**D.iii) The Coligny Calendar**<sup>94</sup> is a long inscription (1.48 m by 90 cm high) on bronze of five years of a lunar calendar, written in the Latin script, but believed to be written in an ancient Celtic tongue. The days of the month are each accompanied by a peg hole, and they are written vertically, beginning with the name of the month, followed by the numbers *I-XV*, then the word *ATENOVX* and then the numbers *I-XIII* or *I-XV*, depending on the month. There are 7 months of 30 days and five of 29 (for a total of 355), although it has been argued that one of the 30-day months, *Equos*, occasionally had 28 days to keep the year to an average of 354 days. Over the course of the five years, there are two intercalary months, each of 30 days. The symbols { | , }, †, { } letters (*M*, *D*, *N*) and words beside the dates are still largely unexplained.<sup>95</sup> A sample from the calendar<sup>96</sup> should give the flavour:

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<sup>94</sup> First published in *Comptes rendus des séances de l'année de l'academie des inscriptions et belles-lettres* (1897), p. 703; Pl. I-VI; and (1898) p. 299 f.; See also Ricci, 1898; Ricci, 1900. The most complete and sober publication is in Duval and Pinault, 1986, including excellent photographs and commentary. See also McCluskey, 1998. More speculative reconstructions, such as those of Hiltz, 1991 and Olmstead, 1992, have been attempted, but these are best approached with caution. More recently, Gaspari and Cernuti, 1997, have tried to put the Coligny calendar into a broader astronomical context, but again, much of their treatment is speculative.

<sup>95</sup> Not to say that attempts have not been made: For a summation of the issues, see Ginzel, 1914, v. III, p. 80 f.; Kubitschek, 1928; and especially Duval and Pinault, 1986, p. 421 f. Generally *D* and *N* are thought to refer to *day* and *night* respectively, but I do not see what this could mean in the context of the calendar.

<sup>96</sup> Ricci, 1898, pl. II.7.

- o XIII M D IVOS
- o XV D IVOS

**MEQVOSANM**

- o I D
- o II PRINI LACIVOS
- o III M D SIMI IVOS
- o III D IVOS
- o V D AMB
- o VI M D SIMIVISO
- o VII D ELEMBI
- o VIII D ELEMBI
- o VIII D ELEMBI
- o X D
- [o] XI D AMB
- [o] XIII D
- [o] XIII D SEMIVIS
- [o] XIII D SEMIVIS
- [o] XV D SEMICANO

**ATENOUX**

- o I M D SEMIVIS
- o II M D SEMIVIS
- o III D AMBSIMIV
- o III D
- o V D AMB
- o VI I+I D SIMISO

- o XIII III D IVODOBCANT
- DIVERTOMV

**MSAMONMAT**

- o I [.....]MANIVOS
- o II I[.....]
- o III †II [.....] IVOS
- o III [...] D [.....]VMIVO
- o V AMB
- o VI M D
- o VII PRINI LOVD N
- o VIII D DVM
- o VIII D
- o X M D
- o XI D
- o XII M D
- o XIII †II D
- o XIII †I D
- o XV †I † D

**ATENOUX**

- o I D DVMAN
- o II II} M D TRINVXSAMO
- o III D AMB
- o III {II D
- o V †I D AMB
- o VI II} M D

*Equos* and *Samon* are the names of the months, the column here usually labeled *D* is sometimes elsewhere labeled *N*. Twenty-nine-day months end with the word *DIVERTOMV*, as above *MSAMON* here. All month names are preceded by the letter *M* as are *EQVOS* and *SAMON* here.

The abbreviations beside the month names, *ANM* and *MAT* (sometimes *MATV*) seem (based on Celtic cognates) to mean 'ungood' (*\*ANMATV-*) and 'good' (*\*MATV-*, cognate with the Irish *maith?*) respectively. *M* beside the dates may be an abbreviation for *MATV*. All 29-day months are *ANM* and all 30-day months are *MAT* except the month of *EQVOS* which seems to have fluctuated between 30 days (in

years I, III and V) and 28 days (in years II and IV).<sup>97</sup> MacNeill argued that *IVOS* referred to a feast of some kind, but Duval and Pinault believe it to be uncertain. Parisot's theory that it refers to possible solar eclipses is implausible, as is his idea that *DIVERTOMV* is an extra day occasionally inserted to correct for the lateness of the significant phase of the moon.<sup>98</sup> If *DIVERTOMV* were a day occurring after the 29th, then it should have a peg hole beside it, which it never does.

The calendar represents the oldest known document in a Celtic tongue, possibly dating from the second century A.D.<sup>99</sup> and as such is of great importance, but its highly abbreviated character and lack of parallels (apart from the tiny fragments of the Villards d'Héria calendar)<sup>100</sup>, make it difficult to interpret.

**D.iv) The *Ariminum Nundinal Parapegma***<sup>101</sup> is a puzzling fragment bearing an inscription apparently pertaining to a nundinal list, with peg holes preserved beside the inscription.

**D.v) The *Suessula Nundinal List***<sup>102</sup> is a small stone inscription, lacking peg-holes, with a partial list of nundinal days written

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<sup>97</sup> See MacNeill, 1928, p. 27-30; Duval and Pinault, 1986, p. 411-415.

<sup>98</sup> See Parisot, 1985.

<sup>99</sup> According to Duval and Pinault, 1986; MacNeill, 1928 dates it to the late first century B.C. or early first century A.D.

<sup>100</sup> Published in Duval and Pinault, 1986, p. 251, f. The Villards d'Héria calendar seems not to be a parapegma, as near as can be determined from the few remaining fragments. It does seem to be written in the same language, and to use some of the same abbreviations as the Colligny calendar, however.

<sup>101</sup> Degrassi, 1963, vol. XIII.2, p. 306.

<sup>102</sup> See Degrassi, 1963, vol. XIII.2, p. 303.

vertically: [T]IANESI[BVS] CAMPAN[IS] ATELLANI[S] SVESSELA[NIS]  
NOLANIS CVMANI[S] CALINI[S].

**D.vi) The Allifæ Nundinal Lists**<sup>103</sup> consist of two fragments each listing eight different nundinal days vertically, with no peg-holes preserved. A third fragment was lost sometime after 1750. Unlike Degrassi, I see them as essentially three different lists. They read

(fr. 1)	(fr. 2)
IM ALTINATI[BUS]	[B]EN[EVENTANTIS]
INTERAMNA[TIBUS]	NUCERI[NIS]
TELESINIS	[L]UCERINIS APVLIS
SAEPINATIBVS	[S]VESSANIS
PVTEOLANIS	[CA]LENIS
ATELLANIS	[SVES]VLANIS
CUMANIS	[SIN]VESANIS
NOLANIS	[CALA]TINIS

The third fragment had only *ALLIFANIS, CEREATIS*.

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<sup>103</sup> Published in Degrassi, 1963, vol. XIII.2, p. 302.

*E) Reports of Parapegmata*

**E.i) Cicero**, in a letter to Atticus<sup>104</sup> announcing that tomorrow will be the beginning of his year in office in Laodicea, says (following all modern editions): *Ex ea die, si me amas*, παράπηγμα ἐνιαύσιον *commoveto*. The next day he sends another letter<sup>105</sup> saying *Ex hoc die clavum anni movebis*. A number of problems have arisen in the interpretation of these passages, which have not been completely resolved.

The Loeb edition, translated by Winstedt,<sup>106</sup> follows Tyrell and Purser's 1890 edition which offers the following commentary:

παράπηγμα] The very same meaning is conveyed by *clavum anni movebis* in the next letter. The phrase is said by the old commentators to take its rise 'from an old custom which came from Etruria to Rome, whereby the *Pontifex Maximus*, on the Ides of September, stuck a nail into the right wall of the temple of Jupiter Optimus Maximus, to keep count of the years.' *Commoveto*, like *movebis*, in the next letter, is used as a Latin equivalent for κινεῖν in the sense of 'to take in hand,' e.g. ἐκίνουον θύρσον ἐς βακχεύματα. Eur. Bacch. 724.<sup>107</sup>

A few years after this was written, the Miletus and Puteoli parapegmata were discovered, offering an alternative interpretation noted by Constans and Bayet in the Budé edition. In a note on the phrase παράπηγμα ἐνιαύσιον *commoveto*, they say

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<sup>104</sup> Cicero, *Ad Att.*, V.14.

<sup>105</sup> Cicero, *Ad Att.*, V.15.

<sup>106</sup> Winstedt, 1928, vol. I, p. 373, n. 1.

<sup>107</sup> Tyrell and Purser, 1890, vol. III, p. 52, n.

C'est-à-dire: compte de ce jour mon année de charge. Il s'agit d'un calendrier à fiches mobiles. On a trouvé récemment à Pouzzoles [Puteoli] un fragment de calendrier latin de ce genre.<sup>108</sup>

But they refer to the older interpretation in their note on Cicero's next letter, commenting on *clavum anni movebis*:

*Clauom* (sic) *anni mouebis*: littéralement 'tu déplaceras <sur ton calendrier mobile> la fiche marquant l'année'. Cf. *Att.*, V, 14, I: παράπηγμα ἐνιαύσιον *commoueto*.—Mais l'expression semble être une métaphore assez usée, remontant à l'ancien rite de la 'plantation (annuelle) du clou', par le *prætor maximus* ou un dictateur, dans le mur du temple de Jupiter au Capitole.<sup>109</sup>

Shackleton-Bailey, in his edition of the *Letters to Atticus* follows Constans by mentioning the Puteoli calendar as an example of the kind of time-keeping device referred to by Cicero, but he does not repeat the nail-in-the-temple-wall story.<sup>110</sup>

While I think that Constans and Bayet's *double entendre* is not impossible, I would argue that Cicero primarily has in mind a calendrical *parapegma* in both passages: in the first, because he says so explicitly, and in the second, because he refers to 'moving' the nail, a practice nowhere attributed to the *Pontifex Maximus*, who was supposed to have added a new nail for each year.<sup>111</sup> I note in this context that a *clavus* does not correspond directly to our word 'nail', but can refer also to a metal, wooden or bone peg, such as was used in the *parapegmata*.

<sup>108</sup> Constans and Bayet, 1969, vol. III, p. 242, n. 2.

<sup>109</sup> Constans and Bayet, 1969, vol. IV, p. 246, n.

<sup>110</sup> Shackleton-Bailey, 1968, vol. III, p. 215, n.

<sup>111</sup> The veracity of this ancient story does not concern me here. All that matters is what Cicero may or may not have believed. For an ancient account of driving the nail into the temple, see e.g., Livy, VII.iii.4 f. Specifically note that Cincius reports having seen *clavos* [plural] marking the number of years.

Looking at the Latin parapegmata published by Degrassi in 1963, we can, I think, be fairly certain that Cicero was referring *not* to the kind of parapegma found at Puteoli, as Constans and Shackleton-Bailey supposed, but to one more like the Guidizzolo Fasti. Unlike the astrometeorological fragment from Puteoli, the Guidizzolo Fasti seems to be strictly calendrical, with the peg moved daily to keep track solely of calendar dates.

It is worth pointing out that the text of Cicero is corrupt at just this point, insofar as none of the MSS reads παράπηγμα in this passage. Instead we find παράγγελμα, ΠΑΓΓΕΓΜΑ, or ΠΑΤΤΕΤΜΑ, obviously none of which are acceptable.<sup>112</sup> Curiously, Tunstall's emendation of this to παράπηγμα, made in 1741, was based on no knowledge of inscriptional parapegmata, which were only discovered in the early part of this century.<sup>113</sup> This fact led to the odd interpretations found in the nineteenth and early twentieth-century editions, as noted above. The discovery of the Puteoli fragment seemed to vindicate what was a good bit of *divinatio* on Tunstall's part.

In any case I think it safe to conclude that Tunstall's emendation is essentially correct, though for reasons Tunstall could not have foreseen, and that Cicero is referring in these passages to a calendrical parapegma similar to the Guidizzolo Fasti.

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<sup>112</sup> See Ernesti, 1810, vol. V, p. 566, n. 93.

<sup>113</sup> To be sure some had been found earlier, but they were not yet known to be parapegmata.

**E.ii) Petronius** in the *Satyricon*<sup>114</sup> has Encolpius mention seeing something that sounds very like an astrological parapegma in the house of Trimalchion:

*sub eo titulo et lucerna bilychnis de camera pendeat, et duæ tabulæ in utroque poste defixæ, quarum altera, si bene memini, hoc habebat inscriptum: "III. et pridie Kalendas Ianuarias C. noster foras cenat," altera lunæ cursum stellarumque septem imagines pictas; et qui dies boni quique incommodi essent, distinguente bulla notabantur.*

Under this inscription there hung from the ceiling a double lamp, and there were two boards fixed to the two posts, of which the one, if I remember correctly, had this inscribed: 'III. and *pr. K. Jan.*, our C. dines outdoors.' The other [had inscribed] the course of the moon, and painted pictures of the seven stars, and which days were good and which bad were marked by a peg that distinguished them.

The seven stars surely refer to the deities of the hebdomadal week<sup>115</sup> (and if so, this is an early reference to them). *Distinguente bulla* is in the singular, and so cannot mean "distinctive knobs," as Heseltine believes.<sup>116</sup> The 'course of the moon' may well have been simply the numbers I-XXX as in so many Roman parapegmata, and these would seem to have been marked by a separate peg from the weekdays. Rehm agrees that the calendar marked the hebdomadal days and lunar days, but thinks there were many *bullæ* which he argues would probably have been of different colours, or painted with letters to mark the two kinds of day.<sup>117</sup> Dölger thinks that a white peg was

<sup>114</sup> Petronius Arbiter, *Sat.*, 30.

<sup>115</sup> Heseltine's note that the "seven stars" refers to the "sun, earth (!), and planets Mercury, Venus, Mars, Saturn, (and) Jupiter" is absurd. See Petronius Arbiter, *Sat.*, p. 53, n. 1.

<sup>116</sup> See Petronius Arbiter, *Sat.*, p. 53.

<sup>117</sup> Rehm, 'Parapegma', *RE*, col. 1363.



used to mark lucky days and a black one to mark unlucky days.<sup>118</sup> But I am unconvinced: if particular hebdomadal days were seen in themselves as lucky or unlucky, I see no reason why coloured or marked pegs must have been used. That is, the days (good and bad in themselves) were simply marked with a peg. The peg need not have specified the qualities.

**E.iii) Diodorus Siculus**<sup>119</sup> paraphrases Hecataeus of Abdera's third-century B.C. report of an astrometeorological parapegma in the tomb of Ramses II. According to the story told to Hecataeus, the calendar, made of gold, was plundered by Cambyses in the sixth century B.C. It is reported to have had entries for 365 days, listing the stellar risings and settings and the changes in the weather for each day "according to the Egyptian astrologers."

If Hecataeus' source is correct, then this would be by far the oldest astrometeorological text. But of course the more-than-third-hand story, told to one Greek by another, who heard it from some unnamed person (perhaps a local "guide," as untrustworthy then as now) carries no conviction on its own.

**E.iv) Proclus** mentions the making of parapegmata in his commentary on Plato's *Republic*.<sup>120</sup> In a discussion of how

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<sup>118</sup> Dölger, 1950, p. 205. He bases this on Macrobius' comment that the Kalends, Nones and Ides were "black" (*atros*) days. See Macrobius, *Sat.* I.16.21.

<sup>119</sup> Diodorus Siculus, I.49.5.

<sup>120</sup> Proclus, *In R.*, II.234.

astronomers model irregular stellar phenomena using a combination of several regular mathematical operations, he says;

So also those who make parapegmata imitate, with the usual arithmetic, nature, which created those things before arithmetic and contemplation.

*F) Related Texts and Instruments*

**F.i)** The Babylonian omen series *Enuma Anu Enlil* includes some weather predictions from fixed stars. These are not ordered or dated, and the exact relation is left unclear: "*Entenabarhum* (is) for early wind," where the relation ("(is) for") is simply expressed with the preposition *ana*. For a more detailed discussion of this text, see chapter 7.

**F.ii)** The Babylonian astronomical compendium *MUL.APIN* associates the annual motion of the sun with seasonal weather changes, as well as giving schematic lunar calendar dates for stellar phases, and a list of stellar phase date differences. For more on this, see chapter 7.

**F.iii)** The *Ṣaft el-Henna Naos*<sup>121</sup> is the only extant Egyptian example of an astrometeorological text. It dates from the early fourth century B.C. For a detailed description of it, see the chapter *Egyptian Astrometeorology*, below. Its relation to the Greek and Latin material is unknown.

**F.iv)** The letter from *Diocles of Carystus* (fourth or third century B.C.) to King Antigonus of Macedonia ends with a list of the beginnings and ends of the seasons<sup>122</sup> relative to the solstices,

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<sup>121</sup> Leltz, 1995.

<sup>122</sup> Diocles of Carystus, , p. 77-8.

equinoxes, and the phases of certain stars.<sup>123</sup> Diocles correlates these with the prominent illnesses for each season. He also tells us how long each season is, in days. He does not correlate the seasons with any calendrical dates.

**F.v)** The Hippocratic treatise *Peri Hebdomadon*<sup>124</sup> contains a short chapter which lists the divisions of the seasons according to the solstices, equinoxes, and the phases of certain prominent fixed stars. For each season it lists the maladies which are common at that time of year.

**F.vi)** The Hippocratic work *On Regimen*<sup>125</sup> also divides the seasons in the same way, and tells the reader what food and activity are proper to each season. It mentions a few pieces of information similar to that in the parapegmata, such as winds and the return of the swallows, but these are attached to seasons generally, rather than to specific dates or phases.

**F.vii)** The *Eudoxus Papyrus* (P. Par. 1) was published by Friedrich Blass in 1887.<sup>126</sup> It is a Greek text dating from probably the second century B.C.<sup>127</sup> and at least partly derived from *P. Hibeh*, though much garbled. Apart from the acrostic, which reads Εὐδόξου τέχνη.

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<sup>123</sup> See Rehm, 1941, p. 37 f. for a discussion of the Greek seasonal divisions.

<sup>124</sup> Hippocrates, vol. VIII, p. 616-673.

<sup>125</sup> Hippocrates, vol. VI, p. 594 f.

<sup>126</sup> Reprinted by *Zeitschrift Für Papyrologie und Epigraphik* in 1997. See Blass, 1997.

<sup>127</sup> Blass, 1997, p. 79, Grenfell and Hunt, 1906, p. 143.

the text has little obvious connection to what we know of Eudoxus' astronomy.<sup>128</sup> The only content pertaining in any way to a parapegma is a list of the number of days intervening between certain stellar phases, similar to the one found in Varro.<sup>129</sup> For example: "From the [setting of] the Pleiades to the setting of Orion, 22 days; from [the setting of] Orion to the setting of Sirius, 2 days; from [the setting of] Sirius to the solstice, 24 days..."<sup>130</sup> This is followed by a list of season-lengths according to Eudoxus, Democritus, Euctemon, and Callippus. No calendar dates are given other than the report that "according to Eudoxus and Democritus, the winter solstice [happens] on either the 19th or 20th of Athyr."<sup>131</sup> There is nothing in the way of weather.

Since no known parapegmata contain an explicit list of day-differences, and since this text contains only one entry resembling any parapegma, it seems unfounded to suppose that this text represents a kind of parapegma, as Rehm, Neugebauer and others have done.<sup>132</sup>

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<sup>128</sup> See Neugebauer, *HAMA*, p. 687 f.

<sup>129</sup> Varro, *RR*, I.28; There is some similarity, too with Columella, *RR* IX.14, where he says that there are forty-eight days of spring, which he defines as the time between the equinox "which occurs on about (*circa*) the VIII K. April, in the eighth degree of Aries" and the rising of the Pleiades. He also mentions that there are roughly (*ferè*) thirty days from the (summer) solstice to the rising of Sirius, and roughly fifty from Sirius to the rising of Arcturus. But the ambiguity and incompleteness of his numbers precludes this from being an *ἀστρῶν διαστήματα* as Rehm claims [Rehm, 'Parapegma', *RE*, col. 1309].

<sup>130</sup> Blass, 1997, col. XXII.

<sup>131</sup> Blass, 1997, col. XXII.

<sup>132</sup> Rehm, 'Parapegma', *RE*; Neugebauer, *HAMA*, p. 686 f.

**F.viii) Varro**,<sup>133</sup> in his first-century B.C. work *On Agriculture*, gives a short description of the seasons in terms of the number of days intervening between certain stellar phases and the solstices and equinoxes. In its entirety, it reads as follows:

*suptilius descriptus temporibus observanda quædam sunt, eaque in partes VIII dividuntur: primum a favonio ad æquinoctium vernum dies XLV, hinc ad vergiliarum exortum dies XLIV, ab hoc ad solstitium dies XLIX, inde ad caniculæ signum dies XXVII, dein ad æquinoctium autumnale dies LXVII, exin ad vergiliarum occasum dies XXXII, ab hoc ad brumam dies LVII, inde ad favonium dies XLV.*

In more accurate divisions of the seasons there are some things to be noted, and [the seasons] are reckoned in eight parts: the first from the west wind to the vernal equinox, 45 days; from there to the rising of the Pleiades, 44 days; from this to the solstice, 48 days; then to the rising of Sirius, 27 days; next to the autumnal equinox, 67 days; from that to the setting of the Pleiades, 32 days; from this to the winter solstice, 57 days; then to the west wind, 45 days.

While I think this sort of text, like the Eudoxus papyrus, is clearly related to the parapegmata, I do not think it is sufficiently similar to warrant inclusion as actually being one.

**F.ix)** The citation from *Hyginus' De apibus* in Columella<sup>134</sup> is a description of the seasons relative to the solstices, equinoxes, and the phases of the fixed stars, with some discussion of the behaviour of bees at each season.

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<sup>133</sup> Varro, *RR*, I.28.

<sup>134</sup> Columella, *RR*, IX.14.

**F.x)** The *Ara Pacis Sundial*<sup>135</sup> in Rome used an Egyptian obelisk as a huge gnomon to indicate the sun's position in the zodiac. The inscriptions are in Greek. Pliny reports that it was designed by a certain Nov(i)us Facundus and erected under the patronage of Augustus.<sup>136</sup> In the preserved part, the beginning of summer and the end of the Etesian winds were indicated by the length of the noon shadow.

**F.xi)** Other ancient *Sundials* indicated zodiacal months,<sup>137</sup> calendrical months,<sup>138</sup> solstices and equinoxes,<sup>139</sup> and the phases of fixed stars.<sup>140</sup> Occasionally the winds are inscribed around sundials as directional indicators,<sup>141</sup> but none other than that in the *Ara Pacis* seem to have been used to actually predict a wind.

**F.xii)** In *Galen's Commentary on Epidemics I*,<sup>142</sup> there is a discussion of the divisions of the seasons, marked by the solstices, equinoxes and stellar phases, in the context of Galen's discussion of seasonal weather patterns. Insofar as he is talking about longer term weather patterns, rather than the weather on particular days,

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<sup>135</sup> Published by Buchner, 1982.

<sup>136</sup> Pliny, *NH*, XXXVI.72 f.

<sup>137</sup> Gibbs, 1976, # 1068G, 4007, 4010, 7002G.

<sup>138</sup> e.g., Gibbs, 1976, # 1068G, 5021.

<sup>139</sup> Gibbs, 1976, # 1072G, 1074, 1075, 3047, 3050G, 3058G, 3060G, 4001G, 4007, 4008G, 4009, 4010, 5021.

<sup>140</sup> Gibbs, 1976, # 1001 (ΕΩΙΑ ΕΠΙ[ΤΕΛΛΕΙ]), 1073 (κύων έκφανής), 7001G (πλειάδων δύσις χειμῶνος ἀρχή; πλείας έκφανής [θέρ]ρους ἀρχή; κύων έκφανής).

<sup>141</sup> Gibbs, 1976, # 4002G, 4008G, 4009, 4010, 5001.

<sup>142</sup> Galen, vol. XVII.1, p. 1-83.

Galen's work is much more general than the astrometeorological parapegmata.

**F.xiii)** The *Astronomical Ephemerides*<sup>143</sup> seem to have performed some of the functions of the astrological and astronomical parapegmata. Specifically, the Ephemeris of 140,<sup>144</sup> complete for most of August, correlates dates in the Roman calendar with Alexandrian calendar dates, days of the week (Saturdays are marked, the rest presumably interpolated), and the dates of planetary entries into zodiacal signs.

The Ephemeris of 467<sup>145</sup> correlates days of the week (every seventh day, probably Saturday, is marked with a number), Roman dates, Alexandrian dates, lunar days, the moon's zodiacal sign, longitude, the time of the moon's entry into each sign, the sun's longitude, the daily positions of the other planets, as well as a column which informs us whether the particular day is good, bad, or indifferent. Two later ephemerides, *P. Vind. G.* 29370b and 29370 (from 471 and 489, respectively) also include days of the week.<sup>146</sup>

A description of the making of ephemerides in some MSS of Theon's commentary on Ptolemy's *Handy Tables* shows that the ephemerides could sometimes have also included fixed-star astrometeorological predictions like the parapegmata, as well as lunar

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<sup>143</sup> For a general description of ephemerides, see Jones, 1999a, p. 40-42.

<sup>144</sup> Jones, 1994.

<sup>145</sup> Curtis and Robbins, 1935.

<sup>146</sup> See Jones, 1999a, p. 41.



and hebdomadal information. The whole of the description reads as follows:

*On the Making of an Ephemeris:*

At the top and bottom, we leave a larger space so that the top can have the headings of the columns, and the bottom the time of new and full moons for each month; in between these, fifteen rows, making the bottom one larger, such that the (rest) will have two lines each, and the (bottom one) three, since the Roman month often has 31 days. For February, it is necessary to mark only 14.

We make the columns thus: before all of them, a wider one for showing the weather changes of the fixed stars (τὰς ἐπισημασίας τῶν ἀπλανῶν), and the third or fourth from there narrower ones, to hold the months: the first for counting down the Roman month, the second for the Alexandrian month, the third, if one wishes, for the calendar of his own land, and the fourth, for that according to the moon. After these columns, we draw three wider and the fourth narrower, and the heading "First Lunar Motion" is written over them all. In particular, the first (column) is the zodiacal signs, the second the degrees and minutes, the third the times of sign entry, and the fourth the winds. From here there are six<sup>147</sup> columns (the sun and five planets). After this we make a narrow column for holding the Roman month, or whatever one wishes, in order, and after all of these, a wider (column) to hold the general predictions (τὰς καθολικὰς καταρχάς) which must be made, thus writing the configurations of the moon, and the stars, and from these, then, the general predictions.<sup>148</sup>

We see here that an ephemeris could contain both stellar astrometeorology and the days of the moon (ὁ μὴν κατὰ σελήνην). Unfortunately, I know of no extant ephemeris which does so. If they were made, and I think this description good enough reason to suppose they were, then some ephemerides, at least, combined the

<sup>147</sup> The MSS all say "seven," but I have only ever seen six in an ephemeris, and only six are described here.

<sup>148</sup> Published in Curtis and Robbins, 1935, p. 83.

functions of *both* the astrometeorological and astrological parapegmata in one document. They thus can be seen as bringing together two distinct parapegmatic traditions, as well as incorporating catarchic astrological information and predictions.

**F.xiv)** The *Alésia Disk*<sup>149</sup> is a flat bronze disk, 11 cm in diameter found by Espérandieu in 1933. It is not a parapegma, but seems to be a related type of instrument for keeping track of the hebdomadal days. There is a single hole punched through the centre. It shows the images of the hebdomadal deities around the face of the disk, with the tops of their heads pointing outwards. A curious feature is described by Espérandieu as follows: "Les bustes sont limités par un cercle et bourdée extérieurement de triangles, alternativement vides et couverts de traits, d'où se détachent quatre ou cinq petites lignes dont il est malaisé de comprendre la destination."<sup>150</sup> As can be seen from his too-crude drawing, there are four or five lines between each deity (a total of 36), but his description seems to indicate four or five more for each one of these. The 36 lines may be meant to represent sections of the zodiacal circle, but even so, they are probably only decorative. The disk was probably used, as Espérandieu thought, by simply rotating it 1/7 of a turn counterclockwise each day, so that the deity shown at the top was the one presiding over that particular day. Espérandieu also mentions a similar disk in the British

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<sup>149</sup> Espérandieu, 1933.

<sup>150</sup> Espérandieu, 1933, p. 384.

Museum, but he fails to give any details about it. Neither Rehm nor myself have been able to locate this disk.<sup>151</sup>

**F.xv)** The *Dijon Disk*<sup>152</sup> is a bronze disk with the names of the hebdomadal deities inscribed in a circle around it. It was probably used in a similar way to the Alésia disk.

**F.xvi)** A *Byzantine Season List*, of unknown date, is found in a sixteenth-century codex (*C. Berol.* 170) and published in the *CCAG*.<sup>153</sup> It lists the time differences (in days) between various stellar phases, the solstices, equinoxes, and the coming of the west wind (Ζεφύρος). It also gives absolute values for the lengths of the seasons: summer, 94 days; autumn, 90 days; winter, 91 days; and spring, 90 days, for a total of 365.

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<sup>151</sup> See Espérandieu, 1933; Rehm, 'Parapegma', *RE*, col. 1366.

<sup>152</sup> *CIL*, vol. XIII, no. 2869.

<sup>153</sup> Cumont, *CCAG*, VII.162-3.

*G) Dubia*

**G.i)** The Egyptian *Calendar of Lucky and Unlucky Days* has been claimed by Lertz to be astrometeorological,<sup>154</sup> but I disagree. For my argument, see the chapter on *Egyptian Astrometeorology*, below.

**G.ii)** The "*Euctemon Parapegma*"<sup>155</sup> is a modern reconstruction by Rehm of the presumed fourth century B.C. calendar from which later parapegmata are supposed to have excerpted their Euctemon citations. Such reconstructions can be useful, insofar as they allow us to isolate and compare particular groups of observations and predictions, as van der Waerden has done.<sup>156</sup> But we cannot be sure that the text from which the citations were taken looked anything like the reconstruction, nor (and this is a very important point) that it was written in the same calendar, as Rehm and van der Waerden believe.<sup>157</sup> Moreover, if we are to include the "Euctemon Parapegma" as genuine, then we should, to be methodologically consistent, do the same with Democritus, Meton, Callaneus the Indian, etc.

Rehm's attribution to Euctemon of a list of the date-differences between various stellar phases (specifically, the very one found in *C. Vind. Gr. philos.* 108, fol. 282v-283r.)<sup>158</sup> supposes (a) that the *C. Vind.*

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<sup>154</sup> Lertz, 1994.

<sup>155</sup> Rehm, 1913.

<sup>156</sup> Van der Waerden, 1984a.

<sup>157</sup> For my detailed arguments on this, see below, chapter 4.

<sup>158</sup> See Cumont, *CCAG*, VI, p. 13.

list can be attributed to Eudoxus; and (b) that it was written as a list of date differences, rather than having been derived by some later author from some source such as a parapegma.<sup>159</sup> But the correspondence between *C. Vind.* and the attributions to Euctemon in Geminus and Ptolemy, even were they perfect—and they are not—would not prove that Euctemon wrote out a list of date-differences. Such a list could quite simply have been excerpted from something he did write. But I do not think that the correspondence is close enough to warrant a claim of exclusive derivation from Euctemon. There are a great number of entries in *C. Vind.* which have no counterpart in any source we have for Euctemon. Even a quick glance at Rehm's table where he sets Geminus and Ptolemy alongside *C. Vind.*<sup>160</sup> will reveal just how unconvincing the correspondence is between the latter and our known sources for Euctemon. Indeed, of the 40-odd date-differences given in *C. Vind.*, only seven (!) can be lined up exactly with the other sources.

Lastly, van der Waerden's claim that Euctemon's parapegma was modeled on MUL.APIN<sup>161</sup> rests in large part on this attribution of *C. Vind.* to Eudoxus, and is thus precarious.

**G.iii)** Van der Waerden argues that there was a *Parapegma of Dionysius*<sup>162</sup> which was the source for Ptolemy's attributions to 'the

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<sup>159</sup> Rehm, 1913; followed by van der Waerden, 1984a.

<sup>160</sup> Rehm, 1913, p. 14-26; p. 30.

<sup>161</sup> Van der Waerden, 1984a.

<sup>162</sup> See van der Waerden, 1985, p. 99-101.

Egyptians.<sup>163</sup> His claim rests on the very dubious 'argument' that (a) the attributions in Ptolemy must have been taken from a source which used a 365 1/4 day year; (b) the calendar of Dionysius, which did so,<sup>164</sup> was "easier to handle" than that of Callippus; but (c) the Egyptian calendar was "more convenient" than that of Dionysius for the dating of observations; so (d) the calendar of Dionysius was really for dating solstices, equinoxes, and stellar phases and therefore Dionysius was a parapegmata. I should point out that point (a) is just wrong, (b) and (c) unfounded (we know next to nothing about the calendar of Dionysius), and (d) is a non-sequitur. Van der Waerden here, as elsewhere, conflates 'parapegma' with 'calendar.'<sup>165</sup>

**G.iv) The *Pompeii Calendar Medallions***<sup>166</sup> are images of the hebdomadal deities, the months, and the seasons from a room in Pompeii. C. R. Long has argued that there were probably originally also images for the signs of the zodiac, and hence that the room is comparable to the *Thermæ Traiani* parapegma. But there are no peg holes, lunar days, or calendrical dates discernible, so this seems to me to be more of a decoration than a functioning calendar.

**G.v) The *Ostia Hebdomadal Deities***<sup>167</sup> are busts drawn on stone, five of which are extant: the Sun, Moon, and Mars, and on another

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<sup>163</sup> On which, see chapter 8, below.

<sup>164</sup> For this argument, see Böckh, 1863, p. 286 f.; van der Waerden, 1984c. For a description of this calendar and the parapegma tradition, see chapter 4, below.

<sup>165</sup> See chapter 4, below, for a disentanglement of the two.

<sup>166</sup> Long, 1992.

<sup>167</sup> Becatti, 1954, p. 116-7; pl. XXXVIII.3.

fragment, Jupiter and Venus. Meyboom has listed this as a parapegma, since holes appear near the heads of the deities.<sup>168</sup> But, as Becatti pointed out, the holes are rather oddly placed: one below the right ear of the Sun, the next to the right of the Moon's head, one between Jupiter and Venus and a fourth to the right of Venus. Becatti thought they were drilled at some later date, possibly to hold hooks for hanging something on. There are also holes in the bottom of the stone, presumably for mounting the stone on iron posts. I think the strange placement of the holes, "senza riguardo alle figurazioni," as Becatti says,<sup>169</sup> makes this inscription doubtful as a parapegma.

**G.vi)** The *Hoffmann Menologium*<sup>170</sup> is a Latin calendar fragment inscribed clockwise on a bronze disc of approximately one Roman foot in diameter. The fragment is complete from the Ides of July through to just before the Ides of December. *VIII K. OCT* is labeled as *AEQVINOCT[IVM]*. Although the drawing in *CIL* does not reproduce them accurately, Noë claims that there are holes punched around the outside of the disk, one for every other day, which leads me to believe that they are not meant to hold a peg or a pebble as a day marker. Noë's suggestion, quoted in *CIL*, that the menologium was meant to represent the length of the days throughout the year does not seem

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<sup>168</sup> Meyboom, 1978, p. 785.

<sup>169</sup> Becatti, 1954, p. 117.

<sup>170</sup> *CIL*, vol. XIII.2.1, no. 5955.

unreasonable. Degrassi mentions this as a parapegma,<sup>171</sup> but it seems to me to be a different sort of instrument.

**G.vii)** I have chosen to exclude from my list of parapegmata the large number of *images of the hebdomadal deities* which can be found on late antique reliefs and inscriptions, on the grounds that these do not seem to have been used as instruments but rather as decoration. In many cases the publications of these inscriptions leaves much to be desired: details about them are often unclear, and drawings or photographs lacking.<sup>172</sup> This being the case, it would not surprise me if some of them should turn out to be parapegmata, but I shall for the moment err on the side of caution and include as genuine only those of which I am certain.

**G.viii)** The *Dusari Sacrum Monuments*<sup>173</sup> are three apparently related rectangular objects, all bearing the inscription *DVSARI SACRVM*, which were found separately at Puteoli. Dusares was the Latinization of an apparently astral deity (Dushara) of the Nabataeans, who seems to have had a cult near Puteoli. One of the monuments has seven rectangular holes in the top, and the other two have three holes each, into which flat tombstone-shaped tablets were fit.<sup>174</sup> Four of these tablets were found with the largest of the three monuments in the port of Pozzuoli in 1965. Meyboom has argued

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<sup>171</sup> Degrassi, 1963, vol. XIII.2, p. 299.

<sup>172</sup> See, e.g., Witte, 1877.

<sup>173</sup> Meyboom, 1978.

<sup>174</sup> See Meyboom, 1978, pl. CLVII.1.



that the seven-holed monument is a hebdomadal parapegma, and that the three-holed ones constitute half of a zodiacal or monthly parapegma (originally comprising four monuments with three holes each). He thinks the tablets would have functioned as pegs. If this is correct, however, we should probably have expected to find only one tablet and not four. If, as Meyboom also suggests, the tablets originally had images of the hebdomadal deities painted or carved on them, then the whole monument would be simply a representation of those gods without being a parapegma, unless only one tablet at a time was inserted, replaced by the next one on the following day. Again, if this is correct, it is surprising that more than one turned up with the monument.

**G.Ix)** The *Esdud Inscription*<sup>175</sup> is a puzzling little fragment from Palestine, which includes four rectangular holes, 12 cm by 3 cm, each labeled with successive Greek letters. It reads:



The rectangular holes are reminiscent of the Dusari Sacrum monuments, but they are aligned vertically rather than horizontally (□□□), and have letters inscribed above them. I, like Germer-

<sup>175</sup> Germer-Durand, 1901, p. 74.

Durand, am at a loss to explain this puzzling inscription. Clermont-Ganneau speculates that it may have been a gaming board of some sort.<sup>176</sup>

**G.x)** The *Eschenz Object*<sup>177</sup> is a clay artifact from Switzerland with seven holes bored into the top of it, conceivably to receive a peg.

There is no inscription of any kind. Urner-Astholz's theory that it is a hebdomadal parapegma seems possible,<sup>178</sup> but is unconfirmable at present.

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<sup>176</sup> Clermont-Ganneau, 1906, p. 208 f.

<sup>177</sup> Urner-Astholz, 1942.

<sup>178</sup> Urner-Astholz, 1960.

## Chapter Four

# When is Thirty Days Not a Month?

*Mason for a while had presum'd it but a matter  
of confusing dates, which are Names,  
with Days, which are real Things.  
-Thomas Pynchon*

### *Introduction*

In this chapter, I examine some well-entrenched claims about the Greek *paraepgmata*, to show what we can and cannot deduce from the evidence at hand. I am faced with the problem of having to deal with Rehm's prolific, difficult, and problematic work on the *paraepgmata*. Neugebauer dismissed most of Rehm's work with one sentence: "I have never succeeded in separating facts from mere hypotheses in this vast literature."<sup>1</sup> I agree that this is the main problem, largely because I think Rehm himself never disentangled the two. Nonetheless, some of Rehm's claims have had a mysterious longevity, partly due to the endorsement of van der Waerden. These claims will accordingly need to be addressed in somewhat more detail than Neugebauer was willing to give them. I will begin with some general comments on the nature of *paraepgmata* and how they are distinct from calendars, and then proceed to address more specific issues in individual *paraepgmata*.

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<sup>1</sup> Neugebauer, *HAMA*, p. 595, n. 17.

*I: Disentangling Calendars and Parapegmata, Generally*

Parapegmata are not calendars.<sup>2</sup> They track temporal cycles, they tell us when particular events will occur, and they situate them in a rich context of other events. In astrometeorological parapegmata we see what stellar phase and what weather phenomena should be happening now, what ones will happen and when, and what ones have happened in the near (or not-so near) past. Inscriptional parapegmata indicate this with a peg or pegs, while literary ones generally do this by linking the information up to a calendar of some sort. Astrological parapegmata give us combinations of hebdomadal days, lunar days, and occasionally calendrical and nundinal days. And this is one of the things that the Roman inscriptional parapegmata excelled at: keeping track of unrelated cycles. Thus at a glance, a parapegma could reveal where the current day stood in the eight-day nundinal cycle, the seven-day hebdomadal cycle, the 29 or 30-day lunar cycle, and the 365-day calendar cycle.

The Greek inscriptional parapegmata, and the Greek and Roman literary ones, are by comparison rather pedestrian devices. They simply indicate the current day in, as near as we can tell, a 365-day combined astronomical and meteorological cycle, sometimes including calendrical information. We should note that a variety of different calendars are represented in the literary parapegmata: thus

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<sup>2</sup> Although they are frequently called "star calendars" (Evans, 1999, p. 256), "astronomical calendars" (van der Waerden, 1960, 1984a, 1984b, etc.), "Steckkalender" (Brückner, 1931, p. 24; Goessler, 1928, p. 1), "Wetterkalender", "Steinkalender" (Rehm, 1941, p. 5), or just "Kalender" (Rehm, 'Parapegma', *RE*, col. 1295).

Ptolemy uses the Egyptian calendar, and Columella, Pliny and Polemius Silvius use the Julian calendar, to name a few examples.

But the fact that *parapegmata* sometimes incorporate calendars does not mean that they *are* calendars.<sup>3</sup> They may contain calendrical information, but they are not conventions for the dating of events. They are rather tools for keeping track of phenomena (astronomical, meteorological) and cycles (astrometeorological, hebdomadal, nundinal, lunar), and specifically, our current position in those cycles. One type of *parapegma* uses a peg or pegs to indicate the current situation, and another uses a calendar of some sort to do the same thing. Knowing the current date, one can find where in the astrometeorological cycle one currently is. Thus the calendars found in many literary *parapegmata* serve to replace the peg as the indicators of the current day.

There is a common contention that inscriptional Greek *parapegmata* had calendars somehow incorporated into them for dating the astrometeorological phenomena.<sup>4</sup> Typically, the claim is that calendrical dates were inscribed on the pegs. But this is, as I have shown in chapter 2, an unnecessary assumption, since a single peg could mark the current day and no calendar was needed.

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<sup>3</sup> That is, with the exception of the *Guidizzolo Fasti*, which is exactly a calendar and nothing more. It seems to be an anomalous morphological extension of the *parapegma* as a tool for indicating the current day, such that it is used to indicate the current day in the calendrical year. The extant fragment does not contain any extra-calendrical information.

<sup>4</sup> See Rehm, 'Parapegma', *RE*; Neugebauer, *HAMA*, p. 587. For a less specific account of the incorporation of calendars, see Bowen and Goldstein, 1988, p. 52 f.

But many *parapegmata* are concerned with astronomical phenomena—the stellar phases—which are closely tied to the annual motion of the sun. It is exactly this annual motion of the sun which Greek civil calendars were unable to keep good track of. And I think that it is no accident that we find pegged astronomical and astrometeorological *parapegmata* almost exclusively in Greece.<sup>5</sup> The late republican and early imperial Romans, whose calendar kept much better track of the solar year (but was useless for lunar cycles), largely used their pegged *parapegmata* to keep track of lunar and other phenomena. Thus these *parapegmata* can be seen as extra-calendrical devices used for keeping track of non-calendrical cycles.

The appearance of calendrical information in literary *parapegmata* does not contradict this point. The calendar simply takes the place of the peg for referencing the current and future situation relative to the current date.

*I.i: On the Alleged Zodiacal Months of the Early Parapegmatists*

Rehm argues that Euctemon and Callippus divided the year up into zodiacal months,<sup>6</sup> and this claim has been accepted by most

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<sup>5</sup> The exception being the Puteoli *Parapegma*, inscribed in Latin, but which nonetheless hails from a city with a significant Greek population.

<sup>6</sup> Van der Waerden goes farther than this to claim that Euctemon was "scientific" since he did "not give his twelve parts of the year the name 'months'." (van der Waerden, 1984a, p. 113) But this is a ridiculous claim, since, even if Euctemon *did* divide the year as Rehm thinks (and I do not think he did), we have absolutely no way of knowing what he may or may not have called them. Nor do I see why the name 'month' should be unscientific.

subsequent writers on the subject.<sup>7</sup> He claims that Euctemon's months, beginning with Cancer, have the following numbers of days: 30, 30, 30, 30, 30, 30, 30, 30, 31, 31, 31, 31, 31.<sup>8</sup> Van der Waerden thought that this made Euctemon's scheme look similar to a Babylonian System A-type function,<sup>9</sup> where the sun moves at one speed over one part of the zodiac, and at another speed over a different part. Van der Waerden uses this reconstruction to derive a Ptolemaic-type eccentric solar model which he ascribes to Euctemon. But, I will argue, there are good reasons for dismissing Rehm's (and with it van der Waerden's) account.

Rehm's argument begins by noting that different season lengths are attributed to Euctemon in the *Geminus Parapegma* and in the *Eudoxus Papyrus*. In *Geminus*, beginning with summer, Rehm counts the lengths as: <92>, 89, 89, and 95 days. In the *Eudoxus Papyrus* we are told Euctemon's seasons are 90, 90, 92, and <93> days. Now, Rehm's restored season lengths correspond only with the latter set, so he needs to dismiss the former as incorrect. He does this by arguing (following Böckh)<sup>10</sup> that the *Geminus Parapegma* was using a Callippian zodiacal division, and goes on to hypothesize that its author simply copied Euctemon's alleged zodiacal-calendar dates

<sup>7</sup> See, e.g., van der Waerden, 1984a; Bowen and Goldstein, 1988, p. 53 f. But Toomer, 1974 sensibly disagrees.

<sup>8</sup> Rehm, 1913, p. 8 f.; Rehm, 1941, p. 14 f.

<sup>9</sup> Van der Waerden, 1984, p. 104; followed by Bowen and Goldstein, 1988, p. 59 f. 'System A' is one of the two ways of modeling solar velocity in Babylonian astronomy. It assumes that the sun moves at one speed (30' per mean synodic month) over one part of the zodiac (from 13° of Scorpio to 27° of Pisces) and at a different speed (28° 7' 30" per mean synodic month) over the remainder of the zodiac. See Neugebauer, *HAMA*, p. 371, f.; Neugebauer, *ACT*.

<sup>10</sup> Böckh, 1863, p. 22 f.

into his own zodiacal calendar, but without preserving Euctemon's season or sign lengths. Thus Euctemon's Cancer 1 or Virgo 5 became Geminus' Cancer 1 or Virgo 5. He ignores the problem posed by the attribution to Euctemon which turns up in the Geminus Parapegma at Taurus 32, an impossible date on Rehm's reconstruction, since Euctemon's Taurus is supposed to have had only 31 days. Pritchett and van der Waerden<sup>11</sup> likewise pass over this problem without comment, and their translation of the Euctemon Parapegma even goes so far as to delete the attribution to Euctemon (the acronychal rising of Sagitta) at Geminus' Taurus 30 to make room to move Geminus' Taurus 31 to their Taurus 30, and Geminus' Taurus 32 to their Taurus 31, as follows:

Geminus:	Pritchett and van der Waerden:
[Taurus] 25: Capella sets in the evening. <sup>12</sup>	[Taurus 25]: Vespertinal setting of Capella.
30: Sagitta rises in the evening.	30: Vespertinal rising of Aquila
31: Aquila rises in the evening.	31: Setting of Arcturus. Sign of weather.
32: Arcturus sets, there is a change in the weather.	—

In addition to this inexplicable Taurus 32, Rehm has failed to prove that Euctemon must have divided his seasons up into zodiacal months in the first place. Even if we were to grant him that the season lengths as found in the Eudoxus Papyrus are the correct ones, there is no reason to assume that Euctemon used the sun's passage

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<sup>11</sup> Pritchett and van der Waerden, 1961.

<sup>12</sup> I omit "according to Euctemon" in all the Geminus entries, to keep the rows parallel.



through the zodiacal signs to divide those seasons into twelve solar months. Moreover, the particular month lengths given by Rehm are essentially pulled out of a hat.

Likewise, Rehm's claim that Callippus must have used zodiacal months, though generally accepted,<sup>13</sup> is unfounded. He attributes the following sign lengths to Callippus, beginning with Cancer: 31, 31, 30, 30, 30, 29, 30, 30, 30, 31, 31, and 32 days. This is based on the report in the Eudoxus Papyrus that Callippus had season lengths of <94,> 92, 89, and 90 days, combined with Rehm's assumption that the signs should (a) have an integer number of days, and (b) show a smooth and symmetrical ascent and descent between a maximum and minimum sign length.

This is also closely tied to his reconstruction of the ancient Roman *Bauernkalender*.<sup>14</sup> This 'rustic calendar' was originally a hypothesis offered by T. Mommsen to account for the appearance of Greek astronomical conventions in Columella, such as the fixing of the vernal equinox at Aries 8°. <sup>15</sup> Mommsen's argument assumes an archaic Roman lunar calendar, and tries to account for the stellar phases in the Roman agricultural works and the zodiacal signs in the *menologia rustica* by assuming an archaic 'farmer's calendar' which used the stellar phases as signposts in the solar year. I agree that stellar phases were probably so used in the agricultural tradition, but

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<sup>13</sup> See van der Waerden, 1984a; Bowen and Goldstein, 1988.

<sup>14</sup> See Rehm, 1941, p. 43 f.; Rehm, 'Parapegma', *RE*, col. 1347 f.; Rehm, 1927.

<sup>15</sup> Columella attributes this to Eudoxus, Meton, and the ancients (Columella, *RR*, IX.14.12); See Mommsen, 1859, p. 54 f.; see also Neugebauer, *HAMA*, p. 596; Bowen and Goldstein, 1988, p. 61.

I would not call this a 'calendar'; nor do I accept the existence of an archaic Roman lunar calendar.<sup>16</sup> Lastly, there is no reason to assume the particular data that the *Bauernkalender* is accounting for need to have been preserved by Roman farmers rather than being lifted out of the same (Greek) texts by Columella and Clodius Tuscus, and others.<sup>17</sup>

Rehm, building supposition upon supposition, actually reconstructs (I should say *constructs*) some of the features of this supposed lost calendar, and then goes on to attribute parts of it specifically to Callippus. Van der Waerden, as usual, followed Rehm, but Neugebauer had the good sense to be sceptical.<sup>18</sup> The most we can say with certainty is that: (1) Some (but not all) entries in Columella, Clodius Tuscus, and in Ptolemy's attributions to Cæsar and the Egyptians are similar,<sup>19</sup> (2) according to the Eudoxus Papyrus, Callippus had season lengths of <94,> 92, 89, and 90 days,<sup>20</sup> and (3) there seems to have been a large and diverse set of rules of thumb used by Roman (as by modern) farmers.<sup>21</sup> But point (3) probably has very little to do with point (2). As for point (1), although it shows that these authors had access to the same sources, it does not demonstrate that this source was Roman.

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<sup>16</sup> For my arguments on this, see chapter 6, below.

<sup>17</sup> As Wenskus, 1998, p. 254, has argued.

<sup>18</sup> Neugebauer, *HAMA*, p. 595-98.

<sup>19</sup> See the chart in Rehm, 1941, p. 106-8.

<sup>20</sup> Letronne reconstructs the first number as 95 rather than 94, but is (I think sensibly) refuted by Böckh, 1863, p. 24.

<sup>21</sup> See above, chapter 5.

*I.ii: On the Alleged Greek Four-Year Solar Cycle*

Pliny tells us that Eudoxus thought there was a four-year weather cycle, and that the cycle began in an intercalary year (*intercalario anno*) at the rising of Sirius.<sup>22</sup> This statement leads Böckh to conclude that Eudoxus must have composed a four-year *parapegma* with a leap day added every fourth year after the seventh day of Cancer, and that this leap day was called the 'second seventh'.<sup>23</sup> But this assumes that an 'intercalary year' was, for Eudoxus, one in which an extra day was added to make a 366-day year, as in the Julian Calendar.<sup>24</sup> This assumption is contradicted by the evidence from the Eudoxus Papyrus, which shows that, for Eudoxus, years were counted as 'Egyptian years,' each of 365 days.<sup>25</sup> I would further counter that Eudoxus is otherwise not known for having composed a solar calendar, but we *do* know that Eudoxus composed an *Octaeteris*, an eight-year luni-solar cycle which used intercalated lunar *months* (not days!)]<sup>26</sup> and so this would be the more natural interpretation of 'intercalary' in this passage. This reading finds further confirmation in Pliny *NH* XVIII<sup>27</sup> where he again mentions a four-year weather

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<sup>22</sup> Pliny, *NH*, II, 130.

<sup>23</sup> Böckh, 1863, p. 124 f. Böckh's reconstruction of Eudoxus' four-year solar-calendar intercalation cycle is very speculative, and I have serious doubts about it. His assertion that it probably came from a Pharaonic Egyptian tradition is simply wrong (Böckh, 1863, p. 254, f.).

<sup>24</sup> Indeed, Rehm sees this as the direct predecessor of the Julian Calendar. See Rehm, 1927; Kroll, 1930 traces it back to a Babylonian dodecaeteris, as does Boll, *Dodecaeteris*. I know of no evidence for such a cycle.

<sup>25</sup> See Neugebauer, *HAMA*, p. 620.

<sup>26</sup> Geminus, p. 110 f.; Blass, 1997.

<sup>27</sup> Pliny, *NH*, XVIII, 217

cycle (this time unattributed) as somehow part of an eight year lunar cycle. He is, however, very short on details. In any case, I do not think either passage sufficient evidence to ascribe a four-year *parapegma* (complete with leap-day) to Eudoxus: one can state that the weather is cyclical without having catalogued the entire cycle in a *parapegma*, nor does a four-year weather cycle necessarily entail a four-year Julian-type calendrical cycle.

*I.iii: On the Alleged Zodiacal Calendar in Geminus and Miletus I*

I noted above my scepticism that Euctemon and Callippus used a zodiacal calendar, and my disbelief that this zodiacal calendar was tied to a four-year solar-calendar cycle, but now I will go one step further to make the following claim: the zodiacal days in Geminus and the zodiacal signs in Miletus I do not represent zodiacal calendars either.

There is a vague sense in which a 'calendar' is any way of dividing time or temporal events, but really we should reserve the use of this word for those which are used for the dating of events over multiple years. Such were the various Greek civil calendars, the Egyptian calendar, the Julian and pre-Julian Roman calendars, the Dionysian calendar, and the Babylonian lunar calendar. Now the question is, was the so-called 'zodiacal calendar' so used?

Certainly we can say that there existed at least one zodiacal calendar in antiquity: the Dionysian calendar divided the year into months whose names were derived from the signs of the zodiac.

Böckh shows that this calendar had an epoch at the summer solstice of 285 B.C. From here, he goes on to reconstruct the calendar itself such that it had 12 months of 30 days each with five epagomenal days at the end, or six every fourth year, as in the Alexandrian calendar.<sup>28</sup> But in order to do this, he needs to emend two of the Dionysian dates.<sup>29</sup> Other reconstructions are equally possible, depending on how the observations reported by Ptolemy are handled.<sup>30</sup> But, to the best of my knowledge, it is not possible to reconcile the month lengths of the Geminus Parapegma with any of the proposed reconstructions. Most importantly, the Geminus sign names are not the same as the Dionysian month names (e.g., Geminus has 'Υδροχόος where Dionysius has 'Υδρῶν).<sup>31</sup> Thus it looks as if the Geminus zodiacal days are not written in the Dionysian calendar. Miletus I, on the other hand, is too fragmentary to be certain about the lengths of most signs,<sup>32</sup> but again the sign names are different from the Dionysian month names: as in Geminus, we find 'Υδροχόος instead of 'Υδρῶν. Moreover Miletus I has some actual calendrical dates preserved in its introductory inscription, and these are in the Egyptian and Athenian calendars, not the Dionysian. This would indicate that these two calendars were

<sup>28</sup> See Böckh, 1863, p. 286-340; see also van der Waerden, 1984c; Samuel, 1972, p. 50-51; Neugebauer, *HAMA*, p. 1066-7.

<sup>29</sup> One of which has been vindicated by a MS not known to him.

<sup>30</sup> On the problems with these observations, see Swerdlow, 1989.

<sup>31</sup> Compare Geminus, p. 224, l. 17 with Ptolemy, *Alm.* IX, 7, p. 169. Goldstein and Bowen, 1991, p. 123, make the improbable claim that 'Υδρῶν is derived from the constellation Hydra, and Αἴγων from Capella (Αἴξ), rather than from the zodiacal signs.

<sup>32</sup> The most we can say is that there are 30 peg-holes in Aquarius.

recognizable to the intended readers of the parapegma, and the lack of Dionysian dates makes it unlikely that the zodiacal divisions later in the parapegma are Dionysian calendar months. But other than the Dionysian, no attested Greek calendar was zodiacal. Even the Dionysian is very rare, being preserved only in a handful of references from Ptolemy's *Almagest*.

Now looking at Miletus I, we should first note that, unlike the Geminus Parapegma, it is not divided into zodiacal days, but into zodiacal signs.<sup>33</sup> And this is no small difference. If we look at how Miletus I was to be used, we see that a peg would have sat beside the current day, and been moved each day to the next hole such that each day's astronomical situation could be easily read off. One of the pieces of astronomical information was the sun's entry into the successive zodiacal signs. The entry beside the peg hole reads: "The sun is in Aquarius,"<sup>34</sup> The days following that entry are not numbered, and so were probably not meant to be counted as dates are. Miletus I thus does not use a zodiacal calendar. Rather, it includes, among the other astronomical phenomena which it was used to keep track of, the sun's entry into the twelve signs. Indeed, Ptolemy, in the introduction to the *Phaseis*, tells us that the sun's entry into the different signs was astrometeorologically significant (he actually says that it is one of the causes of changes in the weather).<sup>35</sup>

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<sup>33</sup> To see this, one needs to ignore the day numbers added by Diels and Rehm in their publication of it.

<sup>34</sup> Diels and Rehm, 1904, p. 104.

<sup>35</sup> Ptolemy, *Phas.*, p. 11, l. 15, f. Curiously, though, Ptolemy does not list the sun's entry into the various signs in the parapegma itself. The other supplemental causes which he mentions (the planets and the quarter and full moons) do not get reported in the parapegma, but this should not be surprising, since they

But what about Geminus? It is quite clear that the astrometeorological information is being indexed according to zodiacal days. But does this imply a zodiacal calendar? If so, it is only in a very weak sense. Certainly the zodiacal signs and days sit exactly where we should expect a calendar to be in a literary *parapegma*. But since there is no attested zodiacal calendar which seems to fit the Geminus *parapegma*, I am tempted to think that its layout merely implies that its users would need to have a modicum of astronomical knowledge, specifically: knowing what sign the sun is in and how long it has been there. Looking at the regular formula by which the signs are introduced: "The sun traverses Cancer in 31 days. On the first day..." seems also to indicate that the signs were seen as astronomical rather than calendrical divisions.

This is a fine differentiation, but I think the distinction is an important one: if we call the zodiacal days in Geminus a zodiacal calendar, then we must presume that someone else besides Geminus (probably some astronomers somewhere, given the nature of the thing), actually used this calendar to mark time and to date events in. Since this is otherwise unattested, I choose rather to interpret the formulæ at the beginnings of the signs literally, and see the zodiacal days simply as 'counters' from one known astronomical event to the next. This known astronomical event can thus be seen to *calibrate* the *parapegma*, and so to render it independent of the vagaries of whatever local calendar was in use.

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would vary so much from year to year. A lunar eclipse does get mentioned in Clodius Tuscus, however.

## *II: Calibration*

Thinking of the zodiacal days as 'counters' necessitates, as I have said, that there be some astronomical event (or events), which was either observed or dated, and which was used to calibrate the parapegma, that is: to synchronize it with the tropical or sidereal year. But what could this known astronomical event be? Would the users of the Geminus Parapegma have needed some external way of knowing when the sun moved into each sign? This would require that the external source in question used the same season and sign lengths as Geminus, which is no small qualification considering the multitude of available options. Another, simpler, possibility is that the users of the Geminus Parapegma needed only an external way of knowing when the summer solstice, the first day of the parapegma, occurred. From there, a simple count or a correspondence with whatever the reader's local calendar was, would situate the reader in the parapegma for the rest of the year. This synchronization with the solstice would calibrate the parapegma for the year.

This means that for users of any calendar at all there would have been a calibration mechanism where each year the parapegma would be re-aligned with the solstice. But this raises a question: how does a Greek know when the summer solstice occurs?



*II.i: How Does a Greek Know When the Summer Solstice Occurs?*

It has been long assumed that observing a solstice is astronomically a fairly simple matter, and that Meton did just that in 432 B.C. in Athens using some sort of sundial or gnomon.<sup>36</sup> But Bowen and Goldstein have argued that Meton could simply have defined some date as the summer solstice using an Uruk-type lunar calendar scheme, a proposal which seems a plausible alternative to the standard view.<sup>37</sup> The Uruk scheme is a Babylonian convention for schematically determining the dates of solstices, equinoxes, and the phases of Sirius in a 19-year lunar calendar cycle. It is attested from the early fourth century B.C.<sup>38</sup> There is evidence of a 19-year Babylonian calendar cycle predating this by about a century, but it is unclear whether it is simply a calendrical intercalation cycle or if it could have included schematic solstice dates, as in the Uruk scheme. Bowen and Goldstein have argued for the latter possibility, and called this a 'precursor' to the Uruk scheme. Besides Bowen and Goldstein's argument, there is no solid evidence for the adoption of an Uruk-type scheme in Greece. But the possibility that the Metonic 19-year cycle was influenced by contemporary Babylonian calendrics is tempting, especially considering (1) the identical number of years in the two

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<sup>36</sup> See Kubitschek, 1893; Rehm, 'Parapegma', *RE*; Toomer, 1974.

<sup>37</sup> They do still think Meton observed the sun on that day, however, but only to determine its position on the horizon for town-planning purposes, a conclusion I am highly sceptical of. (Bowen and Goldstein, 1988, p 73 f.)

<sup>38</sup> Following Neugebauer and Sachs' dating. See Neugebauer, *HAMA*, p. 358, 362 f.; Sachs, 1952, p. 106.

cycles, and (2) the prominence of the summer solstice in both the Uruk and Metonic cycles.<sup>39</sup>

Bowen and Goldstein have not, I should note, eliminated the possibility of actual observation. Solstice observation is not particularly difficult.<sup>40</sup> Meton's observation of one may be remarkable (since no other solstice is known to have been observed in Greece until 280 B.C.) but *someone* had to be the first, and if we discount Meton, then Aristarchus' observation in 280 B.C. becomes suspect for the same reasons as Meton's, and we get a kind of vicious circle.

But even if we cannot be sure whether or not Meton observed a solstice, we do have other information about what he was doing on the Pnyx on the day of the solstice in 432. Diodorus Siculus tells us<sup>41</sup> that he publicly inaugurated his 19-year cycle on Skirophorion 13 in 432 B.C., the very day Ptolemy has him observing a solstice.<sup>42</sup> If we believe Ptolemy that this date *was* a solstice, whether observed, as the standard view has it, or schematically defined, as Bowen and

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<sup>39</sup> Note that Hunger and Pingree, 1999, p. 199-200, have argued that "any observation-based or computation-based method of guaranteeing that, say, the vernal equinox always falls in a synodic month bearing a particular name will necessarily, if successful, involve the intercalation of seven synodic months in nineteen years." While this is true, the coincidence of the emergence of such a method in Babylon, followed shortly thereafter in Greece (if indeed this is what the Metonic cycle is) points to the possibility that this method, or at least the *idea* of such a method, was borrowed by Meton.

<sup>40</sup> As A. Jones has pointed out to me, observing shadow lengths or sunrise/set points over several days around the solstice will give a few days where there is little or no apparent change. Taking the halfway point of this will give a solstice date accurate to half a day. Looking at both the sunrise *and* the sunset points, will give a date accurate to a quarter day.

<sup>41</sup> Diodorus Siculus, 12.36.1 f.

<sup>42</sup> Ptolemy dates it in the Egyptian calendar, Phamenoth 21 (*Almagest*, p. 205-6), but Miletus I equates this date with Skirophorion 13 for the year 432.

Goldstein contend, then we can combine this with the Diodorus report to argue that Meton's 19-year cycle began with a summer solstice.

Now, if Bowen and Goldstein are correct that Meton's 19-year cycle was an Uruk-type scheme for defining the dates of solstices, equinoxes, and possibly some stellar phases, then we can see how it would be a useful tool for calibrating an annual astrometeorological cycle. Whether or not that cycle was written up as a *parapegma* is, I think, not determinable on the current evidence.

I say this simply because we cannot say with certainty that every astrometeorologist is necessarily the author of a *parapegma*,<sup>43</sup> nor can he be assumed to be the author of a calendar or a calendrical cycle (although some certainly are). Conversely, authors of calendars are not necessarily the authors of *parapegmata*. This needs to be kept in mind when reading a great deal of the modern literature, which regularly confuses 'parapegma' with 'calendar' and 'astrometeorologist' with 'parapegmatist'.<sup>44</sup>

But to return to the point at hand: when we say Uruk-type scheme, how flexible are we willing to be? How much does Meton's scheme need to look like the Uruk scheme? We obviously cannot be certain that Meton set up an inscription with a list of dates for solstices in a lunar-calendar cycle. This does, nonetheless, seem like at least a good possibility. In any case, he did make his 19-year cycle

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<sup>43</sup> See my comments on the *Parapegma* of Euctemon in chapter 3, above.

<sup>44</sup> See, e.g., van der Waerden, 1984a; van der Waerden, 1984c; Rehm, 'Parapegma', *RE*; Rehm, 1913; Rehm, 1941.

public on or about the date of the solstice in 432 B.C., and he did do something which saw his name cited in later *parapegmata*. Whether he necessarily wrote a *parapegma* as such, we do not know.

Van der Waerden's argument<sup>45</sup> that Euctemon's 19-year cycle derived from the Uruk scheme is circular. It is based on the unfounded assumption that Euctemon, copying the Uruk scheme, divided months into *tithis*<sup>46</sup> rather than days. The similarities to the Uruk scheme which van der Waerden finds in Euctemon's cycle are then seen as evidence that Euctemon was copying the Uruk scheme.

While the question of whether Meton or Euctemon did schematically define solstice dates in a 19-year cycle must remain open, we do concede at least the possibility that they did so. On the other hand, we should not rule out the possibility that solstices were meant to be observed. In any case, either the schematic dating or the actual observation of a solstice would be sufficient to calibrate a *parapegma*, by the time there were *parapegmata* to be calibrated.

### *II.ii: Self-Calibration in the Four-Year Julian Calendar Cycle*

Although there is no evidence for a Greek four-year solar cycle, there is no denying a Roman one. After the calendar reform of Julius Cæsar, every third or fourth year contained 366 days.<sup>47</sup> But the post-

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<sup>45</sup> Van der Waerden, 1984a, p. 113 f.

<sup>46</sup> The *tithi* is equal to 1/30 of a month. It is thus slightly shorter than a day. It is an abstract unit used only to simplify certain astronomical calculations.

<sup>47</sup> For the first few years, the admonition to add a day "every fourth year" was interpreted, through the peculiar Roman counting system ("first, second, third, fourth (which is first), second third, fourth (which is first), second, ...), to mean that there was an intercalary year (I), then two normal years (N), then an

Julian astrometeorological *parapegmata* (all of which are literary) have only 365 days. One wonders then what these *parapegmatists* did in leap years, and how they moved their stellar phases and weather predictions around to fit them to the intercalary 366-day years. Only the Coligny Calendar shows any evidence of keeping track of anything longer than a one-year cycle, and in that case it is a lunar calendar, not a solar one. No *parapegma* contains an entry for a leap day.

We have, as I see it, several options to choose from: (1) the post-Julian *parapegmatists* simply ignored leap years, and were content to let the leap-day pass without astrometeorological comment; (2) every *parapegma* was written only for a particular year, and all the ones preserved just happen to be from non-leap years; (3) there was some rule of thumb for dealing with the leap-years, of which we are not aware; or (4) the *parapegma* was periodically calibrated to the solar year. I think we can rule out (2), since there is never any indication of what particular year any *parapegma* was written for.<sup>48</sup> As for (3) and (4), we need to ask whether they would be necessary in the case of the Julian calendar. Certainly, the Julian calendar was meant to self-calibrate with the solar year,<sup>49</sup> and so any *parapegma* linked to it should stay synchronized in perpetuity, without need for calibration. The same is true for the Alexandrian calendar, which Ptolemy used. Thus (3) and (4) are reducible to (1),

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Intercalary year, as follows: I-N-N-I-N-N-I..., rather than I-N-N-N-I-N-N-N-I... This was only sorted out and corrected in 8 B.C.

<sup>48</sup> With the possible exception of Clodius Tuscus, on which, see chapter 3, above.

<sup>49</sup> The fact that it did not at first do so is unimportant here. All that matters is that it was *meant* to do so.

the ignoring of the leap day, and since the ignoring of the leap day should have posed no special problems, we can say that post-Julian *paraepgmata*, all of which were literary, were probably meant to be self-calibrating. Indeed, Ptolemy specifically justifies his choice of the Alexandrian calendar based on the fact that it keeps the phases for the most part on the same dates year after year.<sup>50</sup>

### *III: What Sorts of Sources Could the Paraepgmatic Attributions Be Taken From?*

I have said repeatedly that we cannot be certain that the attributions in the astrometeorological *paraepgmata* were taken from earlier *paraepgmata*. They may well have been cobbled together from very different sources. When it comes to reconstructing or even imagining the original sources that the *paraepgmatic* attributions are taken from, we are faced with some problems. The first is that it has so far proven impossible to reconcile the attributed phases and their *sequentia* in Geminus with those in Ptolemy to any satisfying degree. Although we occasionally see what look like identical meteorological quotations on similar dates, (either when counted from the summer solstice or reduced to Julian dates),<sup>51</sup> the overwhelming majority of cases show very poor correspondence, if any. Ptolemy includes

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<sup>50</sup> Ptolemy, *Phas.*, p. 10, l. 5 f. Like all the other *paraepgmatists*, he seems to ignore the precession of the equinoxes, which would have caused the solstices and equinoxes to slip slowly relative to the stellar phases.

<sup>51</sup> For example, compare Ptolemy's (P) Phaophi 5 to Geminus (G) Libra 6; Likewise: P Phaophi 27 = G Libra 30, P Mechir 28 = G Pisces 2; P Phamenoth 8 = G Pisces 12; P Epeiph 29 = G Cancer 28.

attributions to Meton, Euctemon, Callippus, and Dositheus (to name a few) that have no counterpart in Geminus, and vice versa.

Bowen and Goldstein argue<sup>52</sup> that there may have been some problems of translation of star names from the time of the early astrometeorologists to the time of the attributive *parapegmata*. But this should not present a problem if the original sources of the attributions looked substantially like the later *parapegmata*. It would, however be a problem if the original sources lacked calendrical and date-differential information, so that obscure star-names could not be figured out from their rising-times relative to known stars.

But even if the astral vocabulary was similar or well understood, it is still possible to see how incompatible dates and attributions could have found their way in to the different sources. One possibility is that the attributions were taken from a number of different sources. Euctemon, for example, seems to have included stellar phases in his *Phænomena*, but he could well have mentioned others in some other works, along with a smattering of astrometeorological information here and there. Not all his works need to have been in perfect agreement, and so we can imagine a Geminus or a Ptolemy trying to collect as much of this material as he could, but either incorporating it into his individual schema differently, or stressing different bits of it, or even having access to different works or conflicting versions of the same work. This is not

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<sup>52</sup> Bowen and Goldstein, 1988, p. 56-7.

even to mention the possibility of mistaken attribution or falsification, as in the *Ars Eudoxica*.<sup>53</sup>

We are told by Aelian that Meton set up stelæ inscribed with the 'turnings of the sun,'<sup>54</sup> which Pritchett and van der Waerden interpret as full-blown *parapegmata*. But the stelæ could easily have been something as basic as a list of season lengths, or even something like an Uruk-scheme. This, combined with a simple list of phases and their dates or day-differences (what I call their *order*), would provide enough raw material to translate a set of phases into a later *parapegma*.<sup>55</sup> It would also provide enough material for a later *parapegmatist* to write an attributive entry like "(on day *y*): phase *x*, according to *z*." Moreover, any astrometeorological information need not have been attached to the source for the ordered phases, but could have been culled from other sources, and they may have been quite vague, indeed. I offer this simply as an extreme-case possibility to illustrate how cautious we need to be in speculating about the nature of the sources of the attributive *parapegmata*. I see it as a counter-balance for the other extreme case, that of Rehm, which maintains that the earlier astrometeorologists wrote *parapegmata* which looked substantially like the much later preserved ones.

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<sup>53</sup> See Neugebauer, *HAMA*, p. 687 f.

<sup>54</sup> Aelian, *Var. hist.*, 10.7.

<sup>55</sup> But this list of ordered phases need not, of course, have been inscribed on the same stela.



#### *IV: Luni-solar Cycles*

I said above that some of the *parapegmata* preserve astrometeorological attributions from Greeks who are also believed to have composed luni-solar cycles of one sort or another. This is the case with Meton, Euctemon, Eudoxus, Philip, Callippus, Dositheus, Hipparchus, and possibly (though doubtfully) Democritus.<sup>56</sup> I will argue that in all of these cases, the lunar cycles are correlated with astrometeorological cycles. This should not be surprising, since any attempt to reconcile the lunar months with the solar year would synchronize the lunar calendar with either (a) the solstices and equinoxes or (b) the phases of the fixed stars, or (c) both sets of phenomena.<sup>57</sup> But since both (a) and (b) were closely connected to meteorology from the time of the earliest Greek records, then any luni-solar cycle would have immediate meteorological consequences for a Greek writer.

#### *IV.i: The Metonic Cycle*

I have argued for the possibility that the 19-year Metonic cycle may have been a calendrical system for schematically dating solstices and

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<sup>56</sup> On Censorinus' attribution of a luni-solar cycle to Democritus, see Neugebauer, *HAMA*, p. 619-20.

<sup>57</sup> Before the discovery of precession by Hipparchus in the second century B.C., (c) would have been seen as an exact correlation. Afterwards (a) would be seen to slip slowly away from (b) at a rate only barely perceptible over a single lifetime.

equinoxes. Of course, this is speculative, and it rests on the underlying assumption of an unattested calendar of some sort in which the solstices and equinoxes were so dated. The most we can say with reasonable certainty about his cycle<sup>58</sup> is that it equated 19 years with 235 months and 6940 days,<sup>59</sup> that this relationship would give a year length of  $365 \frac{5}{19}$  d,<sup>60</sup> and that he inaugurated this cycle on Skirophorion 13, in the archonship of Apseudes (= June 27, 432 B.C.), the same day he is supposed to have observed the summer solstice. The description of the Metonic cycle in Geminus seems to indicate that it was used to determine a sequence of *full* (30-day) and *hollow* (29-day) months which would repeat after 19 years.<sup>61</sup> Diodorus indicates that the Metonic cycle was found to be in agreement with the cycle of the motions of the stars and their attendant changes in the weather, and he seems to imply that Meton wrote on this subject. He says:

In Athens, Meton, the son of Pausanius, (who is) renowned for astronomy, set out what is called the 19-year cycle, starting it on the 13th of the Athenian month Skirophorion. In that number of years the stars

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<sup>58</sup> This cycle is also attributed to "Meton and Euctemon" (Ptolemy, *Alm.* III.1; Theodosius, *De diebus* II, 18), and to οἱ περὶ Εὐκτῆμονα καὶ Φίλιππον καὶ Κάλλιππον (Geminus, p. 120).

<sup>59</sup> 19 years was equated with 235 months in the Babylonian calendar from 490 B.C. onwards.

<sup>60</sup> It is unclear whether the year length was a by-product of the equation of days to months to years, or vice versa. The same is true of the Callippic modification of this cycle, on which, see below.

<sup>61</sup> The reliability of the details of Geminus' account, i.e., exactly *how* the full and hollow months were determined, has been questioned by Neugebauer, *HAMA*, p. 617; Bowen and Goldstein, 1988, p. 43 n. 27. Jones, 2000, p. 152, f., sees it as less problematic. Van der Waerden's interpretation of this passage is extremely strained (van der Waerden, 1984b, p. 121 f.).

make a return and they complete a kind of great year.<sup>62</sup> Because of this, it is called by some the *year of Meton*. And it seems that this man was wondrously successful in this prediction and forecast,<sup>63</sup> for the stars make both their motion and their changes in the weather in agreement with what he wrote.<sup>64</sup> Thus the majority of the Greeks down to our own time use his 19-year cycle and are not misled from the truth.<sup>65</sup>

We can, I think, conclude from this that the 19-year cycle was meant to correlate lunar and astrometeorological cycles in some way, as I have argued above.

It has been long assumed that the Metonic cycle had something to do with the setting up of a *parapegma*.<sup>66</sup> As I have shown, however, there is good reason to be sceptical of whether Meton or any of the other early Greek astrometeorologists actually composed what we would recognize as a *parapegma*.

I have already remarked on the similarities of the Metonic cycle with the Babylonian 19-year calendar cycle, and I should perhaps say a few words on the differences. Unlike the Metonic, the Babylonian cycle is not concerned with the exact sequence of full and hollow months. In the Babylonian calendar the beginning of the month was always determined by the observation of the new moon, and so their 19-year cycle always allowed for any particular month to be determined as either hollow or full. The Metonic cycle by contrast,

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<sup>62</sup> τὰ ἄστρα τὴν ἀποκατάστασιν ποιεῖται καὶ καθάπερ ἑνιαυτοῦ τινος μεγάλου τὸν ἀνακυκλισμὸν λαμβάνει. I assume by this that he means a return to the same lunar calendar day. Of course, Diodorus may just mean that the cycle comes around after 19 years and repeats itself.

<sup>63</sup> ἐν τῇ προρρήσει καὶ προγραφῇ ταύτῃ...

<sup>64</sup> τὰ γὰρ ἄστρα τὴν τε κίνησιν καὶ τὰς ἐπισημασίας ποιεῖται συμφώνως τῇ γραφῇ.

<sup>65</sup> Diodorus Siculus, XII.36.2.

<sup>66</sup> See Heath, 1913; Rehm, 1941, p. 7 f.; Kubitschek, 1893; van der Waerden, 1960; Toomer, 1974; Neugebauer, *HAMA*, p. 622; Bowen and Goldstein, 1988.

seems to have prescribed the order of hollow and full months. The real purpose of the Babylonian cycle was to prescribe when intercalary months would be inserted over the course of 19 years, in order to keep the Babylonian months in line with the solar year. It had the effect that the summer solstice was almost always in the same month from year to year. Geminus tells us that the Metonic 19-year cycle contained 7 intercalary months, which happens to be the same number as the Babylonian system.<sup>67</sup> But there are no dates preserved which are expressly in a 'Metonic calendar' or counted from a 'Metonic epoch.'<sup>68</sup>

This mention of a specific prescribed number and sequence of intercalary months sets the Metonic cycle apart from the irregularly-intercalated Athenian calendar,<sup>69</sup> and is, I think, the best evidence that the Metonic cycle was somehow calendric.

#### *IV.ii: The Octaeteris*

The octaeteris is an 8-year lunar intercalation scheme sometimes associated with Eudoxus and Dositheus.<sup>70</sup> It prescribes intercalary months in the years 3, 6, and 8 of the cycle, and also prescribes the sequence of full and hollow months. Unfortunately the details of this

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<sup>67</sup> Toomer believes that Meton may have used the exact same spacings for his intercalations as the Babylonians (Toomer, 1996).

<sup>68</sup> Toomer, following Fotheringham, believes three eclipse-dates in the *Almagest* to be in the "astronomical calendar of Meton" (Toomer, 1984, p. 211 n. 63), but his argument is very thin.

<sup>69</sup> See Pritchett and Neugebauer, 1947.

<sup>70</sup> For a discussion of its authorship, see Neugebauer, *HAMA*, p. 620-1.

have been lost.<sup>71</sup> Although the attributions to Eudoxus and Dositheus are sketchy, there is other evidence to connect the octaeteris with astrometeorology, specifically the passage in Pliny,<sup>72</sup> where he situates a four-year astrometeorological cycle within an eight-year lunar cycle. There is no evidence that this cycle was ever used as a civil or astronomical calendar.

#### *IV.iii: The Callippic Cycle*

The Callippic cycle was a modification of the Metonic cycle which removed one day every fourth cycle (i.e., every 76 years). This reduced the year length from 365 5/19 d to 365 1/4. There were 28 intercalary months over the course of the 76 years. The epoch of the cycle is the summer solstice of 330 B.C., and several observations cited in the *Almagest* are dated in years from this epoch. Thus we see years reckoned as follows: "in the thirty-second year of the third Callippic cycle..."<sup>73</sup> There are, however, problems with seeing this as a calendar *per se*. Hipparchus records observations counted in years from the Callippic epoch, but dated in the Egyptian calendar, whereas *Almagest* observations attributed to Timocharis are counted in years from the Callippic epoch but dated with Athenian and Egyptian month names, and a recently-published first-century A.D. eclipse

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<sup>71</sup> See Blass, 1997, col. XIII.12 f.

<sup>72</sup> Pliny, *NH*, XVIII.217.

<sup>73</sup> Ptolemy, *Alm.*, III.1, 204.

canon also uses both types of dates.<sup>74</sup> The Timocharis observations have led scholars to attempt reconstructions of the 'Callippic calendar,' as an artificial astronomical calendar using Athenian month names and dating conventions, but none of the reconstructions is satisfying, and most require emendations of one or another of the Timocharis citations.<sup>75</sup> The Hipparchus dates are even worse, leading Toomer to conclude that Hipparchus used the Egyptian calendar for days and months, but the Callippic Cycle for years, and that he may have used different dating conventions for different observations.<sup>76</sup> Jones has, I think convincingly, refuted this.<sup>77</sup>

The problematic nature of this evidence leads Neugebauer to be sceptical that the Callippic and Metonic cycles are calendrical. Toomer and Jones argue, on the other hand, that the Metonic and Callippic cycles do represent an astronomical calendar,<sup>78</sup> and that this would best explain how the Athenian month names came to turn up in Miletus I, in Timocharis' observations at Alexandria, and in the Oxyrhynchus eclipse canon.<sup>79</sup>

As far as I can see, the gamut of possibilities can be enumerated as follows: the Callippic cycle represents (a) a simple correlation of a whole number of days to a whole number of months to a whole number of years; (b) an Uruk-type scheme; (c) a calendar

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<sup>74</sup> Compare, e.g., Ptolemy, *Alm.* III.1, 204 with VII.3, 25 and with P. Oxy LXI.4137, l. 18 f. (In Jones, 1999a). For commentary, see also Jones, 2000, p. 146.

<sup>75</sup> For details, see Ginzel, 1914, vol. II, p. 409-19; Samuel, 1972, p. 42-9

<sup>76</sup> See Toomer, 1984, p. 13.

<sup>77</sup> Jones, 2000, p. 148-150.

<sup>78</sup> Toomer, 1974, Jones, 1999a, p. 89-90; Jones, 2000, p. 143; 156 f.

<sup>79</sup> Jones, 1999a, no. 4137.

used by astronomers, including Timocharis and Hipparchus, from 330 B.C. until at least the first century A.D.

Point (a) seems not to offer enough to account for the use of a Callippic epoch. Neugebauer argues against (c), and seems rather to prefer something like (b) when he says that "Meton did not attempt to introduce a new lunar calendar but intended to establish a definite starting point in the solar year for the construction of *parapegmata*."<sup>80</sup> He offers no argument against Toomer's point about why the Athenian calendar should have shown up in Miletus I or Timocharis.<sup>81</sup> On balance, I find it the evidence to weigh in favour of the Callippic Cycle being a regulated lunar calendar which probably used the same month names as the Athenian civil calendar. This calendar is attested as being used for the dating of astronomical observations, and also probably served to calibrate lunar and astrometeorological cycles.

### *Conclusion*

The *parapegmata* should be seen as extra-calendrical tools for tracking phenomena which are not directly linked to one's local calendar. In the case of the Greeks, the calendars in question were lunar, and the *parapegmata* are overwhelmingly concerned with phenomena tied to the sidereal year. In the case of the Romans, the calendar is fairly well tied to the solar year, and the phenomena

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<sup>80</sup> Neugebauer, *HAMA*, p. 622.

<sup>81</sup> Or at Oxyrhynchus, for that matter.

tracked in inscriptional parapegmata are frequently non-solar. Some Greek parapegmata treat the sun's entry into zodiacal signs as an important phenomenon, either because it was seen as astrometeorologically significant, or (less likely) as a means to calibrate the parapegma from year to year. The summer solstice, I have argued, was probably used for calibration. The Metonic cycle may have been (or included) schematic lists of solstice dates, and the Callippic Cycle was a more precise version of the Metonic, and also probably functioned as a regulated astronomical calendar.



## Chapter Five

# De signis

### *I: What the Predictive Sign Is and What it Is Not, or at Least Not Necessarily*

It is apparent from even a cursory look at the astrometeorological parapegmata that the stars are seen in these texts to function as signs for predicting coming weather patterns. But this simple statement hides a multitude of difficulties. We need to be clear in the first place on what we mean by 'sign,' and in the second place on how these signs were observed and interpreted.

For the purposes of this work, A *predictive sign* is defined as:

any *object* which, through the application of some non-random process of *formal* or *informal reasoning*, serves as the *temporally preconditional interpretand* of a prediction.

By *formal reasoning* I mean the application of some set of implicit or explicit rules to arrive at a prediction. This should be understood broadly enough to include the following of some authority such as a text, a table, or a precedent. It would include, for example, an omen-watcher's consultation of a canonical text before interpreting an observed event. The model for ancient divination as a professionalized practice is overwhelmingly one of formal reasoning. By *informal reasoning* I mean to include, strictly for the sake of completeness, any less rigorous interpretations of signs, such as a

peasant's vague and unsure guess that an event is somehow ominous, but also what Bottero called *divination inspirée*.<sup>1</sup> This work is concerned only with formal reasoning.

*Object* is here meant to include not only physical objects (e.g., two-headed calves, stars) but also events (e.g., stellar phases, eclipses) and, perhaps surprisingly, texts. For my argument on this, see the section below on *Text as Predictive Sign*.

*Temporally preconditional interpretand* serves to delimit precisely (if not particularly gracefully) certain aspects of the predictive sign, as distinct from the linguistic sign. These are: (1) the sign typically (but not always) occurs before or at the same time as the event it is used to predict will occur; (2) the sign is a precondition of the prediction, either necessary, sufficient, or both; (3) the sign functions as the object which is to be interpreted by being fed into the mechanism (so to speak) of formal or informal reasoning in order to produce a prediction. The *prediction* is what is foretold based on the result of the process of formal or informal reasoning. I will sometimes refer to the prediction as the *sequens* (pl.: *sequentia*), here meaning simply the event which is predicted to follow from the occurrence (or predicted occurrence) of the sign. Thus in the *parapegmata*, a sign may be the rising of Arcturus, and its *sequens* a storm at sea. The particular temporal relationship between the sign and the *sequens* such that the sign occurs either before or at the same time as the *sequens*, I will call the *normal case*.

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<sup>1</sup> See Bottero, 1974.

Before proceeding any further, I would like to make clear one other aspect of what I mean by 'predict'. One frequently encounters discussion of how ancient astrologers and diviners '*attempted to predict*' the future.<sup>2</sup> What is meant by this, I take it, is not that they were trying to make a prediction when they were somehow prevented, but that they said that something would happen, and then that event may have (coincidentally) transpired, but quite likely (given the methods they were using) it did not. This use hinges on a common conversational use of 'predict' where the phrase 'I predicted that X would happen' often implies that I predicted X *correctly*. This is not the meaning of predict I will use. I choose to keep 'predict' to its literal, non-extended meaning where it refers simply to the act of saying that a certain event will occur in the future. Whether what actually happens is in agreement with the prediction or not is irrelevant, and, in the particular study here undertaken, actually unknowable. I say unknowable because the weather events which followed the predictions, i.e., what actually occurred on the designated day, are opaque to us insofar as we have, to the best of my knowledge, no follow-up reports concerning the accuracy of ancient weather prediction. Now this opacity is not trivial. It limits our inquiry in a fundamental way: we cannot ask questions about the accuracy or inaccuracy of ancient weather prediction, since no answers can be forthcoming.<sup>3</sup> More important, though, is the fact

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<sup>2</sup> See, e.g., Jenks, 1983

<sup>3</sup> By contrast, Bowen and Goldstein, 1988, p. 56, argue that the *parapegmata* must have been very inaccurate, and so their primary use must have had little to do

that the question of the veracity of astrometeorology seems not to have been asked in the ancient texts themselves.<sup>4</sup> Quite simply it seems not to have been much of an issue. This being the case, I think it historiographically unsound to import our notions of what is and is not reliably predictable into the *paraepgmata*. What we can more profitably ask is how the prediction itself works as a product of formal reasoning.

### *I.i: Text as Predictive Sign*

I said above that texts could function as predictive signs. I did so on the recognition that much astrological practice in antiquity did not necessarily involve looking at the stars at all. One could consult texts to determine the state of affairs in the heavens, and did not need to actually observe events to know they were happening.<sup>5</sup> This is particularly the case with the astrometeorological (and astronomical) *paraepgmata*, which predicted not only the weather, but also the stellar phases. We thus have two levels of signification

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with actual weather prediction, and more to do with medicine and town planning. But this assumes (a) that ancient standards for weather prediction were more or less the same as ours, and (b) that it would be self-evident to an ancient farmer that the actual weather was frequently in disagreement with the predictions. I think the incredible tenacity of rule-of-thumb weather predictions (for examples, consult a modern *Farmer's Almanac*, or, for that matter, many modern farmers) disproves (b).

<sup>4</sup> Geminus, XVII has often been interpreted as doing so, but all Geminus is there arguing against is one type of theoretical justification for the *paraepgmata*, which is that there is a direct physical force being effused by the stars and reaching as far as the earth. He nowhere makes the more general claim that astrometeorology has no predictive veracity.

<sup>5</sup> A good example of this is horoscopic astrology, which retrodicted planetary positions from tables rather than consulting observation reports.

in these (as in other astrological texts): a text tells the reader that a certain star will rise, thus the text functions as the sign for the prediction of an astronomical event, and this astronomical event serves as the sign that a particular meteorological event will occur.<sup>6</sup> In fact, textual consultation is the primary mode of signification which concerns us in the present work, since most of the evidence for ancient astrometeorological practice derives from such texts. Apart from a few sketchy reports,<sup>7</sup> we do not see observers out looking at the sky in the astrometeorological texts. Rather, we see works to be consulted independent of astronomical observation. In inscriptional *parapegmata*, one need only look at the entry with the peg beside it to read off the current day's astronomical situation and/or weather forecast. Similarly, counting date-differences (holes) would furnish a prediction for any future date. In literary *parapegmata*, one usually read off the current or future astrometeorological situation by referencing the calendrical date. That is: one did not see Arcturus rise and then search through the *parapegmata* to find out the current calendrical date and meteorological prediction (the organization of the *parapegmata* would make this awkward). One rather looked to the current date to find out what should be happening in the sky. In that sense, the *parapegmata* must be seen, somewhat surprisingly

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<sup>6</sup> I note that in genethliological astrology the text often tells us about *past* rather than future states of affairs.

<sup>7</sup> I am thinking here of Geminus' story (ch. XVII) that astrometeorology was based on repeated observation of the heavens and the climate, Sextus Empiricus' similar report (*Adv. Math.* V), and possibly the Clodius Tuscus *parapegma*.

perhaps, as tools for *eliminating* the need for observation.<sup>8</sup> Indeed, in many cases, the very phenomena they are used to predict—storms, rain, snow—would have, by their very occurrence, prevented any astronomical observation.<sup>9</sup> I would thus distinguish the *practical level of semiosis* and prediction from the *theoretical level*,<sup>10</sup> where the practical level is the consultation of texts, and the theoretical level is the assumption lying behind (and justifying) the texts, that the stellar phase functions as a sign for the coming weather. This practical level is perhaps the more semiotically complex of the two, since it has features of the traditional (i.e., linguistic) sign, as well as the predictive sign. That is: the text, composed of written words, is interpreted (read) by someone according to a set of formal grammatical (or grammar-like) rules. Nonetheless, the predictive model does still apply, since the interpretation of the text leads to a prediction of future states of affairs, which prediction is always temporally situated, and is grounded, legitimated, and effected in a context necessarily much broader than just the set of grammatical rules used in the linguistic interpretation. I note also that in some *parapegmata*, the theoretical level has dropped out entirely. So Polemius Silvius is able to simply correlate meteorological phenomena

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<sup>8</sup> This is not the case with texts like Hesiod, *Op.*, for example, which tell us of certain significant astronomical events to watch for, but do not date the events. Hesiod's reader is expected to actually watch for the astronomical event, and when it occurs, to recall or look up what Hesiod said about it.

<sup>9</sup> In her edition of Ovid's *Fasti*, Fantham agrees that the astronomy in the text is not meant to be observationally corroborated, though for quite different reasons than mine. See Fantham, 1998, p. 36; see also Newlands, 1995.

<sup>10</sup> This might more accurately be called the *theoretico-rhetorical level*.

[taken from Columella] with calendar dates only. The stellar phases have disappeared.

*I.ii: Departures from the Normal Case*

We should note that the semiotic situation as I have defined it—that is, the normal case—seems curiously reversed in a few instances: Pliny says that we can tell "from storms that a star is completing (its phase)" at the equinoxes,<sup>11</sup> and Ovid tells us that "when it is the Nones of January, the rains sent to you from dark clouds will give the sign that the Lyre is rising."<sup>12</sup>

Far from disproving the normal case, these examples can rather be seen to broaden its catchment area. In these, as above, we have, at the theoretical level, a sign serving to give us information about (in this case) contemporaneous events in the heavens which are presumably not visible, due to the very phenomena (storms, clouds) that betray them.<sup>13</sup> And as in the normal case the other level of signification, the practical level, is textual. We can read these passages as predicting a pair of related sequentia: from the text of Pliny or Ovid, we can predict both the stellar phase and the weather, even if the very weather predicted would necessarily prevent our seeing the stellar phase of which it is the sign.

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<sup>11</sup> Pliny, *NH* II.108

<sup>12</sup> Ovid, *Fasti*, I.315: *institerint Nonæ, missi tibi nubibus atris signa dabunt imbres exoriente Lyra*. See IV.901 f. for a similar passage.

<sup>13</sup> It is tempting to see a parallel here to Sextus' definition of a reminiscent sign: one which indicates something not at the moment visible [Sextus Empiricus, *PH*, II.99 f.], but Sextus' reminiscent sign has a weaker implicative force than I think we can see here.

Even stranger, perhaps, is that several sources explicitly tell us that sometimes the predicted weather event can occur *before* its sign.

So Geminus tells us:

Often (the parapegmatist) has marked a change in the weather<sup>14</sup> with the rising or setting of a star three or four days too late, and sometimes he has anticipated the change by four days.<sup>15</sup>

In the Aëtius parapegma<sup>16</sup> there is a similar flexibility with regard to the temporal sequence of weather and phase, and Columella tells us that "the force (*vis*) of a star is sometimes before, sometimes after, and sometimes on the actual day of its rising or setting."<sup>17</sup>

While these cases do represent an increased complexity in the temporal relation between sign and sequens at the theoretical level of the normal case, there is no problem at the practical level. And even the apparent theoretical problems, where the sign is occurring after the sequens, are alleviated to some extent by the certainty, provided on the authority of the parapegma, that the sign must definitely be coming on a particular day.

## *II: Causation vs. Signification*

Typically, the question of signification in the astrological texts has been framed as one of *mere signification* versus causation, such that

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<sup>14</sup> I am treating ἐπισημαίνει here as an extended use of the verb, meaning 'to mark an ἐπισημασία.' The grammar of this sentence is odd, but the sense is clear. For more detailed comments, see section III, below.

<sup>15</sup> Geminus, p. 188, l. 18 f.

<sup>16</sup> A.xv, above.

<sup>17</sup> Columella, RR, XI.1.32.



when a sign merely signifies something, it is an inherently somewhat uncertain indication of the likelihood of that later event, as opposed to a *cause*, which necessitates the later event, the consequent. So Erwin Pfeiffer, whose framing of the problem greatly influenced Rehm, writes:

Regarding astrometeorology, one of the most fundamental questions is whether the fixed stars (i.e., the stars other than the sun, moon, planets and comets) have an effective power—primarily on the atmosphere and on weather-phenomena—(one would call this a ποιεῖν of the fixed stars), or whether they only give an indication of events in the atmosphere and on Earth, as Sextus Empiricus reports (the ancient term for this is σημαίνειν).<sup>18</sup>

Here Pfeiffer is attributing to Sextus a definite statement that the stars *indicate but do not cause* the weather. But this is not what Sextus is saying. The Sextus passage Pfeiffer cites reads as follows:

It now lies before us to inquire concerning astrology, or the mathematical art, [by which I do] not mean the complete practice of arithmetic and geometry taken together, nor the predictive ability<sup>19</sup> of the followers of Eudoxus, Hipparchus, and other such men, which is also called 'astronomy,' *for this is the observation of phenomena*, as in agriculture and navigation, from which it is possible to foretell droughts and downpours, plagues and earthquakes, and other such atmospheric changes.<sup>20</sup>

The most important thing to note in this is that Sextus says nothing about whether the stars cause or merely signify the atmospheric phenomena. There is no discussion of causation at all. What he *does* say is that meteorology is observationally grounded, but this is

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<sup>18</sup> Pfeiffer, 1916, p. v.

<sup>19</sup> δύναμις

<sup>20</sup> Sextus Empiricus, *Adv. Math.*, V.1-2, italics mine.

quite a different claim than that Pfeiffer wishes to impute to him. To say that meteorology is based on the observation of phenomena is to say nothing at all about causation. Phenomena which are observed to occur together can be either causally linked, or merely coincidental (but frequently coincident), and Sextus does not commit himself to either position here.

Beyond this, Pfeiffer's analysis, while incomplete (his book lamentably ignores Pliny and Ovid among others), is useful insofar as he looks at a wide range of sources for astrometeorological beliefs, from Homer all the way through to Plotinus, and shows when claims about the causative powers of the stars (whatever this may mean exactly) are being explicitly or implicitly made, and when they are not. But he takes many refutations of causation and questions about the certainty of astrometeorology as arguments in favour of (mere) signification. It is this opposition I wish to contend.

His approach misses a fundamental point about ancient notions of signification: that sign-relations were often *necessary* rather than just *likely*.<sup>21</sup> That is, signification, on the ancient understanding of it, could entail absolute certainty, and causation could just as easily lead to uncertainty. On the latter count, Aulus Gellius<sup>22</sup> repeats a lecture against astrology by Favorinus where Favorinus interestingly attempts to refute astrology by arguing that the causal forces of astrology would have to be so many and so

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<sup>21</sup> See, e.g., Philodemus, *De signis*, 2; *De signis*, 50; Sextus Empiricus, *Adv. Math.*, II.99 f.

<sup>22</sup> Aulus Gellius, *Attic Nights*, XIV.1.1 f.

diverse as to be necessarily incomprehensible to any one astrologer. Pliny also talks of the multitude and complexity of atmospheric and sidereal causes,<sup>23</sup> which lends some uncertainty to astrometeorology.

I should also note that the notion of cause which shows up in Pfeiffer and Rehm is overly simplistic. M. Frede<sup>24</sup> has shown that the notion of what constituted a cause changed over the years, so that by later antiquity it began to often—but not always—resemble our modern conception of cause as an *active agent*.<sup>25</sup> But many of Pfeiffer's sources are pre-Hellenistic, and so his modern interpretation of cause represents a misreading of those sources.

On top of this, it is important to note that the ancient concept of signification was broad enough to include causative relationships as one species of sign-relation: that is, in the situation where X causes Y, then X can also function as a sign of Y.<sup>26</sup> This is quite a departure from Pfeiffer's use of signification.

Thus, the astrometeorological and astronomical parapegmata function, at a practical level, as predictive signs. But the astrometeorological parapegmata also contain, at a theoretical level, other predictive signs, the stellar phases, which could, by themselves and in the absence of the text, be used to predict the weather. The

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<sup>23</sup> Pliny, *NH* II.105 f.

<sup>24</sup> Frede, 1980.

<sup>25</sup> I decline the opportunity here to go into the tangled mess of problems with clarifying the modern notion beyond merely saying that I am here using an ordinary-language sense of 'cause'.

<sup>26</sup> A standard ancient example of this is that lactation is a sign of having recently given birth. (See, e.g., Sextus Empiricus, *Adv. Math.*, II.106; Aristotle, *An. Pr.* II.27.13; Plato, *Menex.*, 237e).

case of the astrological *parapegmata* is slightly less clear, insofar as we must posit an extra-textual set of interpretative tools which the readers of the *parapegmata* must have used to understand the significance of the combination of hebdomadal days, lunar days, and so on. Nonetheless, if we allow for that set of interpretative rules, then these *parapegmata* work in analogous ways to the astrometeorological *parapegmata*.

### *III: The Meaning of ἐπισημαίνει*

From the fact of their derivation from σημαίνει, the verb ἐπισημαίνει and its related noun ἐπισημασία would seem to imply signification in some fundamental sense. But these two words have specialized technical meanings in the astrometeorological and medical traditions which depart from the sense of their root words. These specialized meanings, particularly in the astrometeorological texts, have been misunderstood by modern commentators. Attempts to understand ἐπισημαίνει and ἐπισημασία have suffered from the attempts at preservation of this sense of signification. In particular, ἐπισημασία has found its way into the German literature as the word *Episemasia* (pl. *Episemasien*) which is contrasted with *Phasen* and functions as a very general term for the weather indications (*Witterungsanzeichen*) (i.e., the 'significations,' what I have called the *sequentia*) of the *parapegmata*.<sup>27</sup>

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<sup>27</sup> See esp. Rehm, 'Episemasia', *RE*; Boll, 1893.

But this use is based on a misunderstanding of the Greek word. I will argue that the Greek verb ἐπισημαίνει and the noun ἐπισημασία have specialized technical uses in the astrometeorological literature, where the verb (both intransitive and impersonal in Greek) means "there is a change (in the weather)," and the plural noun means "changes in the weather." They thus have nothing to do with an idea of signification, as scholars have supposed.

As a parallel, a look at the medical use of the noun ἐπισημασία will show that it too has departed from an idea of signification, implying instead the *access* of a fever, which, it should be noted, is not just the onset, but also the *duration* of its symptomatic phase. This parallels the astrometeorological use by referring to an *observable thing*, not just the *sign* of an *unobservable thing*. I think the close connection between astrometeorology and medicine in antiquity may show this parallel to be no mere coincidence.

The parapegmatic literature in Greek contains repeated uses of the verb ἐπισημαίνει in an unusual construction. The verb, primarily supposed to mean 'indicate', 'mark' or 'give signs' by the LSJ, is used intransitively and without an obvious subject, as in Geminus: ἡμέρα Καλλίπῳ Καρκίνος ἀρχεται ἀνατέλλειν· τροπαὶ θεριναί· καὶ ἐπισημαίνει.<sup>28</sup> The LSJ offers the following definition of this use:

III. intr., *give signs, appear as a symptom in a case, ...; ... of puberty show itself, ...; of weather signs, indicate a change of weather, ...; impers., symptoms appear...*

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<sup>28</sup> Geminus, p. 210, l. 14-15.

Note that the definition as it pertains to weather signs implies that the verb is intransitive, but personal. But there is no obvious subject in the example from Geminus. Unless we supply a subject, such as 'this stellar phase' or 'this day,' we cannot, strictly speaking, use the LSJ's intransitive personal definition.<sup>29</sup>

Rehm treats ἐπισημαίνει as an impersonal by translating it as "Bei einer Phase gibt es ein Zeichen."<sup>30</sup> But a sign *of what* exactly? He argues that in the parapegmatic literature ἐπισημαίνει implies something about a change in the weather,<sup>31</sup> which I think is correct, but he maintains the notion of signification as being always at the heart of the meaning of ἐπισημαίνει. Pfeiffer also sees signification as central: he translates ἐπισημαίνει as "läßt erwarten, zeigt an, deutet auf."<sup>32</sup> Pfeiffer further claims that ἐπισημαίνει was sometimes written just as σημαίνει;<sup>33</sup> however, all but one of his examples are easily dismissed as scribal errors. His remaining example, from Lydus' *De mensibus*<sup>34</sup> cannot be an alternate writing for the intransitive

<sup>29</sup> The example cited by the LSJ, Theophrastus, *De sig.*, 10, does seem to be both intransitive and personal, and in this respect, Theophrastus' use of ἐπισημαίνει does not fit that of the astrometeorological literature. Theophrastus uses ἐπισημαίνει intransitively but personally in *De Signis* exactly where we would expect σημαίνει with a direct object. Indeed, he runs the two constructions in parallel: καὶ ἂν ἐπὶ τὸ Πήλιον νεφέλη προσίζη. ... ὕδωρ ἢ ἄνεμον σημαίνει. ὅταν ἶρις γένηται, ἐπισημαίνει (Theophrastus, *De sig.* 22). Hort translates ἐπισημαίνει as "It is an indication of rain," following, presumably, from the chapter title ("The Signs of Rain") he has artificially inserted just above section 10. But since signs of wind etc. are also discussed in this section, it seems presumptuous to assume Theophrastus meant specifically 'rain' here. I think 'indicates a change in the weather' is better. Signification also seems to be present in Epicurus' use of the noun in the *Letter to Pythocles*. See Diogenes Laertius, X.98.8;115.9; 116.1.

<sup>30</sup> Rehm, 'Episemasial', *RE*, col. 181

<sup>31</sup> Rehm, 'Episemasial', *RE*, col. 181 f.

<sup>32</sup> See Pfeiffer, 1916, p. 85-86.

<sup>33</sup> Pfeiffer, 1916, p. 87.

<sup>34</sup> See Lydus, *De ost.*, p. 296, l.1.

ἐπισημαίνει since σημαίνει is being used transitively, with βροχάς as its direct object. Pritchett and van der Waerden translate ἐπισημαίνει with the verbless noun-phrase "sign of weather."<sup>35</sup>

But these interpretations do not depart significantly from the LSJ's interpretation, which stresses indication or signification as central to the meaning of the verb. Moreover, they are all dissatisfyingly vague. I will argue that in the astrometeorological *parapegmata* and related literature, the meaning of ἐπισημαίνει does not centre on signification, but primarily implies the idea of changing. I would translate it thus as 'the weather changes', or impersonally as 'there is a change (in the weather).'

In the first place, the *parapegmatic* uses of ἐπισημαίνει are best understood as true impersonals. There is no obvious subject stated, and implied subjects are, in the main, unsatisfactory. Take, for example, *Geminus*, 1 Cancer: ἡμέρα Καλλίππῳ Καρκίνος ἀρχεται ἀνατέλλειν· τροπαί θεριναί· καὶ ἐπισημαίνει.<sup>36</sup> Here there is no grammatical subject, although there is a candidate for a logical subject: the beginning of the rising of Cancer. But this interpretation does not work for passages such as 16 Leo: ἡμέρα Εὐδόξῳ ἐπισημαίνει.<sup>37</sup> Since there is no stellar phase mentioned which could serve as logical subject, and the dative construction rules out taking ἡμέρα as an implied subject.

<sup>35</sup> See van der Waerden, 1984a, p. 105, f.

<sup>36</sup> *Geminus*, p. 210, l. 14-15.

<sup>37</sup> *Geminus*, p. 212, l. 23. See also p. 214, l. 5; Ptolemy, *Phas.*, p. 15, l. 10, etc.

If, however, we treat these uses as impersonal, we can render the meaning of ἐπισημαίνει as 'there is a change in the weather,' more or less equivalent to μεταβάλλει ὁ ἀήρ. The attempt to maintain the sense of signification, reading ἐπισημαίνει as 'there is a sign that the weather will change,' does not fit the general nature of the *parapegmata*. An astrometeorological *parapegma* typically correlates days with stellar phases and weather predictions. The predictions are, almost without exception, concrete: 'it will rain,' 'there will be a south wind,' etc. The few instances where predictions are more vague are characterized by the following two traits: 1) they take the form of either a) 'a storm *usually* happens,' e.g. ἡμέρα Δημοκρίτω ... ἄνεμοι χειμέριοι ὡς τὰ πολλὰ,<sup>38</sup> or rarely, b) 'wind *tends to* blow,' e.g. ἡμέρα Δημοκρίτω ... ἐπιπνεῖν φιλεῖ,<sup>39</sup> and 2) they are frequently attributed to Democritus, one of the earliest named sources for the *parapegmatic* tradition. In no case do the entries in the *parapegma* tell the reader to watch for vague and unspecified signs of any kind. Rather, they state that particular phenomena will occur on particular days.

Likewise, texts from outside the corpus of astrometeorological literature point to such an interpretation as well. Stobæus reports that Anaximenes thought that τὰς δὲ ἐπισημασίας γίνεσθαι διὰ τὸν ἥλιον μόνον.<sup>40</sup> This sentence appears in the middle of a longer section on Anaximenes' beliefs about the stars in general, and by saying that

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<sup>38</sup> Geminus, p. 218, l. 15-16. The possible exception to this is the calendar of Clodius Tuscus, which occasionally has entries of the form ἔστι δ' ὅτε ὑεὶ or ἔστι ὅτε καὶ βροχαί [see Lydus, *De ost.*, Jan. 27 and Feb. 10, respectively]. I suspect these mean 'intermittent rain' rather than 'in some years, rain.'

<sup>39</sup> Geminus, p. 218, l. 16.

<sup>40</sup> Stobæus, *Anth.*, vol. I, p. 203.



they happened because of the sun, Stobæus would seem to imply from this that Anaximenes did *not* think that the ἐπισημασίαι came about because of the fixed stars.<sup>41</sup> Now, if we interpret the ἐπισημασίαι here as signs of some kind, then the sentence is difficult to understand. Keep in mind what was being observed: the horizon was watched at either sunrise or sunset for the appearance of a particular star. It was not the sun that was observed, although information about its position or motion could perhaps have been abstracted from the observation. So the phenomenon seen was simply the appearance of a star close to the horizon at sunrise or sunset. If we take ἐπισημασίαι to imply signification then we have the strange situation of the signification (by definition, something manifest, observable) happening by means of something not observed (the sun). We get around this problem, however, by translating ἐπισημασίαι here as 'changes in the weather'. So what Anaximenes is saying is that changes in the weather (contrary, perhaps, to what Hesiod may lead one to believe) are due to the sun, not the stars.

Such an interpretation *does* turn up in the LSJ's treatment of this noun. It reports that in the plural, ἐπισημασία can mean "changes in the weather." I am at a loss to explain why this meaning is absent in their entry for the verbal form of this word.

Further confirmation of the centrality of the notion of 'change' rather than that of 'signification' can be found in the earliest

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<sup>41</sup> Note that my argument here does not claim that Anaximenes actually used the word ἐπισημασίαι (in which case he would be the earliest author known to have used it in reference to weather). All that matters is that Stobæus used the word in the particular sentence under examination.

preserved astrometeorological parapegma, P. Hibeh 27, dating from c. 300 B.C. There we find the following:

[Ἐπειφ] κγ ἰσημερία φθινοπωρινή, ἡ νύξ ὠρῶν ἰβ. ἡ δ' ἡμέρα ἰβ. τοῦ Ἀνούβιος ἑορτή, καὶ ὁ ποταμὸς ἐπισημαίνει πρὸς τὴν ἀνάβασιν.<sup>42</sup>

Here we note that, unlike elsewhere in the parapegmatic literature, ἐπισημαίνει is being used personally. Grenfell and Hunt offer the following comment: "This entry 'the river gives indication of rising,' ... refers apparently to the flood reaching its full height, which it usually does early in October. Epeiph 23 ... being the day of the autumn equinox, was probably Sept. 27."<sup>43</sup>

As it stands, however, this interpretation makes little sense. It is clear, I think, that the entry *does* refer to either the end of the rising of the river, or to the beginning of its receding. But rendering the idea that the river begins to recede as 'the river gives indication of rising' loses this sense entirely. It is almost as strange as if we were to translate ἀνεμος μέγας πνεῖ as 'the wind gives indication of calmness.' The solution of this difficulty lies in treating ἐπισημαίνει here as we have in the other parapegmata, as fundamentally implying change, rather than signification. Our understanding of ὁ ποταμὸς ἐπισημαίνει πρὸς τὴν ἀνάβασιν would thus be: 'the river changes with respect to its rising,' i.e., either 'it finishes rising,' or 'it begins to recede.'

<sup>42</sup> Grenfell and Hunt, 1906, vol. I, p. 149, col. xii.

<sup>43</sup> Grenfell and Hunt, vol. I, p. 156, n. 168-9.

Combining this with the other evidence we have seen, I think the best translation of ἐπισημαίνει in the *parapegmata* would thus be 'there will be a change (in the weather).'44

Likewise, the noun ἐπισημασία should be translated, at least in astrometeorological contexts, as 'a change in the weather'. I note that in other astronomical contexts, it can just mean 'significance'.45

### *III.i: ἐπισημαίνει with a Dative Object*

Rehm has argued that the verb ἐπισημαίνει never appears with an accusative object:

Der medizinische Terminus kann transitiv gebraucht werden (einen Menschen ‚zeichnen‘); beim meteorologischen kommt ein Akk.-Objekt niemals vor. ... Dagegen ist es durchaus logisch, daß die Witterungserscheinung, die als Zeichen zu betrachten ist, wofern eine bestimmte angegeben werden kann, im Dat. instr. hinzutritt, wie ὕδασι καὶ ἀνέμοις<sup>46</sup> ... Gleichen Sinn hat es wenn eine solche Angabe in der knappen Sprache der *Parapegmen* im Nominativ oder mit verbalem Ausdruck selbständig daneben tritt, wie κάπειτα ἐπισημαίνει χειμῶν κατὰ θάλασσαν [Euktemon 15. IX. G [= Geminus p. 214, l. 24]].<sup>47</sup>

But the MSS of Geminus unanimously contain one use of ἐπισημαίνει with an accusative object: Δημοκρίτῳ ... ἐπισημαίνειν φιλεῖ βροντὴν καὶ ἀστραπὴν καὶ ὕδατι ἢ ἀνέμῳ ἢ ἀμφοτέρα ὡς ἐπὶ τὰ πολλά.<sup>48</sup> The

44 Using the present tense to indicate future events is standard practice in the *parapegmata*.

45 See, e.g., Ptolemy, *Alm.*, I<sup>1</sup> 536.21, 537.8, 540.7.

46 Ptolemy, *Phas.*, p. 63, l. 24. Note that Rehm's citation ("Demokrit, 19. VIII. G") is incorrect.

47 Rehm, 'Episemasiai', *RE*, col. 181.

48 Geminus, p. 222, l. 10.

strange switch here from accusatives (βροντήν καὶ ἀστραπήν) to datives (ὔδατι ἢ ἀνέμῳ) is puzzling. Wachsmuth emends the sentence to read βροντῆ καὶ ἀστραπῆ καὶ ὔδατι ἢ ἀνέμῳ ἢ ἀμφοτέρω, <sup>49</sup> and Manitius follows Wachsmuth. Halma prefers to leave the accusatives and emend the sentence to βροντήν καὶ ἀστραπήν σὺν ὔδατι ἢ ἀνέμῳ ἢ ἀμφοτέρω. <sup>50</sup>

Against Halma I would argue that his emendation would be the only instance of ἐπισημαίνει governing a weather condition in the accusative. This being said, it should be noted that there are only two other instances in which ἐπισημαίνει clearly governs a weather condition in the dative, one being a Democritus fragment from Ptolemy cited by Rehm: Δημοκρίτῳ ἐπισημαίνει ὔδασι καὶ ἀνέμοις <sup>51</sup> (which prompted Wachsmuth to emend the Geminus passage to include the string of datives in the first place), and the other being Miletus II, 456B: καὶ ἐπισημαίνει χάλαζι. <sup>52</sup> A third instance occurs in a restoration by Rehm of a dative in Miletus II:

ὔαζ ἐώια ἐπιτέλλει καὶ ἐπισημαίνει νότῳ] κατ' Εὐκτήμονα <sup>53</sup>

but given the degeneration of the text this reading is highly uncertain.

Rehm has argued that these datives following ἐπισημαίνει must be instrumental, meaning that the sign itself is *derived from the*

<sup>49</sup> Wachsmuth, 1897, p. 188, l. 13.

<sup>50</sup> See Wachsmuth, 1897, p. 188, n. 13.

<sup>51</sup> Ptolemy, *Phas.*, p. 63, l. 22-3.

<sup>52</sup> Diels and Rehm, 1904, p. 110: left side, l. 4. Diels and Rehm's restoration of καὶ ἐπι] does not seem unlikely. σημαίνει χάλαζι on its own would be even more puzzling.

<sup>53</sup> Rehm, 1904, p. 756.

weather phenomenon in the dative. He distinguishes two distinct uses of ἐπισημαίνει: 1) "Bei einer Phase gibt es ein Zeichen,"<sup>54</sup> where the sign implicitly refers to a change in the weather, and 2) "Bei einer Phase gibe es ein Zeichen durch Witterungswechsel,"<sup>55</sup> where the sign derives *from* the weather phenomenon associated with the phase. He states quite explicitly that the datives refer here to a sign given *by* the weather, not *of* the weather: "Dagegen ist es durchaus logisch, daß die Witterungserscheinungen, *die als Zeichen zu betrachten ist*, wofern eine bestimmte angegeben werden kann, im Dat. instr. hinzutritt."<sup>56</sup> This would imply that the *parapegma* contains a prediction of a weather event *qua* signifier of something else. We have already seen that sometimes weather phenomena can function as signs of otherwise unobservable astronomical phenomena, but in cases where this is so, both the sign (rain, storms) and the sequens (some stellar phase) are made explicit. But in Δημοκρίτῳ ἐπισημαίνει ὕδασι καὶ ἀνέμοις<sup>57</sup> there is no clear sequens, i.e., no stellar phase that the rain is supposed be a sign of.

Lastly, only three weather predictions in the *parapegmata* are in this dative construction, and Rehm fails to show why so few occurrences of rain, wind or hail were signs of particular phases. Moreover, the common absolute use of ἐπισημαίνει frequently has no stellar phase, nor anything else attached to it and thus, if we apply

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<sup>54</sup> Rehm, 'Episemastal', *RE*, col. 181.

<sup>55</sup> Rehm, 'Episemastal', *RE*, col. 183.

<sup>56</sup> Rehm, 'Episemastal', *RE*, col. 181, italics mine.

<sup>57</sup> Ptolemy, *Phas.*, p. 63, l. 22-3.

Rehm's interpretation consistently, these instances would be vague to the point of meaninglessness.

Rehm's argument that these are instrumental datives is, therefore, untenable.<sup>58</sup>

It makes much more sense, I think, if we take these datives to be comitative rather than instrumental: 'There will be a change in the weather, with hail,' i.e. 'including hail.' Indeed, this is exactly how the dative is being used in the following: καὶ [Ἀπριλίῳ] ἐὰν ἀνέμῳ ἀστράφῃ, ὁ βασιλεὺς τοὺς ἄρχοντας αὐτοῦ φονεύσει.<sup>59</sup> Another possibility, albeit one I consider less likely, is that these are datives of respect: 'There will be a change in the weather (in particular) with respect to the winds and rain.'

### III.ii: *The Extended use of ἐπισημαίνει*

In Geminus XVII there is an unusual use of ἐπισημαίνει. In a passage criticizing the parapegmaticists, he says:

πολλάκις δέ μεθ' ἡμερας τρεῖς ἢ τέσσαρας ἐπεσήμηνε τῇ ἐπιτολῇ ἢ τῇ δύσει τοῦ ἀστρου, ἔστι δ' ὅτε προέλαβε τὴν ἐπισημασίαν πρὸ ἡμερῶν τεσσάρων.<sup>60</sup>

<sup>58</sup> There are, to be sure, instances of ἐπισημαίνει governing words for 'stars' in phrases analogous to the instrumental dative, e.g., Δημοκρίτῳ ἀρχεται ὠρίων ἐπιτέλλειν καὶ φιλεῖ ἐπισημαίνειν ἐπ' αὐτῷ (Geminus, p. 232, l. 21-2. See also Rehm, 1904, where he restores [Ἰάδεις] ἐπιτέλλουσι ἐωθε[ν καὶ ἐπισημαίνει αὐταῖς κατὰ Φίλιππον...]). But there is nothing unusual about a prediction of changing weather being made from a star (Orion in this case). Indeed this is what the parapegmatic literature is all about.

<sup>59</sup> Cumont, CCAG, vol. III, p. 48.

<sup>60</sup> Geminus, XVII, p. 188, l. 18 f. Manitius inserts a <τις> after πολλάκις δέ, but I see no real need for it. He translates the passage thus: "Oft hat jemand drei oder vier Tage zu spät an den Auf- und Untergang des betreffenden Gestirns eine Voraussage geknüpft, biswellen eine solche auch vier Tage zu früh angesetzt." (See Geminus, p. 189). Aujac, also eliminating the τις, offers the following rather

which I translate as:

Often (the *parapegmatist*) *has marked a change in the weather with the rising or setting of a star three or four days too late, and sometimes he has anticipated the change by four days.*

Here the subject of ἐπεσήμηνε (the *parapegmatist*) is carried over from the previous sentences, and the verb itself seems to mean that he has put down or marked an ἐπισημασία beside or with the stellar phase. This use is a simple extension of the normal use of the nominal form ἐπισημασία.

### III.iii: ἐπισημαίνει as Medical Terminology

Another specialized use of ἐπισημαίνει occurs in the medical literature. Galen defines the derived noun, ἐπισημασία, as follows:  
καλῶ δ' εἰσβολὴν παροξυσμοῦ τὸν ἀκριβῶς ἤδη πρῶτον χρόνον ἀπλατῆ, τὸν δ' αὐτὸν τοῦτον ἐπισημασίαν εἰώθασιν ὀνομάζειν.<sup>61</sup> Elsewhere, he says: ...ὅταν ἐν ταῖς ἀρχαῖς τῶν παροξυσμῶν, ἅς ἐπισημασίας ὀνομάζουσιν...<sup>62</sup> and ...ἐν ταῖς εἰσβολαῖς τῶν πυρετῶν, ἅς ἐπισημασίας ὀνομάζουσιν...<sup>63</sup> According to this use, then, the noun ἐπισημασία refers to the onset (and in some cases, the duration) of the appearance of the symptoms in a cyclic fever,<sup>64</sup> and not, typically to

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freely idiomatic translation: "Souvent aussi les indications données valent avec 3 ou 4 jours de retard sur le lever ou le coucher de l'étoile; à d'autres moments, les indications sont en avance de 4 jours." (Aujac, 1975, p. 87).

<sup>61</sup> *De morborum temporibus Liber*, in Galen, vol. VII, p. 426.

<sup>62</sup> *In Hippocratis aphorismos commentarii*, in Galen, vol. XVIIb, p. 452.

<sup>63</sup> *In Hippocratis prognosticum commentaria*, in Galen, vol. XVIIIb, p. 120.

<sup>64</sup> I exclude non-cyclic fevers, since Galen seems to think that continuous fevers do not have ἐπισημασία: ἐν μὲν γὰρ ἄλλοις ἅπασιν πυρετοῖς αἱ τοιαῦται εἰσβολαὶ ἀθλιπτοὶ γίνονται χωρὶς τοῦ τραφῆναι· κατὰ δὲ τοῦς ἐκτικῶς πᾶν τὸ

the symptoms themselves. Elsewhere, ἐπισημασία is contrasted with ἀνεσις, remission,<sup>65</sup> and means the 'manifestation' of the disease, by which translation I wish to imply not simply a symptom abstracted as such, but rather the *period* of the disease during which the patient is feverish. Indeed, Galen even refers to the 'symptoms of the ἐπισημασία': τὰ τῆς ἐπισημασίας σημεῖα<sup>66</sup> I choose 'manifestation' rather than *access* simply because of the ambiguity of the English term *access*, which often can just refer to the onset of symptoms. That more than just onset is implied becomes clear in the contrast between ἐπισημασία and ἀνεσις, as in Galen's *De typis* where diseases are classified according to the *duration* of the ἐπισημασία versus that of the ἀνεσις:

τῶν τύπων οἱ μὲν εἰσι πρῶτοι, οἱ δὲ δεύτεροι· καὶ οἱ μὲν ἐστῶτες, οἱ δὲ κινούμενοι· καὶ πάλιν οἱ μὲν εἰσιν ἀπλοῖ, οἱ δὲ σύνθετοι. πρῶτοι μὲν οὖν εἰσιν οἱ μικρὰν μὲν ἔχοντες τὴν ἐπισημασίαν, μακρὰν δὲ τὴν ἀνεσιν.<sup>67</sup>

Moreover, duration is implied in such statements as κατὰ τὸν καιρὸν τῆς ἐπισημασίας,<sup>68</sup> 'during the time of the ἐπισημασία'; καταρρήξει τῶν ἐπισημασιῶν,<sup>69</sup> 'there will be discharges during the ἐπισημασία'; κατὰ μὲν οὖν τὸν πρῶτον χρόνον τῆς ἐπισημασίας.<sup>70</sup>

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ἐναντιώτατον, οὐδ' ὄλως ἐπισημασία γίνεται κατ' οὐδένα χρόνον, ἀλλ' εἰς ἐστὶ συνεχῆς πυρετὸς ὡσπερ, ὁ καλούμενος ἰδίως σύννοχος. *De diff. feb.*, Galen, vol VII, p. 322.

<sup>65</sup> e.g., in Galen's *De typis*, Galen, vol. VII p. 464, 5, 7 *et passim*.

<sup>66</sup> See *De differentiis februm*, in Galen, vol. VII, p. 356; *Synopsis librorum suorum de pulsibus*, in vol. IX, p. 475; *De prænotione ad posthumum*, in XIV, p. 661.

<sup>67</sup> Galen, vol. VII, p. 464, l. 5, f. The use here is identical to that elsewhere in *De typis*.

<sup>68</sup> Galen *Synopsis librorum suorum de pulsibus*, in Galen, vol. IX, p. 480.

<sup>69</sup> Archigenes, *Fragmenta inedita*, p. 68 l. 6.

<sup>70</sup> Anonymi Medici *Peri lycanthropias*, l.16.



'during the beginning of the ἐπισημασία'; ἡ ἀκμή τῆς ἐπισημασίας.<sup>71</sup> 'the peak of the ἐπισημασία'; ἐν ταῖς ἀρχαῖς τῶν ἐπισημασιῶν.<sup>72</sup> 'in the beginning of the ἐπισημασία'. The best way to keep the sense of these examples clear is to interpret ἐπισημασία as durative, i.e. taking place over some nontrivial length of time.

Thus the word refers, in at least some instances in the medical literature, to a phase of a disease, during which the symptoms, σημεῖα, are outwardly manifest. And different diseases are characterized by different patterns of the duration of their manifestations and remissions. How frequently the noun refers to manifestation rather than onset is difficult to tell. In many cases it is clearly manifestation, but at least one of Galen's definitions (cited at the beginning of this section) would lead us to believe that it only meant access, and phrases such as πρὸ ὥρων β τῆς ἐπισημασίας obviously could go either way. I wonder if the difference between onset and manifestation isn't less pronounced in the Greek medical literature than the two English words would lead one to believe. Symptoms come on with varying intensity over time, and they change over the course of a bout of fever, such that one feels alternately hot and cold, and may occasionally (but clearly not constantly) vomit, etc. It may be the case that the Greek conception of how a fever manifests itself saw it as an instance of continual 'becoming' or 'coming-on,' rather than as a two-step process of 'beginning' (onset) followed by a period in which it is 'manifest' (but no longer

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<sup>71</sup> Aetius Med. *Iatricorum*, 78.41.

<sup>72</sup> Aetius Med. *Iatricorum*, 83.25.

'beginning'). More research certainly needs to be done on the medical uses of this word.

In any case for our present purposes, what is important to note here is that the idea of 'signification' is, as in the astrometeorological literature, entirely absent.

This holds true for virtually all the Galenic uses of ἐπισημασία,<sup>73</sup> and for post-Galenic medical writers in general.<sup>74</sup> This is not, however, generally the case in the Hippocratic *Corpus*.<sup>75</sup>

In the Hippocratic works, a number of different uses of both the noun and the verb are evident: 1) meaning 'indicate' (synonymous with σημαίνει),<sup>76</sup> 2) meaning 'symptoms appear,'<sup>77</sup> or just 3) 'appear.'<sup>78</sup> This last meaning, that of 'appearance,' is related to several other uses of ἐπισημαίνει in Greek.

It seems obvious that the Galenic use of ἐπισημασία as 'manifestation of a disease' is related to this sense of 'appearance,' and we should note that there are a number of other uses of both the verb and the noun which orbit around this meaning as well. I mention them here for the sake of completeness: 1) 'Appear', or 'show itself,' often (but not always) referring to the maturation process of

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<sup>73</sup> The exceptions occurring in either discussions of seasons and changes in the weather (as at *De diebus decretoriis*, Galen, vol. IX, p. 914), or in his quotations from and commentaries on Hippocratic works.

<sup>74</sup> e.g., Paulus Ægineta, Stephanus of Athens, Ælius Aristides, Aetius, Erotianus, Dioscorides Padanius, Alexander Trallianus, and Adamantius Judæus.

<sup>75</sup> With the notable exception of Hippocrates, *De articulis*, 67.16.

<sup>76</sup> *De morbis popularibus*, I.9.5; VII.46.6, and possibly *De septimestri partu*, 9.4.

<sup>77</sup> *De morbis popularibus*, IV.39.5.

<sup>78</sup> e.g., *De Semine*, 21.18, 44.3; *De articulis*, 30.14, 41.36; *et passim*.

humans or animals, as in "breasts appear,"<sup>79</sup> 2) 'Show approval, applaud,'<sup>80</sup> and lastly, 3) 'Show of disapproval by the gods'<sup>81</sup>

It seems clear, then, that from an earlier sense of something like 'appear', a specialized medical use developed, where ἐπισημαίνει came to mean the onset or the manifestation of the symptomatic phase of a cyclic fever. Like the astrometeorological use, this has departed from any notion of 'signification'.

### *Conclusion*

It is apparent, then, that ἐπισημαίνει has some hitherto unrecognized meanings in the astrometeorological literature. Its impersonal and intransitive use in the parapegmatic tradition, meaning '(the weather) changes,' is, I think, quite different from its use in, e.g., Theophrastus (intransitive, but personal: 'x indicates a change in the weather'). This loss of the sense of indication or signification is not, however, unusual. It is exactly what happened in post-Hippocratic medical literature, where its derived noun takes on the meaning of '(the onset of) the symptomatic phase of the disease.'

<sup>79</sup> Aristotle, , *De gen. anim.*, 727a.8. See also 728b.24, 728b.29 *et passim*; Galen *De usu partium*, in Galen, vol IV, p. 174; [Hippocrates] *De semine*, 21.8.

<sup>80</sup> See, e.g., Diodorus Siculus, XIX.23.1.2; Dionysius Halicarnassensis, VI.72.2.6 *et passim*; Polybius, VI.6.8.4 *et passim*.

<sup>81</sup> See, e.g., Diodorus Siculus, XVI.83.2.9 *et passim*; Pausanias, III.12.7.7.

## Chapter Six

# Spelt and Spica

"Now John," quod Nicholas, "I wol nat lye,  
I have yfoundede in myn astrologye  
As I have looked in the moone bright,  
That now a Monday next, at quarter nyght,  
Shal fall a reyn, and that so wilde and wood  
That half so greet was nevere Noes flood."  
-Chaucer, The Miller's Tale

### *Introduction:*

The class of what I have called *astrological parapegmata* is used to keep track of the days of the moon (i.e., simply counting days from new moon to new moon), among other things. One may legitimately ask what reasons the ancients had for doing this. The ephemeris of 467 and Petronius seem to indicate that the interplay of days of the week with lunar days played a role in the determination of good- and bad-luck days. But it is also clear, as we shall see, that lunar days were of great importance in their own right in Roman agricultural practices.

In his monumental work on Roman agricultural practice, *Roman Farming*,<sup>1</sup> K. D. White discusses the history of almost all aspects of Roman agricultural practice, including estate organization, tools, methods of cultivation, crops, manure, livestock, servants, and so on. But he does not mention astronomy, astrology, or calendrical

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<sup>1</sup> White, 1970.

reckoning at all. This is a little surprising, since so much of the ancient agricultural literature that has survived pays no small amount of attention to the heavens. Planting, pruning, manuring, ditch-digging, sheep-shearing, harvesting and ploughing instructions, for example, are given with specific attention to the phases of the moon or the fixed stars. This raises a handful of questions which need to be answered. Specifically: (1) How exactly are lunar phases and days used in Roman agriculture, (2) Were the lunar beliefs related to a kind of primitive Roman calendrical almanac, as suggested by Eugene Tavenner? and (3) How are stellar phases used in ancient farming?

In addressing these questions, I will need to also look at the ancient ideas of sympathy and antipathy, which, I argue, are to be seen as natural rather than supernatural forces.

*I: Types of Lunar Influence:*

There are three distinct lunar influences apparent in the ancient sources: the phase of the moon, the day of the moon, and the position of the moon relative to the horizon. Each of these influences determined the timing of various farming practices, such that certain activities were best carried out under a waxing moon, others avoided on a particular day of the moon, or still others performed when the moon was above the horizon.

(a) *Phase*: One should only plant beans when the moon is increasing or full, according to Columella.<sup>2</sup> The idea behind this would seem to be that the increasing moon will bestow an increasing influence on the beans. A waning moon would be seen as destructive. The full moon also bestows beneficial influence. Pliny, however, instructs that vetch and fodder crops be sown when the moon is invisible<sup>3</sup> (i.e. at new moon). As with Columella's full moon, the new moon is here seen as beneficial, though I must confess I am at a loss to explain why. The idea that the new moon is an increasing moon would seem tempting,<sup>4</sup> until one considers that on this logic the full moon would be a waning moon, which would therefore seem to be destructive to planting, contrary to what Columella believes. It is possible that some difference between the uses or growing patterns of beans versus vetch was thought to call for different planting times. Another possibility is that there were several schools of thought on the issue (or at least variant traditions) in antiquity, with different ideas about what influence a particular phase would have.

(b) *Day of the Moon*: Vergil tells us that the seventeenth day of the moon is propitious for planting vines, the ninth lucky for fugitives but unlucky for thieves, and that the fifth day is unlucky for all work.<sup>5</sup> The passage is striking in two respects: first, the seventeenth

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<sup>2</sup> Columella, *RR*, II.x.10; XI.ii.85. This flatly contradicts Tavenner's notion that "all plants, trees and vines should be planted either during the dark of the moon or during the increase of the moon." See Tavenner, 1918, p. 69.

<sup>3</sup> Pliny, *NH*, XVIII.314: *hoc silente luna serit tubent*.

<sup>4</sup> See Tavenner, 1918, p. 69.

<sup>5</sup> Vergil, *Georg.* I.276-286.

day would be a waning moon,<sup>6</sup> and second, the unluckiness of the fifth day has nothing to do with the phase of the moon at all: rather it was the lunar day on which, Vergil tells us, “pale Orcus and the Furies were born,”<sup>7</sup> and was therefore seen as unlucky. He is unfortunately silent about what (if anything) happened on the seventeenth to make it fruitful for viniculture, or on the ninth to make it helpful for fugitives. Since the day of the moon is here being used as a way of keeping track of the ‘anniversary’<sup>8</sup> of an event, one may be tempted to see in this a remnant of an ancient lunar calendar. And one would be correct to do so, but the calendar in question is Greek, not Roman: Pliny tells us that Vergil was following Democritus in this dating.<sup>9</sup> Thus this, the sole example of a clearly lunar calendrical instruction in the Roman agricultural literature, is of Greek rather than Latin origin.

I note also that Vergil's admonition differs from the ancient Roman belief that certain calendrical dates (recurring of course only once a year) were unlucky, since Vergil is branding days of every lunar cycle as significant, not just of particular months. Interestingly, however, like many of the ancient ominous calendrical days, a tradition of the occurrence of a particular event on a particular day ‘colours’ that day, so to speak, in perpetuity for Vergil.<sup>10</sup>

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<sup>6</sup> As Tavenner noted, p. 69-70.

<sup>7</sup> Vergil, *Georg.*, I.277-8: *quintam fuge: pallidius Orcus Eumenidesque satae.*

<sup>8</sup> Or more accurately: ‘mensiversary’.

<sup>9</sup> Pliny, *NH*, XVIII 321: *namque Vergilius etiam in numeros lunæ digerenda quædam putavit Democriti secutus ostentationem.*

<sup>10</sup> For a discussion of these calendrically ominous dates, see Grafton and Swerdlow, 1988. Babylonian parallels can be found in Langdon, 1935, and

The use of days of the moon to govern certain activities turns up also in Pliny where he reports that "Varro has advised us to heed the observation (of the rising of the Pleiades) for sowing beans. Others say they are to be sown at full moon, and lentils between the twenty-fifth and thirtieth, and vetch on the same days of the moon (*viciam quoque iisdem lunæ diebus*), for this is the only way they shall be free of slugs."<sup>11</sup>

(c) *Lunar Position Relative to the Horizon*: Another, hitherto unnoticed, kind of lunar influence can be found in Pliny. In the *Natural History*,<sup>12</sup> he tells us that we should "prepare nurseries when the moon is above the earth," (*seminaria cum luna supra terram sit fieri*) which Tavenner mistakenly interprets as "during the light of the moon."<sup>13</sup> But this interpretation renders the long passage following Pliny's admonition entirely senseless. Here Pliny goes to great lengths to explain the difficult business of determining when the moon is above and below the earth *during all its phases*. Pliny demonstrates that the moon is not just "above the earth" when it is visible, but also when it is invisible, such as at the new moon. During a new moon, the moon is above the earth all day, exactly when the sun is above the earth (*supra terras autem erit quamdiu et sol interlunio et prima tota die*), and during a full moon it is above the earth from sunset to sunrise, i.e., all night. He then gives us a linear

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Egyptian ones in the *Calendar of Lucky and Unlucky Days* (on which, see below, ch. 8).

<sup>11</sup> Pliny, *NH*, XVIII.228.

<sup>12</sup> Pliny, *NH*, XVIII.322.

<sup>13</sup> Tavenner, 1918, p. 69.



interpolation rule for calculating when it will be above the horizon on any subsequent day or night.<sup>14</sup> His detailed explanation shows that Pliny quite literally means “when the moon is above the earth” rather than simply “when the moon is shining.” Conversely, some operations (felling timber and treading wine must) are best carried out when the moon is below the earth (*cum luna sub terra*), which again does not mean at a new or waning moon, but rather quite literally, when the moon is below the horizon, whatever its phase. We should note however that Pliny does think phase is important for certain other activities, such as manuring and gelding, for which a waning moon is beneficial, or ditch-digging which is best done at the full moon.<sup>15</sup>

The idea that the moon's position above or below the earth matters in agriculture shows up also in the *Geoponica*, in a chapter called ὅτι ἀναγκαῖον ἐστὶν εἰδέναι, πότε ἡ σελήνη γίνεται ὑπὲρ γῆν, πότε δὲ ὑπὸ γῆν, which is attributed to “Zoroaster”. It is justified on the grounds that “many of the farmer's tasks are necessarily carried out when the moon is above the earth, or when the moon is below the earth.”<sup>16</sup> Rather than interpolation rules, it simply lists the hours for each day of a 30-day month during which the moon is above or below the earth, beginning with the new moon.<sup>17</sup>

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<sup>14</sup> Add ten-and-a-quarter twelfths of an hour to its rising and setting time each day.

<sup>15</sup> Pliny, *NH*, XVIII.322.

<sup>16</sup> *Geoponica*, I.7.

<sup>17</sup> Compare also *Enuma Anu Enlil* tablet XIV, tables A and B, in Al-Rawi and George, 1991.

We have seen that there were three lunar influences active on Roman agricultural activity: one, by far the most common, which related beneficence and maleficence to the phases of the moon generally; another, previously confused with the first kind, which believed that the position of the moon above or below the earth, regardless of its phase, would affect certain agricultural operations; and a third, which saw influences of lunar days as affecting farming activity.

The position of the moon relative to the horizon could be easily calculated, as Pliny instructs, or looked up in a book, as in the *Geoponica*, provided one knew the lunar day. But the lunar day was also important, as we have seen, in its own right. Phase was either simply observed or, when the moon was invisible, perhaps worked out from lunar days. These examples show at least one set of related uses for the lunar days column in the astrological *parapegmata* and in the *ephemerides*.

### *II.i: A Roman Lunar Almanac?*

I do not accept Tavenner's claim that this Roman moon-lore is necessarily related to an archaic Roman, and completely non-Greek, calendrical almanac which, he implies, was meant to regulate agricultural activity throughout the year.<sup>18</sup> Tavenner's claim that the moon-lore could not have come from Greece, since the Roman farmer

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<sup>18</sup> Tavenner, 1918, p. 67.

“would, in fact, be the last person to hear of strange beliefs introduced from foreign countries”<sup>19</sup> is absurd. The Roman agricultural literature is full of information explicitly derived from foreigners, including the Greeks, the Etruscans, and the Carthaginians.<sup>20</sup> The Democritus passage in Vergil is one case in point.

Moreover, Tavenner equates this “rough and ready almanac”<sup>21</sup> with an (assumed) early Roman lunar calendar. But it is misleading to uncritically point to a relation between that calendar and the activity-governing phases of the moon, since these two things are conceptually quite distinct. Instructions to dig ditches under the light of a full moon, or to prune vines in the dark of a new moon are meant to accord one’s actions with favourable forces in the Cosmos. They prove nothing about a lunar calendar, which is essentially a time-keeping device. The instructions concerning the beneficial lunar phases are based on perceived sympathies between the phase of the moon and the state of things on earth.

But if the lunar agricultural practices are not straightforwardly derived from an early Roman lunar calendar, what other evidence is there for the existence of such a calendar? As we shall see, the answer is: not terribly much.

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<sup>19</sup> Tavenner, 1918, p. 82.

<sup>20</sup> See, e.g., Varro, *RR*, I.1.8 f., where he mentions more than fifty foreign sources.

<sup>21</sup> Tavenner, 1918, p. 67.

## *II.ii: The Supposed Archaic Roman Lunar Calendar*

The earliest attested Roman calendar is luni-solar,<sup>22</sup> with a standard year of 355 days divided into twelve schematic months of 28, 29 or 31 days (very roughly equal in length to a lunar month), and with complex rules of intercalation to keep it roughly in line with the solar year.<sup>23</sup> Most scholars see this calendar as having developed from an earlier calendar based on actual observation of the phases of the moon,<sup>24</sup> with month lengths of 29 or 30 days alternately,<sup>25</sup> and Flammant argues that the change to the luni-solar calendar from the "primitive" calendar was both deliberate and sudden.<sup>26</sup> The evidence for this observational lunar calendar centres on the facts that (1) the Kalends, Nones and Ides of a month can be seen to correspond roughly (but, I argue, *too* roughly) with the first appearance of the

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<sup>22</sup> The earliest Roman date cited in the ancient sources is a solar eclipse mentioned by Cicero which occurred on the Nones of June in c. 401 B.C. As Samuel, 1972, pointed out, even if the Roman calendar *had* once been lunar, it certainly was no longer so by 401, since an eclipse can only happen at the conjunction of the sun and moon, i.e., at or before the Kalends rather than on the Nones of a given month.

<sup>23</sup> For details, see Brind'Amour, 1983; Michels, 1967; Samuel, 1972, ch. V; Gjerstad, 1961.

<sup>24</sup> See Samuel, 1972, p. 159, n.2; p. 166; Michels, 1967, p. 16; p. 119 f.; Brind'Amour, 1983, p. 225 f.; Nilsson, 1952; Pedroni, 1998. Holleman, 1978, however, has argued (unconvincingly) for an original 306-day year. An alternate (and truly ridiculous) account has been advanced by V. Johnson, 1963, who sees the Roman calendar as derived from an original four-month (120-day) year which was based on the breeding cycles of pigs. The argument rests on facts such as that figs and beans are among the prominent items in the rites of the Caprotine Nones (in March), which products "would seem more appropriate to pigs than goats," and that *Caprotinus*, the original name for March (!) may have meant "boar" in primitive times.

<sup>25</sup> Gjerstad, 1961, p. 197; See also Macrobius, *Sat.*, I.13.6-7; Censorinus, *De die nat.*, 20.2-5.

<sup>26</sup> See Flammant, 1984.

moon, the half moon and the full moon respectively; (2) Macrobius reports that the Kalends, Nones and Ides were once feasts timed according to the observation of the new crescent;<sup>27</sup> and (3) the 355-day 'standard' (i.e., non-intercalated) year is close to a true 354-day lunar year. A fourth assumption which I think lurks in the background is that a lunar calendar is supposed by many scholars to be somehow more primitive than a solar one.<sup>28</sup>

Of these arguments, none is quite convincing. The discrepancy between the Kalends, the Nones and the Ides on the one hand, and the three corresponding lunar phases on the other is as much as two days. And if we believe Macrobius, then even in the archaic calendar this strange discrepancy must have existed between the true phases and the idealized dates of the feasts, for on Macrobius' account, only the Kalends was truly observational, the other feasts were schematic:

So in ancient times (before the *fasti* was produced by  
Gn. Flavio the clerk, and made publicly known, against

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<sup>27</sup> Macrobius, *Sat.*, I.15.9-12. Gjerstad has claimed that Varro, *LL.* VI.27 is further evidence for this point, but I don't see how. Varro says: *Primi dies mensium nominati Kalendæ, quod his diebus calantur etus mensis Nonæ a pontificibus quintanæ an septimanæ sicut futuræ, in Capitolio in curia Calabra sic: "Dies te quinque calo, Juno Covella; septem dies te calo, Juno Covella."* The last bit is an emendation by Scaliger from *dictæ quinque calo* and *septem dictæ calo*.

<sup>28</sup> Much of the work on ancient chronology and calendrics is founded on assumptions made explicit by Nilsson's *Primitive Time Reckoning*. There Nilsson states, without proof, that "the moon is indeed the first chronometer" and that "while the human mind arrives only gradually at the conception of the year, the month is already given by the natural phenomena" (see Nilsson, 1920, p. 148, f.). The entirety of his book is coloured by his questionable method of using nineteenth-century anthropologists' reports of (for example) the 'primitive' temporal conceptions of indigenous South American tribespeople as indicative of 'primitive' early European calendrics. While such reports may point out certain possibilities, they can offer nothing in the way of proof. More recently, M. Lalonde has used this same method to offer a Marxist interpretation of primitive time reckoning. Lalonde, 1996, p. 247, n. 35, dubiously appeals to "la structure quasi universelle des 'calendriers' primitifs et des calendriers des civilisations historiques."

the will of the nation) this duty was assigned to a *Pontifex Minor*: to observe the first [sign] of the new moon, and its appearance<sup>29</sup> noted and reported to the High Priest.<sup>30</sup> And so, a sacrifice being performed by the High Priest,<sup>31</sup> and the *Pontifex*, having called (that is: summoned) the people to the Capitol, beside the *curia* of Calabria, which is near the house of Romulus, the *Pontifex Minor* would declare how many days there were between the Kalends and the Nones, repeating the word  $\kappa\alpha\lambda\omega$  five times if [the Nones were on] the fifth [day], and seven times if [they were on] the seventh [day]. ... And so the *Pontifex Minor* made known the number of days which remained until the Nones, since after the new moon, on the Nones, the people from the country had to meet in the city to hear from the High Priest the reasons for the festivals and what sacrifices were to be performed that month.<sup>32</sup>

There are a number of problems with this account. Firstly, the combination of observation and schematic dating of feasts is disconcerting. Moreover, as Gjerstad noted, the title of *Pontifex Minor* is entirely anachronistic here. Thirdly, the fact that the '*Pontifex*' (whatever he may have been called) is supposed to have made his pronouncement *in Greek* to the Roman peasantry is odd. But these anomalies are easily accounted for by the fact that Macrobius is writing at least 700 years after this supposed calendar must have fallen out of use,<sup>33</sup> and his information was corrupted. But of course if Macrobius is not reliable on these counts, can we trust him that the Kalends were originally observational? The answer is: not unless there is other evidence.

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<sup>29</sup> *aspectus*.

<sup>30</sup> *rex sacrificulus*.

<sup>31</sup> Here and afterwards simply *rex*.

<sup>32</sup> Macrobius, *Sat.*, I.15.9-12.

<sup>33</sup> It was luni-solar by at least the end of the fifth century B.C., possibly earlier. See Brind'Amour, 1983, p. 227.

Is the 355-day year such corroborating evidence? I would argue not. The reason is that the 355-day year first shows up as the product of the lengths of the 12 schematic months of the luni-solar year, such that four months of 31 days (clearly not observationally lunar) plus seven of 29 days plus one of 28 days (again, clearly not observationally lunar) equals 355 days. But of course this year length was seen as unsatisfactory in the earliest records we have of it, such that the Romans irregularly intercalated extra months in order to keep the calendar in line with the solar year, and this intercalation involved shortening February to 23 or 24 days (clearly not lunar) and adding an intercalary month of 27 or 28 days (yet again: clearly not lunar).<sup>34</sup> Although the earliest known Roman calendar does seem to show some connection to the behaviour of the moon, we cannot ignore the fact that it equally undeniably shows a strong connection to the behaviour of the sun.

This being the case, we could just as easily argue that the Archaic calendar, rather than being a degenerate lunar calendar, was a degenerate solar calendar. Or, what seems most likely based on the evidence available to us for the earliest known Roman calendar, that it was never purely either, but was *from its inception* luni-solar. The evidence of Macrobius does not, I think weigh in favour of any of these possibilities. His account is nothing more than speculation based on the rough coincidence of the monthly feasts with the lunar

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<sup>34</sup> Michels, 1967, has argued that the intercalary month was always 27 days, but most scholars think it was sometimes 27 and sometimes 28. For the ancient sources and her arguments on the question, see her *Appendix 1*.

phases, and ultimately can be reduced to the identical (and no more convincing) modern argument.

Since we have no really secure evidence for an archaic lunar calendar, the question arises of why the late Republican and early Imperial romans were so concerned with the moon. The answer, I think, is that their interest was purely astrological rather than calendrical.

### *III: Stellar Phases and Agriculture*

Of course lunar phase instructions could apply during any lunar month. But some farming activities are only carried out in certain seasons, or at particular times of the solar year. The Roman agricultural writers give rules for keeping track of these seasons as well. We find two types of dating accompanying the instructions: one is the standard and familiar-looking calendar date, such as “it is best to plough [sloping ground] between the first and thirteenth of September.”<sup>35</sup> The other is more clearly astronomical: “between the vernal equinox and the rising of the Pleiades...”<sup>36</sup> These astronomical dates were used in several ways: firstly to delimit the seasons generally, as in the season lists (in class *F*, above) and secondly to precisely indicate a particular date in the solar year. As the Roman calendar evolved and established a better connection for itself with

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<sup>35</sup> Columella, *RR*, II.iv.11.

<sup>36</sup> Varro, *RR*, I.xxx.



the solar year, the use of stellar phases gradually began to be replaced by, or at least intertwined with, Roman calendar dates. This is why we see post-Julian writers using calendar dates where the Greeks and earlier Romans would have used stellar phases as date indicators.

The relationship between the solar year and the Julian calendar is first made explicit in Varro, and we can see the change from stellar to calendar dates being made:

The first day of spring (the sun) is in Aquarius, of summer in Taurus, of autumn in Leo, of winter in Scorpio. The twenty-third day of each of these four signs is the first day of (each of) the four seasons, and this makes it so that spring has 91 days, summer 94, autumn 91, and winter 89. Which (seasons), rendered in our current civil dates,<sup>37</sup> (sets) the first (day) of the season of spring on the VII id. Feb., of summer on the VII id. May, of autumn on the III id. Sextilius, of winter on the IV id. Nov.<sup>38</sup>

Before the Julian reform, of course, such dating would have been sloppy at best, since the calendar months had a somewhat irregular back-and-forth motion with respect to the seasons.<sup>39</sup>

For the most part, however, it is the stars that delimit the seasons of the year. Thus Varro tells us:

(The year is) divided in eight parts: the first from the (beginning of the) west wind to the vernal equinox, 45 days; from there to the rising of the Pleiades, 44 days; from this to the solstice, 48 days; thence to the sign of the Dog Star,<sup>40</sup> 27 days; from there to the autumn equinox, 67 days; then to the setting of the Pleiades, 32

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<sup>37</sup> *quæ redacta ad dies civiles nostros, qui nunc sunt...*

<sup>38</sup> Varro, *RR*, I.xxviii.

<sup>39</sup> Not that the Julian reform fixed this situation immediately. It was not until Augustus' reign that the bugs got worked out of this system.

<sup>40</sup> *ad caniculæ signum.*

days; from which to the winter solstice 57 days; then to the (beginning of the) west wind, 45 days.<sup>41</sup>

We note that stellar phases, the solstices and equinoxes, as well as a meteorological phenomenon are all used here. This points to a close connection between certain annual weather patterns and stellar reckoning.

Of course the links between weather and the stars are made explicitly obvious in the astrometeorological *parapegmata*, where we get entries of the following sort:

On the 16th of Jan. the sun enters Aquarius, Leo begins to set in the early morning, there is a south-west, or occasionally a south wind with rain.

On Jan. 17th Cancer finishes setting, wintry [weather].<sup>42</sup>

Such day-by-day predictions are much more temporally specific than the seasonal indicators, insofar as they apply only to specific days rather than to a span of time. Nevertheless, their presence in the agricultural treatises indicates their importance for the Roman farmer. We can reasonably speculate that Greek farmers, who presumably had access to public *parapegmata*, as at Miletus, would have had a similar use for them.

Some of the phases more directly governed agricultural practices, thus the best time for activities such as planting was, as Pliny tells us, *magnaue ex parte rationi siderum conexas*.<sup>43</sup>

Vergil says to plant wheat and spelt after the setting of the Pleiades, barley between the autumn equinox and

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<sup>41</sup> Varro, *RR*, I.xxviii.

<sup>42</sup> Columella, *RR*, XI.ii.4.

<sup>43</sup> Pliny, *NH*, XVIII.201.

the winter solstice; vetch, kidney beans and lentils at the setting of Boötes; thus it is that the times of these and other stars are to be set out according to their days.<sup>44</sup>

But he adds that

Some, ignoring the exactness<sup>45</sup> of the heavens, designate (this) calendrically:<sup>46</sup> so flax, oats and poppy (are planted) before the festival of Minerva<sup>47</sup> (as they now do beyond the Po); beans and wheat in the month of November. Thus these people show no concern for nature, where the previous people show too much,<sup>48</sup> and so their exactness is blind. So the matter is treated by farmers and literary men, not only those who know the stars.

But it is acknowledged that it is mostly dependent on the heavens, as Vergil, to be sure, tells us to have foreknowledge of the winds from the habits of the stars above all, just as they are used for navigation.<sup>49</sup>

And it was to keep track of these "habits of the stars" that the astrometeorological and astronomical *parapegmata* were used, in the setting out of seasons generally, the prediction of day-to-day weather, and in the regulation of farming and navigational activity.

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<sup>44</sup> Pliny, *NH*, XVIII.202.

<sup>45</sup> *subtilitas*.

<sup>46</sup> *temporibus*.

<sup>47</sup> Which ran for five days from the fifth day after the Ides of March (i.e., Mar. 19-23).

<sup>48</sup> *ita his nulla naturæ cura est, illis nimia*... I think Pliny says "too much" here not because he thinks that those who use the stars are wrong, but because they do not pay enough attention, in his opinion, to the other causes that can affect the weather. So *NH*, XVIII: "Even though all this depends on stationary stars, fixed in the sky, the motion of [other] stars intervene, affecting the halls and clouds to no small extent, as we have shown, and they disturb the expected arrangement."

<sup>49</sup> Pliny, *NH*, XVIII.205.

*IV: Magic and Physis*

Tavenner thought these astrological beliefs, particularly the lunar ones, depended on "sympathetic magic." But the category of magic is out of place here, and ancient ideas of sympathy are best thought of in terms of physics rather than supernatural forces.

Now, in order to talk of the relation between astronomy and magic in Roman agronomics, it will be first necessary to ascertain what we mean by the term 'magic'. It seems that the ancients were not entirely clear on what they meant by magic, and its definition seems to have been variously reckoned to suit the reckoner. At times during the Roman Empire, laws against magic included all forms of divination and astrology,<sup>50</sup> and modern works on ancient magic subsume these topics as well.<sup>51</sup> But I will argue that it is incorrect to do so, insofar as the ancient astrologers themselves, like their Arab and Renaissance counterparts, saw astrology as more akin to physics than to magic.

We do find some odd practices in the agricultural literature, such as (a) that, according to Democritus, a menstruating woman can cure crops of caterpillar infestation;<sup>52</sup> or (b) that seeds spread

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<sup>50</sup> Barton, 1994, p. 64f.; Linderski, 1996; For a complete treatment of the legal status of Astrology in Roman law up to Diocletian, see Cramer, 1954.

<sup>51</sup> See, e.g., Luck, 1985; Luck, 1990; Thorndike, 1923.

<sup>52</sup> Columella, *RR*, XI.iii.64. She should walk around the plant bed three times barefoot and with her hair hanging loose. See also VII.v.17; VIII.viii.7 for other Democritean magical practices.

from the skin of a hyena will prosper; and many, many others.<sup>53</sup> Lumped together with these are the lunar-phase instructions such as we have seen, above. Judging from their frequency, we can assume that these so-called 'superstitious' practices were of great importance to the ancient farmer. Discussions of, for example, the types of manure to be used on a particular crop, would be followed immediately by a prescription concerning which phase of the moon it was best to spread the manure under,<sup>54</sup> which Tavenner thought depended on a kind of sympathetic magic.<sup>55</sup> But will the ancient practice of farming in accord with the phases of the moon fit a usable definition of magic? I think that it will not.

For, if Tavenner is right about such acts depending on sympathetic magic, then he requires a definition of magic that is considerably more inclusive than we would be comfortable with. A good definition would look something like that of C. Faraone, who, in his *Ancient Greek Love Magic*, sensibly limits the scope of magic to "a set of practical devices and rituals used by the Greeks in their day-to-day lives to control or otherwise influence supernaturally the forces of nature, animals, or other human beings."<sup>56</sup> this definition sees magic as quite limited in scope, since it would, for example, rule out astrology or divination as magical practices, insofar as these do not rely on the imposition of human will on nature. They are rather

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<sup>53</sup> Columella *RR*, II.ix.8. See also Palladius, X.3.

<sup>54</sup> It is best under a waning moon. See, e.g., Cato, *De Agr. Cult.*, XXIX; Pliny, *NH*, XVII.322; Columella, *RR*, II.5.1; II.16.1; II.15.9; Palladius, X.12.

<sup>55</sup> Tavenner, 1918, p. 82.

<sup>56</sup> Faraone, 1999, p. 16; compare also Versnel, 1996, p. 909; Luck, 1985, p. 3; Luck, 1990.

methods of interpreting or reading events using specialized, but not unnatural, knowledge.

But what of sympathy and antipathy, beliefs Tavenner claims to be central to magic? The examples I have cited from Roman agricultural writers seem, as Tavenner was aware, to rely on these for their efficacy. Indeed, Columella specifically tells us that the cure for caterpillars is taken from a work by Democritus entitled *περὶ ἀντιπαθῶν*.<sup>57</sup> But what exactly is this antipathy? Is it magical or physical? Is it reconcilable with a reasonable definition of magic?

In his discussion of sympathy and antipathy, Pliny uses as examples phenomena that we would be hard-pressed to class as magical. He says:

Here the peace and war of Nature with itself will be told, the hatreds and friendships of things deaf and dumb, ... which the Greeks call *sympathy* and *antipathy*, in which all things participate:<sup>58</sup> water extinguishing fire, the sun evaporating water and the moon bringing it forth, ... the magnetic stone drawing iron to itself, another kind repelling it from itself..<sup>59</sup>

But then, as though to confound us, he adds that "adamant, a rare and delightful wonder,<sup>60</sup> unbreakable and unconquerable by any other force, is smashed by goat's blood," which the translator of the Loeb edition amusingly sees fit to point out is "of course untrue."<sup>61</sup>

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<sup>57</sup> Columella, *RR*, XI.iii.64.

<sup>58</sup> *quibus cuncta constant*.

<sup>59</sup> Pliny, *NH*, XX.1-2; For further non-magical examples, see, e.g., XXIV.3 where Pliny says that gum is removed by vinegar, but ink by water, or that oil and water will not mix.

<sup>60</sup> *adamanta rarum opum gaudium*.

<sup>61</sup> Pliny, *NH*, p. 210 n.

Likewise, Cicero's arguments about the *cognatio in natura rerum* offers us the following:

Yet I do concede that there is a sympathy (*cognatio*) [between] the different bits in the nature of things. And the Stoics have drawn inferences from many [examples]. The livers of mice are said to grow larger in winter, and dried fleabane to bloom on the exact day of the solstice, and its seed-pods inflate and the seeds in them spread out in all directions; in a lyre, when some strings are struck, different ones resonate;<sup>62</sup> it befalls oysters and all shellfish to grow and decrease with the moon; trees are easiest to fell in winter under a waning moon, for then they are dry.<sup>63</sup>

It could be argued that, as in Pliny, some of his examples have moved us out of the realm of physics into that of fantasy or superstition, but is this a fair assessment to make?

As anthropologists have done,<sup>64</sup> we need to resist the urge to dismiss such beliefs as credulous and deluded, or as somehow 'inferior' to rational scientific practice, and try to see it in the cultural contexts in which it is manifest. Where Malinowski classed magic as a pseudo-science,<sup>65</sup> we should rather try to see whether and when the very distinction between magic and science makes any sense in the intellectual contexts we are studying. Now, I would not dismiss the category of magic outright, but I do think we should be

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<sup>62</sup> Plotinus, IV.iv.41 uses the same example.

<sup>63</sup> Cicero, *De Div.*, II.xiv.33.

<sup>64</sup> The views of Tyler, 1871, Frazer, 1900, and Mauss, 1902-, which saw magic as superstitious and inferior to scientific rationality began to be modified by Malinowski, 1948 and Evans-Pritchard, 1937. Challenges to the methodology used to compare magic and science are raised by Douglas, 1984, and Peel, 1969 rejects the classification outright, since it is, Peel argues, always value-laden and culturally conditioned. Brown, 1997, argues for maintaining magic as a classification for certain activities, but warns that we need to be careful not to imply value-judgments when using the term.

<sup>65</sup> One might well ask why he did not class science as pseudo-magic.

careful to keep its signification clear. Michael Brown has tentatively defended the term magic as (ideally) a value-neutral classification for kinds of practices which rely on symbol and metaphor in their causal nexus, as opposed to physical causation.<sup>66</sup> This definition would, I think, be conformable to Faraone's (or *vice versa*), and would include, for example, such mechanisms as Plotinus' idea of *ὁμοιότης*.<sup>67</sup>

Now, Faraone's definition would not, I think, be contended in its essence by a practicing magician, nor does it place the 'scientific' observer in a privileged ontological position. But as I noted, it limits magic to particular kinds of practices involving (a) supersensual powers and (b) the imposition of human will on the world, practices such as sorcery, necromancy, love magic, and even medicinal magic.<sup>68</sup> This distinguishes magic from other practices such as astrology and divination, which are interpretive and predictive, rather than interventional, and do not rely on supersensual powers any more than the operation of gravity does.

Magic, then, should not imply superstitious nonsense, nor should we dismiss the beliefs of the ancients as naïve and deluded. If Pliny saw the extinction of fire by water and the destruction of adamant by goat's blood, or Cicero the blooming of fleabane only on the winter solstice and the sympathetic vibration of the strings of the

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<sup>66</sup> Brown, 1997.

<sup>67</sup> Plotinus, IV.iv.

<sup>68</sup> I say this last with extreme caution, because a thorough disentanglement of ancient medicine from magic, if even possible, would involve a whole other book. For example, the ancient notion of the healing drug, the *φάρμακον*, is intimately tied with magic and yet it is tempting to see it from a modern point of view as medical technology.



lyre as the same sort of thing, then we must concede that, in the worlds of these two undeniably intelligent men, these phenomena were of a kind, neither belief more foolish than the other.<sup>69</sup> With Quine, we can prefer not to live in such a world, but we cannot refute its epistemological foundations.<sup>70</sup>

Now, I should clarify the phrase 'supernaturally influence the forces of nature,' from the definition of magic that I took from Faraone, specifically to draw attention to the view that the interventionist magical approaches share of the causal network, where things can affect other bodies without actually touching, contrary (for example) to Aristotle's *Physics*.<sup>71</sup> Forces are operative in the magical universe which are non-physical, but nonetheless real.<sup>72</sup> But is sympathy such a non-natural force, or is it more precisely physical in nature, operating by means of contact?

This turns out to be a difficult question to answer. In some authors, such as Pliny and Cicero, we are told what sympathy *does*, but not exactly what it is. Whereas in the Stoics it is physical, but also bound up with the divine, and hence, is physical. And while the parapegmatisms are not Stoics, the Stoic conception does show us that sympathy was natural, rather than supernatural in antiquity.

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<sup>69</sup> See Kuhn, 1970, p. 111-135.

<sup>70</sup> Quine, 1953, p. 44: "Physical objects are ... irreducible posits comparable, epistemologically, to the gods of Homer. For my part I do, qua lay physicist, believe in physical objects and not in Homer's gods, ... but in point of epistemological footing the physical objects and the gods differ only in degree but not in kind."

<sup>71</sup> Aristotle, *Phys.*, VII.245b; VIII.528a.

<sup>72</sup> See Brown, 1997, p. 126-130.

The Stoic conception seems readily applicable to the question at hand. Cicero sees the existence of sympathy as evidence of the divine in nature,<sup>73</sup> and Chrysippus, Antipater and Posidonius are reported to have believed something similar.<sup>74</sup> Alexander of Aphrodisias also reports that Stoic sympathy depended on the presence of the divine in nature.<sup>75</sup> Sextus Empiricus outlines the Stoic theory of the unity of the Cosmos and the sympathies that betray it. His examples include, as in Cicero, that creatures wax and wane with the moon, and

So also from the risings and settings of certain stars there are changes in the atmosphere and variations in the air, sometimes for the better, and sometimes pestilential, from which it is manifest that the Cosmos is ordered as a unified body.<sup>76</sup>

He seems to be implying physicality here, insofar as he says that the Stoics thought that sympathy proved the Cosmos to be *a unified body*. This is confirmed later in the passage when he says that the changes in the weather brought about by the heavenly bodies by means of sympathy were seen as evidence that the Cosmos was a *physically* cohesive entity:

But the Cosmos submits to notable changes, such that the atmosphere becomes sometimes cold and sometimes hot, sometimes dry and sometimes wet, and in other ways changing according to the motions of the celestial (bodies). So the Cosmos is not held together by mere arrangement, but rather by *physis*.<sup>77</sup>

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<sup>73</sup> Cicero, *De nat. deor.*, II.vii.19.

<sup>74</sup> Cicero, *De div.*, II.xiv.35.

<sup>75</sup> Alexander of Aphrodisias, *De mixtione*, 223.25 f.

<sup>76</sup> Sextus Empiricus, *Adv. math.*, VII.79.

<sup>77</sup> Sextus Empiricus, *Adv. math.*, VII.83-4.

But we need to be cautious about reading too much into the use of the word *physis* here. It often carries meanings in Greek quite separate from ideas of *physicality*. Indeed, it is used in Homer to describe the *nature* of the magical plant  $\mu\omega\lambda\upsilon$ .<sup>78</sup> Fortunately, Sextus is clear about his use, and he defines the sense of *physical cohesion* as the way a plant is held together as a unified entity: certainly it is not metaphysical.<sup>79</sup>

All this occurs in the context of a proof of the existence of the gods, thus, like the other sources for the Stoic doctrine, tying the idea of sympathy in with the divine. But god, for the Stoics, is an all-pervasive *pneuma*,<sup>80</sup> which is equated with soul,<sup>81</sup> a corporeal entity.<sup>82</sup> Thus sympathy exists only as a corporeal, i.e., physical force. Indeed, on the Stoic conception, sympathy can only act on physical bodies if it is itself physical.<sup>83</sup>

Although the parapegmatis and agricultural writers are not necessarily Stoics, and do not offer us the same depth of explanation as the Stoics, I think that the Stoic conception of sympathy at least gives us an indication of how naturalistic the concept was in antiquity, and so allows us to move away from the overly-limiting and inaccurate classification of sympathy as magical or supernatural.<sup>84</sup>

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<sup>78</sup> Homer, *Od.*, X.303.

<sup>79</sup> Sextus Empiricus, *Adv. math.*, VII.81.

<sup>80</sup> See Aetius, 1.7.33; Alexander of Aphrodisias, *De mixtone*, 223.25.

<sup>81</sup> Calcidius, 220.

<sup>82</sup> Nemesius, 78.7-79.2; 81.6-10.

<sup>83</sup> See, e.g., Cicero, *Acad.*, I.39; Sextus Empiricus, *Adv. math.*, 8.263.

<sup>84</sup> For the open question of how pervasive the Stoic idea of sympathy was in antiquity, see the discussion in Dillon, 1996, p. 106 f.

*Conclusion*

The astrometeorological, astrological, and astronomical parapegmata were used in Roman and probably also Greek agriculture to regulate a wide variety of activities with the aim of according the farmer's actions with the perfectly natural forces of sympathy and antipathy.

## Chapter Seven

# Calendars, Weather, and Stars in Babylon

*Never mix your cement when the moon is in Libra*  
-Kevin McNamee

### *Introduction:*

In this chapter, I will look at various Mesopotamian sources of weather, calendrical, and stellar omina. While none of these texts directly parallel the classical paraepigmatic tradition, we will see that there are scattered omina which show similarities to parts of the different types of paraepigmata. Most similar to the classical paraepigmata is MUL.APIN, which has a list of schematic heliacal rising dates, and some seasonal meteorological predictions.

Although there are other texts (the *astrolabes*) which associate months and stars, I will argue that these were more likely mythological associations, which were used in omina, rather than truly representing the *dates* of the stellar phases. I begin by assessing a group of arguments about stellar observations for the purposes of determining intercalations in Mesopotamia, and then go on to look at weather omina in MUL.APIN and *Enuma Anu Enlil*.

*I: Astronomy and the Babylonian Calendar*

The Mesopotamian calendars were luni-solar.<sup>1</sup> Months were counted from first sighting of new moon crescent to first sighting of new moon crescent, although it would seem (from the almost total lack of any attested months longer than 30 days) that some rule was in place to prevent the month from running beyond 30 days, even in cloudy weather.<sup>2</sup> Months were intercalated from time to time, to keep the year roughly in line with the seasons.

As early as the Sumerian period (third millennium B.C.), there is some indication that astronomy was associated with the regulation of the agricultural year. Koch-Westenholz says:

Two of [the goddess] Nisaba's characteristic traits [are] her lapis-lazuli tablet, originally associated with astronomy, and her management and fair distribution of agricultural products .... The overall impression given by the Sumerian sources is that Nisaba was mainly concerned with the management of agriculture and the timing of activities that were dependent on the yearly seasons. The knowledge of astronomy ... attributed to her was used to correct the vagaries of the lunar calendar.<sup>3</sup>

And in a note, she adds: "This is a fairly exact rephrasing in our terms of the statement in *Lugal-e* 721, 'together with Suen, she counts the days'.<sup>4</sup> But this is more than a simple rephrasing.

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<sup>1</sup> With the exception of the Assyrian calendar before the late second millennium, which was lunar.

<sup>2</sup> For a discussion of month length, see Huber, 1982.

<sup>3</sup> Koch-Westenholz, 1995, p. 33.

<sup>4</sup> Koch-Westenholz, 1995, p. 33, n. 3.

'Counting the days,' for example, is considerably less specific than 'timing activities that were dependent on the yearly seasons' and 'correcting the vagaries of the lunar calendar.' Nonetheless, we do note that agriculture, astronomy, and dating are *somehow* combined in this Sumerian deity's functions and attributes, and so may have represented a set of related practices in Sumerian society.

In any case, we do know that the periodic insertion of an intercalary month in the Babylonian calendar<sup>5</sup> was meant to keep the lunar calendar roughly in line with the agricultural year. By probably the fifth century, intercalation was regulated by a 19-year cycle (the Uruk scheme),<sup>6</sup> but before then the intercalations were sporadic.

#### *I.i: Intercalation and the Astrolabes*

Horowitz has recently argued that the heliacal risings of selected fixed stars were used to determine whether or not a particular year would be intercalated.<sup>7</sup> More specifically, he claims that the Babylonian *astrolabes*,<sup>8</sup> which were simple lists of three stars for each month of the year, were used to determine which stars should rise in which lunar month. He bases this in part on a report by one of Assurbanipal's scribes: "Let them intercalate a month. All the stars

<sup>5</sup> The practice of intercalation was also taken up in Assyria beginning in late second millennium. See Weidner, 1935, p. 28-9; Horowitz, 1996, p. 37, n.5.

<sup>6</sup> On which, see Rochberg-Halton, 1992, p. 810. I have argued in chapter 4 that the 19-year Uruk scheme may have been used as a prototype for the Metonic cycle.

<sup>7</sup> Horowitz, 1996. This claim was earlier made by Weidner, 1928-, p. 72-3.

<sup>8</sup> The name *astrolabe* is perhaps unfortunate, since these instruments are completely unrelated to the more modern instruments known as *astrolabes*.

of heaven are late. Let Adar not pass unluckily. Let them intercalate it."<sup>9</sup> There are also omens pertaining to 'early' and 'late' risings of stars (e.g., in *EAE* 51, on which, see below).

But there is also abundant evidence for a three-year intercalation cycle,<sup>10</sup> as well as for a 360-day stellar year,<sup>11</sup> and it is unclear how or if these were supposed to be used in conjunction with the lunar calendar and the astrolabes, or whether there were regional, professional, or other uses for each cycle. Lastly, Hunger and Reiner, and Cohen after them, raise the (not unlikely) possibility that intercalations were based on observations of agricultural and meteorological phenomena up until the first millennium.<sup>12</sup>

Moreover, there are some problems with seeing the astrolabes in particular as listing ideal heliacal risings, which Horowitz does not offer any argument to dispel: in the first place, the associations of the stars with particular months and the three 'paths'<sup>13</sup> seems to be in part purely mythological,<sup>14</sup> in the second place, some of the stars in the astrolabes are planets, with no annual cycles to preserve in a calendar, and in the third place, two of the stars are circumpolar, and it is difficult to see how these might have been used in a calendar.<sup>15</sup>

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<sup>9</sup> Hunger, 1992, no. 98, rev. 8-10; Horowitz, 1996, p. 38.

<sup>10</sup> See Hunger and Pingree, *MUL.APIN*, II.ii.11-12; Horowitz, 1996, p. 39-41.

<sup>11</sup> See Hunger and Pingree, *MUL.APIN*, I.iii.35-50; Horowitz, 1996, p. 38-40.

<sup>12</sup> Hunger and Reiner, 1975, p. 21; Cohen, 1993, p. 5.

<sup>13</sup> The 'paths' or Ea, Anu, and Enlll probably refer to segments of the horizon over which the stars were seen to rise. See Reiner and Pingree, 1975-, vol. II, p. 17.

<sup>14</sup> Reiner and Pingree, 1975- vol. II, p. 3; Hunger and Pingree, 1999, p. 63; Langdon, 1935, p. 10, f.

<sup>15</sup> See Hunger and Pingree, 1999, p. 50 f. Langdon tries to use the modern composite reconstruction known as "Pinches' astrolabe" together with the menologies to reconstruct features of (a) an archaic Sumerian calendar, which started with the month of Nisannu at the rising of the Pleiades, and (b) a prehistoric calendar which began with the autumn equinox (Langdon, 1935, p.



*I.I.a: Intercalation and 'Astrolabe B'*

*Astrolabe B*,<sup>16</sup> unlike the other astrolabes, states explicitly that the stars named rise in their month. The text itself was copied at Assur in the late second millennium,<sup>17</sup> and is the oldest of the astrolabes. It is a bilingual Sumerian/Akkadian text. Cohen notes that it is unclear whether Akkadian or Sumerian is the original language.<sup>18</sup> He notes further that the translation from the one language to the other is "inexact". Part A of this text<sup>19</sup> associates each of the twelve months with a constellation and a god, as well as with mythological events:

Month of Nisannu, Pegasus, seat of Anu<sup>20</sup>  
the king is installed, the king is appointed;<sup>21</sup>  
a good beginning<sup>22</sup> for Anu  
and Enlil; month of Nanna-Suen,  
oldest son of Enlil.<sup>23</sup>

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1-2, 21, 67], but he falls prey to the same problems with the astrolabes as Horowitz does.

<sup>16</sup> Published by Schroeder, 1920, #218; Transcribed in Weidner, 1915, 66-7; 76-79; 85-87; A much improved transcription of section A can be found in Reiner and Pingree, 1975-, vol. II, p. 81-82. For duplicates of *Astrolabe B*, see Cagırgan, 1985. W. Horowitz has promised a new edition of the astrolabes as part of the *AfO Beiheft Series* (Horowitz, 1996, p. 37, n. 5).

<sup>17</sup> During the reign of Tiglath-Pileser I (1113-1075 B.C.), according to Horowitz, 1996, p. 37 n.5; van der Waerden, 1949, p. 10. Hunger and Pingree, 1999, p. 51, date it to the reign of Ninurta-apil-Ekur (1191 B.C.-1179 B.C.).

<sup>18</sup> Cohen, 1993, p. 306, n. 4.

<sup>19</sup> The best transcription is in Reiner and Pingree, 1975-, vol. II, p. 81-82.

<sup>20</sup> Weidner, 1915, p. 87, adds a verb to this sentence in his translation: "Zum monat Nisan gehört der <sup>kakkab</sup>DIL-GAN..."

<sup>21</sup> *šarru iššagan*. Weidner translates this as "der König wird proklamiert" and Cohen, 1993, p 306, as "the king is invested (with authority)."

<sup>22</sup> *šurrum damqum*. I am unsure why Cohen leaves *šurrum* untranslated: "a good ... for Anu and Enlil."

<sup>23</sup> *Astrolabe B*, A.I.7-11; For a text closely related to this section, see Reiner and Pingree, 1975-, vol. II, *Text X*, lines 24-35 and 37-49.

Some agricultural activities are associated with months as well.<sup>24</sup>

Part B<sup>25</sup> of this text is a list of stars in the paths of Ea, Anu, and Enlil, and part C<sup>26</sup> lists three constellations, each in its path, for each month, and then says that those three constellations rise in that month, and that three other constellations set.<sup>27</sup> The constellations which are said to set are specifically those that rise six months later. For example:

Month of Nisannu: Pegasus, *Dilbat*, and the Plough Star rise; Vela, the Scales, and *Entenabarḫum*<sup>28</sup> set.

Month of Ajaru: the Pleiades, the Old Man, and *Anunītu* rise; the Mad Dog, the Scorpion, and the King set.<sup>29</sup>

and six months after Ajaru:

Month of Arahsamna: the Mad Dog, the Scorpion, and the King rise; the Pleiades, the Old Man, and *Anunītu* set.<sup>30</sup>

The main problem with seeing this as some kind of intercalation rule is that this schematic six-month difference is astronomically impossible, and so could not have been used to regulate the calendar. Hunger and Pingree, in a discussion of a similar passage in MUL.APIN, point this out most forcefully:

This list is meaningless as an astronomical document (it is basically mythological), as is also the list at the

<sup>24</sup> E.g., at I.19-25; I.45-50; II.43-6.

<sup>25</sup> Transcribed in Weidner, 1915, p. 76-9.

<sup>26</sup> Transcribed in Weidner, 1915, p. 66-7.

<sup>27</sup> There is a minor departure from this formula in the month of Tešritu, lines 25-6.

<sup>28</sup> Weidner transcribes this as EN.TE.NA.MAŠ.ŠIG. *Entenabarḫum* is equated with part of Centaurus in Koch-Westenholz, 1995, p. 207. In Reiner and Pingree's catalogue, MUL.EN.TE.NA.BAR.ḪUM = *ḫabašīrānu*, "Centaurus". (Reiner and Pingree, 1975-, vol. II, p. 10-16). Labat, 1988, p. 303, reads MUL.EN.TE.NA.BAR.HUM as *ḫašīrānu*.

<sup>29</sup> Astrolabe B, part C, lines 13-16.

<sup>30</sup> Astrolabe B, part C, lines 25-28.

end of *Astrolabe B* where this list is mechanically converted into one in which three constellations rise in a month and three set. The person who composed this totally misunderstood the nature of his source (already in -1100!) and unfortunately misled several scholars of this century.<sup>31</sup>

Donbaz and Koch have published yet another type of astrolabe,<sup>32</sup> which they argue was used for the determination of intercalary years, but this interpretation has been sensibly questioned by Hunger and Pingree.<sup>33</sup>

On balance, I think the fact that the astrolabes in general prove unworkable as astronomical calendar regulation devices indicates that they were probably not intended as such.

#### *I.ii: Intercalation in MUL.APIN*

*MUL.APIN* (*'The Plough Star'*) is an early first millennium astronomical compilation,<sup>34</sup> which includes a star list, a list of heliacal rising dates and another of their date differences, a dated list of *ziqpu* stars,<sup>35</sup> and a list of constellations in the path of the moon. There is some planetary material as well, including periods of planetary visibility and invisibility. In *MUL.APIN* we also find explicit observational astronomical rules for determining intercalation, according to two distinct schemes:<sup>36</sup> one at II.i.9-24, and the other at

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<sup>31</sup> Hunger and Pingree, 1999, p. 63.

<sup>32</sup> Donbaz and Koch, 1995.

<sup>33</sup> Hunger and Pingree, 1999, p. 57.

<sup>34</sup> Published by Hunger and Pingree, *MUL.APIN*.

<sup>35</sup> *ziqpu* stars are those that culminate just when another known star is rising.

<sup>36</sup> See Hunger and Pingree, *MUL.APIN*, p. 150-152.

II Gap A.1-ii.20. The first uses stellar phases together with the moon's position relative to the Pleiades or the Hired Man to determine whether a given year is intercalary. The second uses ideal equinox dates and the risings of certain stars, together with the conjunctions of the moon with the Pleiades on particular dates to determine intercalation. We should note the central role of the moon in both of these schemes, which distinguishes them from the strictly stellar schemes that scholars have argued for in the astrolabes. As Hunger and Reiner have shown, evidence from attested dates indicates that this *Pleiaden-Schaltregel* may not have actually been implemented in practice,<sup>37</sup> and different versions of it are contradictory.<sup>38</sup>

## *II: The Fixed Stars and Weather Omina in EAE 50 and 51*

The celestial omen series *Enuma Anu Enlil* ('When Anu and Enlil') was first published as *L'Astrologie Chaldéenne (ACh)* by Virolleaud.<sup>39</sup> More tablets have since been discovered, as well as mistakes in his original publication. Newer editions and translations of parts (but by no means all) of this important series have since been published,<sup>40</sup> and this work continues. The series itself consists of 68 or 70 tablets of omina, and dates as a collection from around the beginning of the

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<sup>37</sup> See Hunger and Reiner, 1975, p. 26-8; Rochberg-Halton, 1992, p. 811.

<sup>38</sup> Hunger and Reiner, 1975, p. 28.

<sup>39</sup> Virolleaud, 1908-.

<sup>40</sup> Reiner and Pingree, 1975-; Rochberg-Halton, 1988; Al-Rawi and George, 1991; van Soldt, 1995.

first millennium B.C.,<sup>41</sup> although much of it is probably derived from older material. Tablets 1-22/23<sup>42</sup> contain lunar omina, 23/24-39/40 solar omina, 40-49/50 meteorological omina, and the remainder planetary and stellar omina. A sample of weather apodoses from *EAE* Tablet 50 is as follows:

- I.17: The Star of the sunset (is) for (*ana*) raining.
- II. 1: The Rainbow (is) for raining [...]
- II.3: The False star (is) for the rising of wind.
- II.14b: *Dāpinu*<sup>43</sup> (is) for [...] wind.
- III.4: The Rainbow (is) for not raining.
- III.4a: "When on a cloudy day when it has rained a rainbow has arched, it will not rain."
- III.5: *Entenabarḫum* (is) for early wind.
- III.5c: ... the early-sown cultivated field will be fine, at the end of the year rain will cease.
- III.6: *Šārīru*<sup>44</sup> (is) for the rising of wind.
- III 6b: "When *Šārīru* has been red, the flood will increase."
- III.6c: "When the Field's stars have been very red, the flood will increase."<sup>45</sup>
- III.7: The False star (is) for the rising of wind.

What we should note here is that only a minority of the omens have clearly stated protases and apodoses ("When the Flashing star is very red, the flood will increase"). For the most part, there are only associations of stars with weather phenomena ("*Entenabarḫum* (is) for

<sup>41</sup> Hunger and Pingree, 1999, p. 12 date it to the first millennium B.C., Koch-Westenholz, 1995, p. 78, to the 11th century.

<sup>42</sup> Different recensions sometimes have different tablet numbers, and occasionally even combine the omens differently from more than one tablet. For a discussion of the variations in the recension, see Koch-Westenholz, 1995, p. 75-6; 79-82.

<sup>43</sup> MUL.UD.AL.TAR = *Dāpinu*, a name for Jupiter. Reiner and Pingree translate this literally, as "the Herolc".

<sup>44</sup> MUL.AN.TA.SUR.RA. Reiner and Pingree translate this as "the Flashing Star," and comment that it probably refers to a shooting star or meteor. Labat, 1988, p. 301, simply translates it as "Brillante".

<sup>45</sup> The Field, MUL.AŠ.GĀN, is α. β. and γ Peg, and α And. See Reiner and Pingree, 1975-, vol. II, p. 11.

early wind"), but the precise nature of this association is not made explicit. A similar formula appears in the "Great Star List."<sup>46</sup>

Tablet 51 contains a list of stars and the lunar months of their ideal risings (and occasionally their settings), as well as omens derived from their risings. The months of their risings are 'ideal' in the sense that when the star rises in this month, it is generally taken as a non-ominous event. It is usually seen as ominous when the star rises either before or after its ideal month. For example:<sup>47</sup>

- IX.1: The Field rises heliacally in Nisannu. When this star has risen early: [...] When this star has risen late and has passed by its month and has risen [...]  
 IX.2: The Bristle rises heliacally in Ajaru. When this star has risen early, the gods will give good counsel to the land. When this star is late and has passed by its month and has risen [...]

There are some agricultural and meteorological omens, such as:

- IX.11: In Nisannu, the star of the field [...]. When it has risen heliacally at its specified time, the irrigated land and the cultivated lands in the land will prosper. When it has risen heliacally not at its specified time, the irrigated land and the cultivated lands will not prosper. [...] will not bring forth [...]  
 X.23: In Addaru the Fish, Ea, [lord of] mankind [...] high water will mount in the springs. When [it has risen] not at its specified time, rain and high water will be scarce in the springs.<sup>48</sup>

As Reiner and Pingree show, Tablet 51 derives from a tradition closely related to *Astrolabe B*, and indeed, parts of their *Text X* duplicate parts of *Astrolabe B*.<sup>49</sup>

<sup>46</sup> Published and translated by Koch-Westenholz, 1995, *Appendix B*.

<sup>47</sup> This follows Reiner and Pingree's translation, with minor changes.

<sup>48</sup> *Text X* is related to, but not a duplicate of *Text IX* (from which the previous three examples were taken). For commentary, see Reiner and Pingree, 1975-, vol. II, p. 52-4.

<sup>49</sup> Reiner and Pingree, 1975-, vol. II, p. 1; 52-4.

The *EAE* omens in general are somewhat different from the astrometeorology we have been looking at in the other chapters of this work. The weather omens do not derive simply from the phases of the stars. Rather we find the unspecified relation of a star with a weather phenomena where the 'stars' mentioned may not even all be stars: there are the 'Flashing star' (a meteor?) and the 'False star', for example. There are also omens derived from the apparent colours of stars.<sup>50</sup> The most complex of the fixed-star omens involve the timing of their phases in the Babylonian lunar calendar. A phase which occurs in the specified month is seen as non-ominous, and an early or late phase as ominous. There is no parallel for this in Egypt, Greece, or Rome.

I should perhaps also mention a unique weather-omen, which seems to be derived from an intercalation rule, in the text K. 3923 + 6140 + 83-1-18, 479.<sup>51</sup> It says:

When, in the month of Addaru, on the 25th d[ay, you  
[have observed the Pleiades and the moon and they]  
[had the same longitude, then this year is normal;]  
[when they have fallen down, then it is left]  
[behind...]<sup>52</sup>  
Good winds will come [...]<sup>53</sup>

It is unclear whether this may be related to the *EAE* omens.

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<sup>50</sup> Compare also lines 150-153 of the *Great Star List* in Koch-Westenholz, 1995, p. 192-195 and Hunger and Pingree, *MULAPIN*, II.iii.33; II.iv.1-2.

<sup>51</sup> Text A in Hunger and Reiner, 1975, p. 22. My translation follows Hunger and Reiner's, with minor modifications.

<sup>52</sup> The reconstruction here is based on the formula throughout the rest of the text. It is of course unclear whether part of this formula or some extra (now lost) material was meant to be the protasis to the meteorological apodosis.

<sup>53</sup> Line I A in Hunger and Reiner, 1975, p. 22.

*III: Meteorology in MUL.APIN*

It is in MUL.APIN that we see texts which most resemble the *parapegmata*, although without the level of precision and detail generally found in the classical texts. MUL.APIN I.ii.36-iii.12 schematically dates the heliacal risings of certain fixed stars. These ideal dates of visibility are paired, with the culminations of other constellations (*ziqpu* stars) later in the text.<sup>54</sup> The list is schematic, insofar as all the dates given are either the first, fifth, tenth, fifteenth, twentieth, or twenty-fifth of the month. It is useful as a sequential ordering of risings, but with only approximate dates. These heliacal risings are followed by the related lists of the simultaneous risings and settings of fixed stars, and the schematic date differences (again, all multiples of five days) between the heliacal risings. It is unclear how these lists were used.

At the risings of certain stars we are told to "observe the wind that blows,"<sup>55</sup> and later, certain stars are related to wind directions with the formula "constellation *x* lies across (*ina* ZI) wind *y*,"<sup>56</sup> which has been generally taken to mean simply that it lies in one of the four cardinal directions.<sup>57</sup>

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<sup>54</sup> Hunger and Pingree, *MUL.APIN*, I.iv.13-I.iv.30

<sup>55</sup> Hunger and Pingree, *MUL.APIN*, II.i.25-37; a similar admonition for the observation of Mercury at harvest time occurs at II.i.58.

<sup>56</sup> Hunger and Pingree, *MUL.APIN*, II.i.68-71. I follow Hunger and Pingree's interpretation of *ina* ZI tentatively. For the normal meanings of ZI in the astronomical texts, see Neugebauer, *ACT*, p. 496-7.

<sup>57</sup> See, e.g., Hunger and Pingree, 1999, p. 73.



General seasonal meteorological predictions are derived from the sun's presence in each of the three paths of Anu, Enlil, and Ea, and these are related to their calendar months:

From the first of Addaru until the 30th of Ajaru the sun stands in the path of the Anu stars; wind and weather.

From the first of Simanu until the 30th of Abu the sun stands in the path of the Enlil stars, harvest and heat.

From the first of Ulūlu until the 30th of Arahšamna the sun stands in the path of the Anu stars; wind and weather.

From the first of Kislīmu until the 30th of Šabatu the sun stands in the path of the Ea stars; cold.<sup>58</sup>

The omens at the end of MUL.APIN include some meteorological and agricultural predictions, such as "When the U.RI.RI-star (Mercury?)<sup>59</sup> has been seen, rain and flood;"<sup>60</sup> "When the star of Marduk has been seen at the beginning of the year, in this year the crop will prosper."<sup>61</sup> I note that all such omens seem to be either (a) derived from what appear to be planets, or (b) are related to the colour, or brightness of stars at their rising, rather than to the phases themselves.

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<sup>58</sup> Hunger and Pingree, *MUL.APIN*, II.Gap A.1-8.

<sup>59</sup> See Hunger and Pingree, *MUL.APIN*, p. 134, commentary on III.22.

<sup>60</sup> Hunger and Pingree, *MUL.APIN*, II.III.22. Compare II.I.57.

<sup>61</sup> II.Gap B.1.

#### IV: *The Diaries*

The astronomical *Diaries* published by Sachs and Hunger<sup>62</sup> are night by night observation<sup>63</sup> records of astronomical, celestial, and meteorological phenomena, as well as such things as commodity prices, river levels, and political events. Thus we find entries such as:

Night of the 15th, last part of the night, the moon was 2 1/2 cubits in front of [γ] Capricorni. The 15th, gusty north wind.<sup>64</sup>

That month, the equivalent (of 1 shekel of silver was): barley, 1 pān 1 sūt 1 1/2 qa, in the middle of the month, 1 pān 1 sūt 3 qa, at the end of the month 1 pān 1 sūt 1 1/2 qa; dates 1 pān 3 qa [...] At that time, Jupiter and Saturn were in Gemini; Venu[s] was in Virgo; Malrs was in Virgo, at the end of the month, in Libra; Mercury, which had set, was not visible.

That month the river level - remainder 1/2 cubit and 8 fingers...[...]<sup>65</sup>

There has been much debate about the purpose of the diaries. Swerdlow argues that they were tied to omen-watching,<sup>66</sup> and Slotsky, Hunger, and Pingree have argued that they were primarily for the determination of astronomical values.<sup>67</sup> But two parts of Hunger and Pingree's argument will not stand: (1) they claim that "the weather is reported [in the *Diaries*] because it affects observations,"<sup>68</sup> but this can not account for the frequent mentions of wind direction,

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<sup>62</sup> Sachs and Hunger, 1988.

<sup>63</sup> Occasionally astronomical phenomena are computed. See Sachs, 1948, p. 271.

<sup>64</sup> Sachs and Hunger, 1988, -324, B obv. 21.

<sup>65</sup> Sachs and Hunger, 1988, -324, B rev. 9-11.

<sup>66</sup> Swerdlow, 1998.

<sup>67</sup> Slotsky, 1997; Hunger and Pingree, 1999, p. 139-140.

<sup>68</sup> Hunger and Pingree, 1999, p. 140.

or entries such as "The 26th, cold north wind,"<sup>69</sup> which do not affect observation at all; and (2) they claim that "the *Diaries* treat periodic phenomena as predictable; this deprives them of their meaning as omens."<sup>70</sup> If this were true, then there can be no explanation for the frequent use of, for example, eclipses (which were predictable) as ominous portents in official reports and letters. I think here they pin too much on the idea that *randomness* must somehow be inherent in omens. A third point I would raise is that there is no reason to suppose that economic phenomena could be seen as periodic, but that weather was not.

This being said, I still do not think that the purpose of the *Diaries* is clear. What we can say is that they kept track of, among other things, various astronomical phenomena, as well as various meteorological phenomena, but whether or how these were seen to be related is still unknown.

#### V: *Good and Bad Luck Days in the Babylonian Calendar*

As in Egypt and Rome, the Mesopotamians ascribed good and bad luck to different calendar dates. There are a group of Akkadian texts, called *hemerologies* or *menologies*<sup>71</sup> which tell us that particular lunar calendar dates were in general favourable or unfavourable, and more

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<sup>69</sup> Sachs and Hunger, 1988, -369, rev. 12.

<sup>70</sup> Hunger and Pingree, 1999, p. 140.

<sup>71</sup> For a detailed description as well as an edition and translation, see Labat, 1939 and Labat, 1965. Compare the Egyptian *Calendar of Lucky and Unlucky Days*, in chapter 8, below. In this work, I will refer to both the *menologies* and the *hemerologies* as 'hemerologies'.

specifically also offer lists of activities which were prescribed or proscribed for each day. Many of these activities were of a religious nature (e.g., "an offering to Anu will be accepted"), but some economic, medical, divinatory, and dietary proscriptions are also found. There are some astrological omens, and some stellar divinities (the Pleiades, Orion) are mentioned as being receptive to offerings on particular dates in one of the texts.<sup>72</sup> Some tablets list the months favourable for certain activities,<sup>73</sup> and others derive omina from activities performed in certain months.<sup>74</sup> These texts are somewhat more formulaically and topically diverse than their Egyptian and Roman counterparts.

#### *VI: Other Texts*

There are two interesting astrometeorological texts (TU 19 and 20) edited by Hunger<sup>75</sup> which use certain planetary phenomena to predict weather. The phenomena of the protases include oppositions of Jupiter and Mars, conjunctions of Mercury and Venus, planetary passings through certain constellations (including the Pleiades and

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<sup>72</sup> See KAR 178 (in Labat, 1939, p. 61-2), on the 18th and 19th of Nisannu, respectively.

<sup>73</sup> Thus "The king purifies his garments: Nisannu, Ajaru, Simanu, Abu, and Tašritu are favourable" (KAR 177 obv. 2.25-27, in Labat, 1939, p. 155).

<sup>74</sup> E.g., "When, in the month of Nisan, the foundations of a house have been built on the 16th day, the house will not be finished." (Labat, 1965, §2.1.)

<sup>75</sup> Hunger, 1976.

Perseus], and more. TU 20, like TU 11, has a 'goal-year' type of scheme for predicting the weather.<sup>76</sup>

I should also note, at least in passing, the existence of a late tenth or early ninth century B.C. Hebrew agricultural 'calendar' that reports the activities for each (unnamed) month of the year, beginning with the fall harvest. It is written in verse on a stone with a single hole in the middle, presumably for mounting it for display. In its entirety it reads:

His two months are (olive) harvest,  
 His two months are planting (grain),  
 His two months are late planting;  
 His month is hoeing up of flax,  
 His month is harvest of barley,  
 His month is harvest and feasting;  
 His two months are vine-tending,  
 His month is summer fruit.<sup>77</sup>

Lastly, there is a third millennium Sumerian text, commonly called the *Sumerian Farmer's Almanac*, or the *Georgica Sumerica*,<sup>78</sup> which I mention only for completeness. It consists of a list of farming instructions, but these are listed only sequentially, and with no reference to astronomy or a calendar.<sup>79</sup> The name *Farmer's Almanac*, and indeed also the comparison to Vergil's *Georgics*, is therefore unfortunate.

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<sup>76</sup> TU 20, Rs 2-4; TU 11, Rs 23. A goal-year text is one which predicts planetary phenomena for the coming year based on a cycle of x years for that planet, and the occurrence of identical phenomena x years ago. See Sachs, 1948.

<sup>77</sup> Albright's translation, as republished with further commentary in Cohen, 1993, p. 383.

<sup>78</sup> Published, with translation, in Salonen, 1968, p. 202-12. For commentary, see *Reallexikon der Assyriologie, 'Landwirtschaft'*, §8.

<sup>79</sup> 'Stars' do get mentioned once (at §39), but the import is very unclear.

*Conclusion:*

While none of this material shows a clear Mesopotamian precursor to the *parapegma* tradition, we can see from the material surveyed here that there were a number of parallels to various aspects of the *parapegmata*. Where Roman *parapegmata* were partly concerned with good and bad luck days, so we find the Babylonian *hemerologies* with a similar concern, although differently realized. Likewise, we find some Babylonian texts which report the dates of stellar phases, but this is schematic and perhaps not meant to be precise. Lastly, weather omens are numerous but scattered in the Babylonian omen literature.

Although we find no simple cognate of a *parapegma* in Mesopotamia, we do find diverse texts which here and there show interesting similarities. I do not think there is enough evidence to argue for a line of descendancy from Babylon to the classical *parapegmata*. Rather, I think this shows that different ancient cultures addressed agricultural timing, weather prediction, and lucky calendar days in remarkably similar ways.

## Chapter Eight

# Egyptian Astrometeorology

*Alle Welt von Anfang des menschlichen  
Geschlechts hatt erkennt, das die fürliche  
Witterung durch das Gestirne gubernirt werde.  
-Johannes Kepler, 1603*

### *Introduction*

Ptolemy's *Phaseis* gives weather predictions according to particular astronomers, citing such figures as Democritus, Eudoxus, and Cæsar. A typical date reads:

Month of Thoth, day three: (In the Clima where the day is) 13 1/2 hours (long), the (star) on the tail of Leo<sup>1</sup> sets. (In the Clima where the day is) 15 hours (long), the (star) called the Goat<sup>2</sup> rises in the evening. According to the Egyptians, the Etesian winds stop. According to Eudoxus, the winds change. According to Cæsar, there is wind, rain, thunder. According to Hipparchus the east wind<sup>3</sup> blows.<sup>4</sup>

Notice here that in addition to the Greek and Latin sources from which Ptolemy claims to be getting his information, he mentions also "the Egyptians" as an authority. Unfortunately, it has hitherto been unclear whether this refers to native Egyptians, some unnamed Greek astronomers living in Egypt, or else is perhaps an attempt by

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<sup>1</sup> β Leo. See Toomer, 1984, p. 368.

<sup>2</sup> Capella (α Aur). See Toomer, 1984, p. 353; Aratus 157.

<sup>3</sup> ἀπηνλιώτης.

<sup>4</sup> Ptolemy, *Phas.*, p. 14, l. 7, f.

Ptolemy or his sources to legitimate his work by pointing to an ancient culture as being pioneers in the field of astrometeorology.

Neugebauer and Rehm dismiss the idea of an indigenous Egyptian tradition, and believe that the references are to Greek authors living in Hellenistic Egypt. Neugebauer dates the references to a source in the second century B.C., and Rehm pushes it as far back as the third century.<sup>5</sup> Lastly, van der Waerden has argued at some length (but to little avail) that attributions to the Egyptians are based on Greek observations made in Phoenicia, Cyprus or Cilicia, and lifted from the 'Parapegma of Dionysius'<sup>6</sup> Part of the reason for the universal dismissal of an indigenous Egyptian tradition rests on Hellmann's work in archeometeorology, in which he argues, based on modern observations, that the predictions ascribed to the Egyptians must have been made in Northern Greece rather than in Egypt.<sup>7</sup> I am, however, sceptical of the usefulness of comparing modern observations to ancient astrometeorological texts. In the first place, it assumes that climates do not change over long periods of time, and in the second, it assumes that the predictions in the ancient texts were necessarily always based on actual observations, a claim that cannot be proven.

Contrary to the commonly accepted opinion, I will argue that there is new evidence for Egyptian astrometeorology which allows us to confidently assert that there was in fact a tradition among the

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<sup>5</sup> See Neugebauer, *HAMA*, p. 562; Rehm, 1941, p. 101-104.

<sup>6</sup> Van der Waerden, 1985; on the alleged Parapegma of Dionysius, see chapter 3, above.

<sup>7</sup> Hellmann, 1916; Hellmann, 1917.



Egyptians of weather prediction based on stellar observations, and moreover, we can date it to as early as the fourth century B.C., two hundred years earlier than Neugebauer had speculated. The evidence is twofold. A new look at the autobiography of Harkhebi, which was published by M.G. Daressy in 1916, and retranslated by Neugebauer and Parker in their *Egyptian Astronomical Texts* in 1969, reveals that this Egyptian astrologer was interested in predicting weather phenomena in the early Ptolemaic period. Even more remarkably, however, the recently-published naos of Şaft el-Ḥenna <sup>8</sup> (dated to the time of Nektanebos I, 381-364 B.C.), makes an explicit connection between certain decans<sup>9</sup> and particular weather phenomena.

An argument has been made by Christian Leitz that there are both meteorological forecasting and stellar observations in the Ramesside *Calendar of Lucky and Unlucky Days*, but a close look at the *Calendar's* contents and Leitz's arguments will show that, although there are some references to weather phenomena in the *Calendar*, there is no reason to suppose any astrometeorological content. Indeed, even the claims to *astronomical* content made by Leitz are untenable.

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<sup>8</sup> See Leitz, 1995. A *naos* is the inner part of an Egyptian temple.

<sup>9</sup> The decans are 36 constellations situated in a band roughly parallel to the ecliptic, and slightly south of it. By Greco-Roman times they had come to represent 10° sections of the zodiac.

*I: Harkhebi, Astrometeorologist*

The *Autobiography of Harkhebi* was first published by A. B. Kamal in 1906. The text itself consists of a short inscription on a now headless statue. It was dated by M. G. Daressy to the early Ptolemaic period.

In 1916 Daressy re-published the text with a French translation, and included a number of editorial changes. Daressy's translation of Harkhebi's autobiography is unsatisfactory, and the text itself is troublesome in places. In a few instances the writing is abbreviated and difficult to interpret. Neugebauer and Parker include an improved but still imperfect translation of the text in their *Egyptian Astronomical Texts*. Following De Meulenaere,<sup>10</sup> they occasionally change the readings of many otherwise straightforwardly understandable signs in order to obtain particular meanings, even when there is a much simpler reading available. In short, their translation is guided too much at times (and in my opinion, at critical times) by what they expect to find in the text rather than by what is actually present. In one instance of particular relevance, they squeeze the highly improbable (indeed, it would be unique) reading of *hnm* "to unite" out of a perfectly normal writing of the wind sign (*f̄i*). While this is the one really significant sentence in

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<sup>10</sup> See Neugebauer and Parker, *EAT*, v. III, p. 214 f.

Harkhebi for our present purposes, I nonetheless offer a new translation of the whole astronomical part of the Harkhebi text:<sup>11</sup>

Hereditary prince, noble, sole friend, skilled and wise of heart in prophecy, who sees all that is seen in heaven and earth; skilled and wise of heart in observing the starry skies, who does not make mistakes among // them, who tells the rising and setting<sup>12</sup> in their time(s) and the gods who foretell the future. He purified himself for them in their time when (the decan) Akh rose heliacally<sup>13</sup> // beside Venus from the earth in order for him to calm the land with his words, being one who sees every star<sup>14</sup> in the sky, who knows the heliacal rising of every (star) in a good year, // who foretells the heliacal rising of Sirius at the first of the year. He observes her in the first day of her festival, in order to calculate her motion<sup>15</sup> for the times appointed for it (the festival), observing // everything she does every day. She has foretold everything through him, he being one who knows the northward and southward motions of the sun, telling all of its properties, and what they (i.e.: the properties) cause the day to bring.<sup>16</sup> He says what (will) happen // because of them, coming at their times, (being one who) divides the hours correctly at both times (i.e.: night and day), not ever going into error at night,<sup>17</sup> being wise in every thing //

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<sup>11</sup> While my translation, like the others, is not without its uncertainties, it has the advantage of staying closer to the text as presented by Daressy than Neugebauer and Parker do. A fresh look at the statue itself would, however, be very desirable.

<sup>12</sup> Following Neugebauer and Parker, I translate *'nh htp* as "rising and setting."

<sup>13</sup> Following Neugebauer and Parker, I translate the verb *pri* as "rise heliacally."

<sup>14</sup> Neugebauer and Parker, and Clagett, following them, have "the culmination of every star".

<sup>15</sup> *fm.* though it may also be *iwt*, "her coming" or *umut* "her wandering," either of which would still imply "motion."

<sup>16</sup> I read *rdi-sn di hrw*, whereas Neugebauer and Parker, following De Meulenaere, emend it to *di r sn sp*. Clagett follows Neugebauer and Parker almost word-for-word in his translation of this passage.

<sup>17</sup> I read *m tum m grh n nh(h)*, lit.: 'not going in to error at night for ever.' I think Daressy is wrong to read the *grh* sign as "star" and Neugebauer and Parker's emendation (following De Meulenaere) of Daressy's *Hr to m* achieves nothing, and they accordingly leave it untranslated. Kamal, 1906 sees a quail-chick rather than the falcon.

seen in the sky which is applied<sup>18</sup> by him to the earth, (being one who) knows their winds<sup>19</sup> and their omens,<sup>20</sup> being entirely complete in setting out (his) opinion, and being exalted<sup>21</sup> because of his reports when // he discerns the hidden language<sup>22</sup> through<sup>23</sup> everything being observed by him, and every end being complete<sup>24</sup> when (he) counsels<sup>25</sup> on account of it, making judgments for the lord of the two lands.<sup>26</sup>

We should note that Harkhebi does not speak here of doing anything resembling horoscopic astrology.<sup>27</sup> His reference to “knowing the winds and the omens” refers unambiguously to some kind of meteorological prediction which the astrologer was engaged in. A clue to how he calculated his weather patterns may come from his

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- <sup>18</sup> I read this as *sḥ(w)*, “commit”. Neugebauer and Parker translate it as *sḥ* “await,” but this makes little sense, and it forces them to read *r ḥ* as *s*, following Kamal. Clagett again defers to Neugebauer and Parker’s translation here.
- <sup>19</sup> Neugebauer and Parker read the “wind” sign as *ḥmm*, “to join,” but this would be a most unusual (in fact, unique) writing of the word. To be fair, I think that Neugebauer and Parker can be forgiven for misreading the clause which I have translated as “(being one who) knows their winds and their omens.” They translate it as “skilled with respect to their conjunction(s) and their regular movement(s)” (Neugebauer and Parker, *EAT*, v. III, p. 215), which, though it departs from the text considerably, manages to make some sense of what must have appeared to them a completely inexplicable reference to “winds.”
- <sup>20</sup> Neugebauer and Parker emend *šm* to *gsgs*, “to order, regulate,” largely, I think, because no likely meaning of *šm* was known to them. For a discussion of *šm* as “omen”, see Ritner, 1993, p. 36, n. 167.
- <sup>21</sup> I read this troublesome passage as *im* (“be complete” as opposed to Daressy’s and Neugebauer and Parker’s “to not be”) *pri ib r ḏr. kḥw* (as opposed to De Meulenaere’s improbable *ḥḥp rḥ*). The meaning of “be complete” as opposed to “not be” is necessitated by the context, since Harkhebi has been saying all along that he tells what he knows. I see no reason why he should become suddenly reticent about his reports, as Neugebauer and Parker would have it.
- <sup>22</sup> *r* “language” or “intent”. It may also be *r-ḥrw* “he discerns what is hidden from below. Everything is observed by him...”
- <sup>23</sup> I see no reason to read the *ḥr* here as *ḥir*, as Neugebauer and Parker need to do in order to make the text mean “be discreet with” (*ḥḥp r ḥir*).
- <sup>24</sup> again, *im* as “be complete” *r-ḥ*, “end, limit”.
- <sup>25</sup> I take the writing of *šḥr* “to overthrow” as a mistake for *sḥr*, “plan, counsel”. *nb-s* may also be a writing of *ks* “bow down,” but I think this makes less sense.
- <sup>26</sup> From here, Harkhebi goes on to tell us of his skill at charming snakes and scorpions.
- <sup>27</sup> Contrary to Daressy’s reading.

frequent mention of his knowing the heliacal risings of the fixed stars, which accords nicely with Ptolemy's report of what certain unnamed Egyptian astrologers were up to. Ptolemy's calendar uses the heliacal risings and settings of fixed stars as the exclusive predictors for weather phenomena.

We should note also the prominence of Sirius in Harkhebi's description of his work. Since the earliest times the rising of Sirius had marked the feast of the beginning of the year and the rising of the Nile. This correlation of one stellar phase with an agricultural (and navigational) phenomenon<sup>28</sup> demonstrates that from an early date the Egyptians were making limited use of the sort of observation needed for the construction of a stellar phase-calendar. On its own, of course, this correlation of Sirius' rising with the annual flood cannot prove the existence of an Egyptian almanac predating the Hellenistic period, and we shall see<sup>29</sup> that a recent attempt at demonstrating the existence of just such an early almanac fails.

In addition to Sirius, Harkhebi also mentions observing (a) the northward and southward motions of the sun and (b) the planet Venus, so the question arises whether these observations could have been associated with meteorological predictions.

As for observations of Venus, it is possible, if Harkhebi was following a Babylonian model of astrometeorology, that he was using Venus as a predictor of weather phenomena. Indeed, a later source,

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<sup>28</sup> See Depuydt, 1997, p. 14-15.

<sup>29</sup> See the section on the *Calendar of Lucky and Unlucky Days*, below.

the Demotic text of lunar-omina published by Parker<sup>30</sup> includes weather predictions (in particular, inundation and wind) derived from observations of the colour and appearance of the moon, which is similar to Babylonian methods of forecasting.<sup>31</sup>

Observations of the northward and southward motions of the sun, on the other hand are related to weather predictions in two ways: the first being the obvious fact that the sun's progress northward and southward is directly related to broad seasonal climactic changes. In addition to this, the northing and southing of the sun is directly related to the sun's motion through the constellations, and so to the risings and settings of the different stars. This brings us back to the fact that Harkhebi was certainly interested in this phenomenon. He mentions it thrice in his short text, and it is the only type of observation he mentions repeatedly.

I would conclude, then, that Harkhebi used the heliacal risings of the stars as indicators of weather. We shall see from a look at the slightly older *Ṣaṭṭ el-Henna naos* that Harkhebi's work is related to an earlier Egyptian tradition, which may have been later incorporated into or adapted to fit Ptolemy's work, and so found its way into the Greco-Roman world.

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<sup>30</sup> Parker, 1959. See e.g. p. 44-5. This text dates from the late second or early third century A.D., but is probably a copy of a sixth century B.C. original.

<sup>31</sup> Aratus, *Phæn.*, 778, f., also uses the colour of the moon to predict weather.

## II: The *Ṣaft el-Henna Naos*

The *Ṣaft el-Henna naos* is in two pieces. The top half has been in the Louvre for two hundred years, and the lower half was pulled from the Bay of Abukir in the 1940's and is now in Alexandria.<sup>32</sup> Most recently published by Leitz, the naos is valuable in that it preserves the earliest known Egyptian correlation between celestial phenomena and weather. The inscription dates from about a century before the Harkhebi text, and so from about fifty years before the Ptolemies began to rule Egypt.

The text of the naos contains descriptions of the powers of each of the decans during some phase of their appearance, which would presumably be either their heliacal rising, their culmination, or possibly their setting. We have more or less complete entries for decades<sup>33</sup> 3, 6, 9, 11-13, 17, 18-21, and 25-37, with scraps of 8 and 24. Entries are of the form: "The great god in the principal time;<sup>34</sup> he causes<sup>35</sup> such-and-such," where the phenomena caused by the decans range from battles to sickness to rain and wind. I have excerpted here the entries which pertain to weather:<sup>36</sup>

<sup>32</sup> See Leitz, 1995, p. 3.

<sup>33</sup> A *decade* is simply a ten-day period.

<sup>34</sup> Each decade begins with this formula: *ntr ʿ3 m sp tpy*. Leitz translates it as "Der grosse Gott am Uranfang," thus treating *tp* as "first" in the temporal sense, but I find this obscure. *sp* can also mean "act," and thus another possible translation would be "The great god in (his) highest action."

<sup>35</sup> *shpr.* to be discussed below.

<sup>36</sup> For the entire text of the naos, with German translation, see Leitz, 1995, p. 9-37.

- 3rd decade, l. 2: "He causes heat"<sup>37</sup>  
 6th decade, l. 3: "He will be hot for five days."  
 8th decade, l. 3: "... [rai]n for the earth."<sup>38</sup>  
 9th decade, l. 2-3: "He causes rain in heaven."  
 12th decade, l. 1: "He causes ra[in]."<sup>39</sup>  
 13th decade, l. 3: "... in bitterness for twelve days."<sup>40</sup>  
 20th decade, l. 1: "[He cau]ses the south winds in  
 heaven. ...[He causes] three days of  
 bitterness."  
 21st decade, l. 1: "[He causes] the north [wind]s in  
 heaven."<sup>41</sup>  
 24th decade, l. 2-3: "...cold(?)...bitterness..."<sup>42</sup>  
 25th decade, l. 2-3: "...rain in heaven."<sup>43</sup>  
 26th decade, l. 1: "[He c]auses an evil wind in the  
 night."  
 27th decade, l. 2-3: "...and consuming everything on  
 earth in their bitterness."  
 28th decade, l. 1-3: "He draws forth the flood-water  
 from its cavern ... (text unclear) ...  
 He causes sickness in *Mnty*<sup>44</sup> by  
 bitterness in the house<sup>45</sup> for four  
 days and by a sickness in the belly."  
 29th decade, l. 2-3: "He causes bitterness of nine days."  
 32nd decade, l. 2: "...bitterness..."

<sup>37</sup> *ntf shpr smn*. Lertz thinks this refers to fever, which is entirely possible.

<sup>38</sup> The text is fragmentary, having only the last wave of the water determinative with the pool determinative followed by *r t3*. The two determinatives, however, match the usual writing of "rain" in this text.

<sup>39</sup> The text breaks off part-way through the word: *ntf shpr h[w]y[t]*.

<sup>40</sup> *m dhrt n hrw 12*. Lertz takes this to refer to sickness, which seems probable, but I include these references to "bitterness" here since it seems remotely possible that they are references to bad weather. In any case, it is interesting to note that by late antiquity Greek and Latin parapegmata often contained information on medical matters. See Burnett, 1993, p. 28, f.

<sup>41</sup> [*ntf shpr t3*]w *mhwt m pt*. The reasons for reading "wind" in here are the similarity in the traces of the noun with the word "wind" in the previous decan, and the parallel adjective.

<sup>42</sup> parts of *hs* are visible, as is all of *dhrt*.

<sup>43</sup> ...*hwyt m pt*. Lertz notes that "ein Substantiv, *hwyt*: "Regen" erscheint aber anseits der Jahreszeit eher als unwahrscheinlich." [Lertz, 1995, p. 24 n. 94]. I see no reason to emend away what appears in the text here. For my criticisms of Lertz's method of determining which season this decan would fall in, and the likelihood of rain under any given decan, see below.

<sup>44</sup> Or possibly *mr mn t3*: "a lasting and painful sickness."

<sup>45</sup> Contrary to Lertz, who sees the house-sign as superfluous.



It is clear from this text that some of the decans at least were related to certain kinds of weather phenomena as early as the fourth century B.C.

One notable point is that the expression of the activity of each decan is highly formalized throughout the text, and says repeatedly that the particular decan “causes such-and-such to happen” where the verb is the causative form *shpr*. The only exceptions to this in the weather sections<sup>46</sup> occur in decans 6 and 28, respectively reading “He will be hot for five days” (*šmmi-f n hrw 5*) and “He draws forth the flood-water from its cavern” (*nif šdi h'py m ipht-f*). The first of these two instances is not necessarily causative language, but given the fact that for almost every other decan the idea of causation is clearly expressed by *shpr*, and for decan 28 the idea of causation seems to be implied by “He draws forth...,” I think we have no choice but to conclude that the Egyptians saw the decans as somehow acting upon the earth and actively bringing about the weather conditions described.<sup>47</sup>

This conclusion is confirmed by the inscription at the beginning of the naos which also talks unambiguously of causation:

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<sup>46</sup> Slight variations do occur in the context of some other powers, e.g. decan 18 l. 2 has *nif di hpr...*

<sup>47</sup> This is paralleled by a Greek text, *P. Oxy.* 4473, which says a particular decan brings [φέρει] the flood (*P. Oxy.* vol. LXV).

*ḥt-nbs*,<sup>48</sup> the door of heaven. When Re shines, his face causes the great mooring-post<sup>49</sup> ... // ... the disks<sup>50</sup> ... // ... great ... the 36 decanal stars ... // Heaven, earth and the underworld<sup>51</sup> are under their counsel.<sup>52</sup> They rise and they set so that the temples of *ḥt-nbs* // ... // ... [They are the ones who c]ause the flood // ... his praises.<sup>53</sup> They are the ones who cause storms. They are the ones who open the sky and who prevent rain. They bring the day. They bring the night. They rise. They set. They refresh themselves in the northern sea.<sup>54</sup>

And in the almost identically-repeated inscription beside each decan, it says:

Water, wind and (fertile) fields are requested from him in his decade in *ḥt-nbs*. Month III of *šmw*, day 1 to 10: offerings are made to this god by the king in *ḥt-nbs* in order to protect the land from disaster.

He rises<sup>55</sup> in this influence<sup>56</sup> in the decade of (his) motion, (as) master of the earth.<sup>57</sup> He is the one who causes sickness and death.<sup>58</sup>

<sup>48</sup> *Ṣaḥ el-Henna*.

<sup>49</sup> Reading *iw hr-frdi-f n'yt wrt n...* Lertz follows Habachi and Habachi, 1952, p. 255. In emending the text to *iw hr-f <hr> rdit-f <n> n'yt wrt n...*, translating it "Wenn Re aufgeht, wendet sich sein Gesicht <dem> grossen Haus des [...] zu [...]."

<sup>50</sup> Following Habachi and Habachi, 1952, p. 255.

<sup>51</sup> The text actually has *niwt*, "town" rather than *dwḥt*, "netherworld."

<sup>52</sup> Lertz, 1995, p. 7, n. 22, translates *šjr* as "Aufstellung."

<sup>53</sup> Lertz, following Habachi and Habachi reads *sdgw*, "secrets" rather than *dwḥt*, "praises," which is certainly possible.

<sup>54</sup> The remainder of the text is mythological. For the text and translation, see Habachi and Habachi, 1952; Lertz, 1995.

<sup>55</sup> Lertz argues that 'h' must mean "culminate" here.

<sup>56</sup> *šsm* as a noun is derived from the verb *šsm*: "to guide, lead, govern." I have tried to preserve this idea of ruling with the not entirely satisfactory English word "influence." Lertz, following Habachi and Habachi, translates *šsm* as "Gestalt," which is certainly also possible.

<sup>57</sup> Reading *n hbi* (travel) *hry-tp t3*. Lertz translates this phrase as "wenn auf die erde ausgesandt wird" (Lertz, 1994 p. 9). The passive of *h3b* is possible, but I think it makes less sense of *hry-tp*.

<sup>58</sup> Reading *mr mwt*. Lertz reads *mwt dm*, "den stechenden Tod," seeing the *mr* as a mistake for *mwt*, and the two knives as *dm*. I am treating the knives as determinatives and the man with the axe in his head (seen by Lertz as a

His living Ba is master of the earth in this influence.<sup>59</sup> Life is requested from him in his decade in *ṯṣt-nbs*

It is his image which brings peace to every temple in the decade with invocation offerings<sup>60</sup> in his temple.

His living Ba (is) eternal. His body brings peace<sup>61</sup> in the necropolis. A good burial is requested of him in his decade in *ṯṣt-nbs*.

The language in these passages makes it clear that some power exerted by the decans themselves was thought to bring about particular effects, whether meteorological phenomena, disease, or crop growth.

But what was the basis for ascribing certain weather phenomena to certain decans? Did the Egyptians, as the Babylonians had been doing since the seventh century, keep careful records of astronomical and meteorological phenomena?<sup>62</sup> Or rather did they have some magical or mythological ideas about what the effects of a particular decan should be which were wholly or largely independent of observational data? This turns out to be a difficult question to answer.

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determinative) as phonetic *mwt*. Another possibility is that the dying man is a determinative for *mr* (as e.g. in decade 29) and the two knives are meant to be phonetic and represent an adjective describing the particular kind of sickness caused: "He is the one who causes the *dm*-sickness." Habachi and Habachi, 1952, p. 257 think the knives are phonetic *dm = tm*: "evil doers." If this is correct, a preposition is missing.

<sup>59</sup> Again, *sšm*

<sup>60</sup> Following Habachi and Habachi who read *pr-hrw* in place of Leitz's (following Brugsch, 1883, p. 181) *Pr-Spdt*.

<sup>61</sup> Leitz follows Habachi and Habachi in reading this as "gives offerings," which is equally possible.

<sup>62</sup> On the Babylonian *Diary* texts, see chapter 7, above.

Leitz, in his examination of the weather predictions in the *Šaft el-Henna naos*, takes it for granted that the weather phenomena were established empirically by the Egyptians. In attempting to determine, for example, which phase of the decans was responsible for the wind or rain, whether their rising, culmination, or setting, Leitz argues that rain would be most likely at the time of the ninth decan's culmination in the twelfth hour of night, and he settles on this as the correct phase:

Auch hierin liegt wieder ein Argument für die Annahme, dass die in den Beischriften gennante Wirkung der Dekane tatsächlich in die Dekade mit der Kulmination in der 12. Nachtstunde fallen. Wäre es der Augenblick ihres heliakischen Aufgangs, so wären die entsprechenden Daten der 1. und 31. Oktober [greg.], was nicht zu den meteorologischen Gegebenheiten paßt.<sup>63</sup>

But these meteorological 'facts' turn out to be little more than guesses based on modern measured rainfall at Cairo and Alexandria over the course of the year. I consider this line of argument to be misleading on a number of counts: (1) the assumption that rainfall patterns have remained unchanged in Cairo and Alexandria over 2300 years is unfounded; (2) the assumption that the predictions of rainfall in the *naos* must correspond to empirically observed rainfall patterns is unfounded; (3) the assumption that the astrometeorological parts of the text were meant to apply to Abukir where it was found two millennia later is unfounded, and (4) the assumption that the text was composed in the fourth century B.C.

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<sup>63</sup> Leitz, 1995, p. 18, commenting on the ninth decade.

rather than possibly being a preserved older text<sup>64</sup> (which would change the correlated Gregorian<sup>65</sup> dates) is unfounded.

Unfortunately, this highly questionable method of determining dates from known modern weather patterns pervades much of Leitz's work, both on the *Şaft el-Ḥenna naos*, and also in his interpretation of the more obscure bits of the *Calendar of Lucky and Unlucky Days*.<sup>66</sup>

In the absence of any way of determining what weather patterns would have been for the location and time in which the text of *Şaft el-Ḥenna* was composed, the question of whether the predictions were based on observation, magical correlation, or even simple speculation must remain unanswered.

### *III: The Calendar of Lucky and Unlucky Days*

Possibly as early as the Ramesside period,<sup>67</sup> there existed in Egypt a system of calendrical omina, typified by the *Calendar of Lucky and Unlucky Days*,<sup>68</sup> which sought to furnish predictions for any given calendrical date. There is no evidence, as we shall see, that this tradition derived from astronomical or astrological sources. It is more probably akin to something like our own non-astronomical

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<sup>64</sup> Just as the decanal star-clocks in the tombs of Rameses IV and Seti I may have been already 600 years or more out of date by the time of their inclusion in the Ramesside tombs. See Neugebauer and Parker, *EAT.*, and Depuydt, 1998, p. 34-5.

<sup>65</sup> Leitz uses Gregorian rather than Julian dates.

<sup>66</sup> See Leitz, 1994 For more commentary on this, see below.

<sup>67</sup> Leitz gives the *Calendar* a *terminus ante quem* of the reign of Rameses II [Leitz, 1994, p. 6], and Bakir thinks such an early date to be possible, though he is not willing to commit himself fully. (Bakir, 1966, p. 5-6)

<sup>68</sup> Published most recently in Leitz, 1994; earlier by Bakir, 1966.

calendrical superstitions such as Friday the thirteenth bringing bad luck, or to such character-determinants as are found in the birth-day rhyme: "Monday's child is full of grace, Tuesday's child is fair of face..." The omen would thus be fixed solely to a calendar date which has nothing at all to do with any astronomical phenomenon.<sup>69</sup> This does not exclude the possibility, however, that some time between the Ramesside period and the fourth century B.C. such a calendrical tradition could have been combined with a tradition of astronomical observation, but given the complete lack of evidence from this intervening millennium, descendance from the *Calendar* is impossible to prove.

The *Calendar of Lucky and Unlucky Days* lists each day of the year, together with its omens, whether good or bad. Some of these omens are unambiguous references to weather, such as:

- I *ꜣht* 4:<sup>70</sup> ... The gods go as evil winds.
- II *ꜣht* 24: ... Do not go out in any wind until the sunset.
- III *prt* 20: ... You will not see sunlight.
- III *prt* 25: ... This day has a great storm.

There are a number of such entries, whose references are stated in plain language in the text. The calendar, however, includes many

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<sup>69</sup> Remember that the Egyptian calendar of 365 days is not synchronized with any solar or lunar motions, and it accordingly 'slips' over the years such that every four years it falls approximately one day further out of line with the solar year, continually moving away from its original seasons. Thus the calendrical season of 'Inundation,' while it more or less agreed with the actual inundation for a time, would, over the course of the centuries, move away from the seasonal inundation and then back again some fourteen centuries later. For a detailed discussion of the Egyptian Calendar, see Parker, 1950; Depuydt, 1997.

<sup>70</sup> The Egyptian calendar has four seasons, *ꜣht*, *prt*, and *smw*, each divided into four months of exactly 30 days. I *ꜣht* 4 refers to the first month of *ꜣht*, day 4.

obscure references to different gods or demons coming forth or battling with each other, whose meaning is obscure. Leitz sees in these obscurities veiled references to weather patterns, which he interprets with the aid both of modern meteorological statistics,<sup>71</sup> and the Coptic-Arabic almanacs.<sup>72</sup> So, for example, he is able to interpret a sentence like that in IV *pri* 3: “The great ones fight the *wpyt*-serpent” as “The clouds push themselves before the sun.” The terminology of the text has no parallel as weather-language, and I think that Leitz goes too far in reading such meanings into the text based on what are really very uncertain methods of interpretation.

My objections to Leitz’s method of comparison with modern observations have already been noted, above, and comparison with the almanacs is no more secure. For the Coptic-Arabic almanacs to function as evidence for the contents of the millennia-earlier *Calendar* presupposes one of the following: (1) that the tradition of weather prediction using such calendars was both uninterrupted and uncorrupted, which is difficult to believe, given the complete lack of intermediate texts; (2) that the tradition was revived and accurately translated in Coptic times, which claim is also unsubstantiated; or (3) that the following conditions must all be true:

(a) the *Calendar* and the almanacs are based on empirical observation of weather patterns,

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<sup>71</sup> See, e.g. Leitz, 1994, commentaries on: I *3ht* 4; III *pri* 24 and many others.

<sup>72</sup> See, e.g. Leitz, 1994, commentaries on I *3ht* 20 and 29 where he sees references to the hot season which are nonapparent to me; II *smw* 19, 20 and 22 where winds are read into the text based on the almanacs, and III *smw* 12 where he has the clouds vanishing based on nothing I can determine in the text.

- (b) these patterns must have remained unchanged over the millennia,
- (c) both sources were meant to apply to the same parts of Egypt, and
- (d) we know the date of the *Calendar's* composition with a high degree of accuracy.

The number of unknown elements in the necessary components of this last set of assumptions lead me to conclude that it also is most unlikely.

Given my scepticism about these highly-interpreted parts of the *Calendar*, it would seem useful to give a list of all the clearly-worded entries pertaining to astronomy or weather, while leaving out Leitz's dubious interpretation.

I *ḥt* 1: There is purification when<sup>73</sup> the entire land is under the water of the High Nile,<sup>74</sup> going forth as young Nun, as it is said.<sup>75</sup>

I *ḥt* 4: The gods go out as evil<sup>76</sup> winds.

I *ḥt* 24: The majesty of this god sails in good breezes and in peace ... west.<sup>77</sup>

II *ḥt* 24: Do not go out in any wind until sunset.

III *ḥt* 18: If there is a great wind<sup>78</sup> on this day it will not be in a good way<sup>79</sup>

III *ḥt* 19: A great<sup>80</sup> storm is born in the sky.<sup>81</sup> Do not sail upstream or downstream upon the river. Do not travel in any boat on this day.

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<sup>73</sup> *m-ht*. Bakir translates this as "throughout," and Leitz as "über."

<sup>74</sup> *ḥt h'py*. Both Bakir and Leitz take this to refer to the beginning of the flood.

<sup>75</sup> Following Bakir. Leitz translates this as "'Jugendlicher' wird er genannt..."

<sup>76</sup> *sbit ḥiw*. I am uncertain why Leitz translates this as "Gegenwinde" here but as "feindliche Winde" at II *smw* 20.

<sup>77</sup> Leitz reads "Die Majestät dieses Gottes fährt mit guten Winden in Frieden zum Westen..." but this ignores the large lacuna in the papyrus after *h'p* and before *imnt*. See Bakir, 1966, pl. VI

<sup>78</sup> *P. Sallier* only. The sign is uncertain, the determinative strange.

<sup>79</sup> I read *nn 'd st*.

<sup>80</sup> *P. Sallier* only.

<sup>81</sup> Bakir translates this as "The children of the storm of..."



- IV *ḥt* 7: This day, the wind is guarded against in the entire land.<sup>82</sup>
- IV *ḥt* 12: Do not go out on any road in the wind.<sup>83</sup>
- I *prt* 19: The winds in heaven on this day are mixed with the annual pestilence<sup>84</sup> and many diseases.
- III *prt* 19: The children of Nut<sup>85</sup> are in good breezes<sup>86</sup> ... Do not go out from your house therein.<sup>87</sup> You will not see sunlight.<sup>88</sup>
- III *prt* 20: You will not see sunlight.<sup>89</sup>
- III *prt* 25: This day has a great storm.
- IV *prt* 3: As for any lion who says the name of the decan Orion, he will die immediately.<sup>90</sup>
- IV *prt* 6: The stars go forth, bitterness before [them].<sup>91</sup> If anyone sees small cattle,<sup>92</sup> he will die immediately.

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82 *P. Cairo* only.

83 *P. Cairo* has *nn-k pri im-f r wṣt nb(t) m ṯw*, whereas *P. Sallier IV* reads *nn-k pri r wṣt nbt m hrw pn*: "Do not go out on any road on this day."

84 *ḥdt*: "pestilence" can also mean "pouring rain."

85 Bakir has "The birth of Nut..." which is also possible

86 Lertz translates this as "Die Kinder der Nut sind in einem gänzlich günstigen Wind," thus reading *mṣṣ ṯi nfr*. I prefer to read the *mṣṣw* as "breezes" with the wind sign as a determinative rather than as a noun modified by *mṣṣ* "true". Curiously, this is how Lertz himself reads the identical wording at I *ḥt* 24. I am at a loss to explain why he has changed his reading here.

87 *P. Cairo* only. *P. Sallier* has "Do not go out of your house on any road on this day."

88 *P. Cairo* only.

89 *P. Sallier* has "You will not be near sunlight."

90 Although this entry does not deal with an astronomical phenomenon as such, I include it since it does mention a decan. Note however that the decan is being conceived of as a deity rather than as a stellar object, as is evidenced by the use of the god determinative in place of the star determinative.

91 *dhrt ḥft-hr*. Lertz translates this as "mit bitterm Gesicht" and Bakir as "bitterly and openly," although in a note (n. 4, p. 76) he raises the possibility that *dhrt* is a mistake for *dṣrt*, "red," and so offers the possible interpretation of the phrase *sbṣ dṣrt ḥft-hr* as "the culmination of Mars." This seems to me to be extremely unlikely.

92 *wt*. Lertz, 1994, p. 307, argues that this refers to the culmination in the first hour of night of the decan *hry-ib wṣ*, since the small cattle are associated with Seth. I think that if this were true we could expect a star determinative after *wt* rather than the animal determinative, and in any case the chain of reasoning is extremely weak. I prefer to interpret the *wt* as animals of the ordinary domestic kind, since the connection drawn by Lertz is highly tentative, and the naming of the decan would be unusually cryptic.

- IV *prt* 13: Do not go out in any wind<sup>93</sup> on this day.  
 I *šmw* 2: Do not go out from your house in any wind on this day.  
 II *šmw* 20: There are many deaths. They come from evil winds. Do not go out in any wind on this day.  
 IV *šmw* 26: The gods [sail]<sup>94</sup> in every wind.

It is apparent that these predictions are of a different nature from those in the *Šaft el-Henna naos*. Rather than being clearly causative statements about the powers of the decans, they are simple statements of omens, of pre- and proscribed activities for certain days, with little statement of the whys and wherefores. The various winds are said simply to happen on particular days, with no mention of what causes this to be so. There is no evidence to connect these omens with celestial phenomena, and also no evidence that the omens were based on actual observations of weather patterns of the course of the year. It is entirely possible that the winds were 'predicted' according to some unknown magical, mythical or schematic formula.<sup>95</sup> We should also note that the majority of entries do not even predict the weather so much as give hortatory statements about weather phenomena. We cannot assume that the entries imply that the phenomena *will* invariably occur on that date, but only that *if* it does, one should not do such-and-such.

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<sup>93</sup> *P. Catro* only. *P. Sallier* has "Do not go out in it on any road..."

<sup>94</sup> A hole in the papyrus has obliterated all but the determinative.

<sup>95</sup> For example, associations of calendrical dates with certain historical or mythological events could have furnished omen-lore. Although I know of no evidence from the Egyptian tradition which makes a clear case for this possibility, there is evidence of just such a practice in the Roman agricultural literature. See Vergil, *Georg.*, I.276-286. I do not wish to argue that this is what *must* have been happening, but rather to point out the possibility.

We should note also that the only reference in the entire *Calendar* to an astronomical phenomenon of any kind (apart from the setting of the sun)<sup>96</sup> is at IV *prt* 6: "The stars go forth, bitterness before [them]." Based on this one vague entry, it would be rash to suppose a program of stellar observations underlying the predictions of the *Calendar*.

Leitz's idea that certain phrases in the *Calendar* are references to the culmination of particular decans is flatly untenable. I refer specifically to his commentary on IV *ḥt* 26, which offers a considerably different reading of the text than that of Bakir. The text is highly corrupted, especially the *P. Sallier* version, both in this entry and those around it. Specifically: (a) IV *ḥt* 24 is missing entirely from *P. Cairo*; (b) *P. Sallier's* IV *ḥt* 24 is roughly equivalent to *P. Cairo's* IV *ḥt* 26, though highly corrupted; (c) IV *ḥt* 25 is missing from *P. Sallier*; (d) IV *ḥt* 25 is almost entirely destroyed in *P. Cairo*, such that Bakir does not even attempt a translation, although Leitz offers a reconstruction, for what it is worth; (e) *P. Sallier's* IV *ḥt* 26 has no parallel in *P. Cairo*, so Leitz assumes it is equivalent to *P. Cairo's* missing IV *ḥt* 24.

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<sup>96</sup> I should mention for the sake of completeness that after the *Calendar*, on verso XIV is a separate text with a schematic table of the length of daylight in each month, which assumes a 3:1 ratio for the longest to shortest day, and has the longest day in IV *ḥmw*. There is, however, no way to establish a correlation of this text with the *Calendar* itself. Indeed the texts on the papyrus after the *Calendar* seem to be collated from different sources.

As it stands, the *P. Cairo* text for IV 3<sub>ht</sub> 24 reads: ... *nfr smn-in Dhwtj srw R*<sup>97</sup> *hntyw*<sup>98</sup> *Shm*. Bakir translates it as "Thoth establishes the nobles in an advanced position in Letopolis" and Leitz as "Daraufhin setze Thoth die 'Fürsten' (*srw*) des Horus von Letopolis ein." While the latter reading is not in itself objectionable, Leitz's interpretation of it is. He begins with the wholly unfounded assumption that the 'Fürsten' des Horus von Letopolis refers to the stars of the decan *phwy-d3t*, which "begins its work on this day," i.e., culminates at the end of the first hour of the night.<sup>99</sup> His proof runs as follows:

- (1) IV 3<sub>ht</sub> 26 is mentioned as the date of a decanal phase in *P. Carlsberg Ia*;<sup>100</sup>
- (2) the "Horus of Letopolis" mentioned in IV 3<sub>ht</sub> 26 is associated with the decan *Knemis (knmt)*,<sup>101</sup> and;
- (3) IV 3<sub>ht</sub> 26 is ten days before I *pri* 6, into which *Calendar* entry Leitz reads a veiled reference to the decan *Knemis*, based on its association with *Chentiirti/Horus of Letopolis*;
- (4) The only two instances of the word *sr* "noble" (at I 3<sub>ht</sub> 26 and II *smw* 16, respectively) occur 170 days apart in the calendar, which Leitz thinks must correspond to the following phases of the decan *phwy-d3t*: 10 days of marking the end of the first hour of night + 90 days in the west + 70 days in the underworld. Thus Leitz concludes that the calendar entry

<sup>97</sup> The god's name is followed by the Horus-bird determinative, and lacks the sun determinative, which is unusual. Bakir reads it as *r* and Leitz as a mistake for *Hr*.

<sup>98</sup> Leitz reads this as an epithet of Horus: *Hntyw-Hr*.

<sup>99</sup> Leitz, 1994, p. 183. I am unsure why Leitz variously refers to both (a) culmination at the end of the twelfth hour of night and (b) culmination at the end of the first hour of night as the "beginning of the work" of the decan.

<sup>100</sup> Neugebauer and Parker, *EAT*, p. 90-91.

<sup>101</sup> See Junker, 1917, p. 42-44.

at II *šmw* 16: "Anyone born on this day will die great as a noble among all the people" is a coded reference to the heliacal rising of the decan *phwy-dʒt*:

(5) the word "nobles" in the phrase "the nobles of Horus of Letopolis" is plural, and the decans consist of multiple stars;<sup>102</sup>

(6) the Egyptian word *srw* could conceivably be a pun on *sbʒw*: "stars." As Leitz says: "Vgl. dazu pCarlsberg I, II, 36, wo das hieratische *sriw* (Widder, kopt. εϞϞϞ) mit [*sbʒw*] (Sterne, dem. *sw*, *siw*, kopt. ϞϞϞ) übersetzt wird;"<sup>103</sup>

My main objection to this chain of illogic is that, as J. L. Berggren once commented,<sup>104</sup> probabilities do not add up to create greater likelihood. Instead they multiply to create increasingly less likelihood. I would add that remote possibilities do so even more quickly.

To the individual points in Leitz's argument I pose the following objections:

(1) The mention of IV *ʒht* 26 in P. Carlsberg Ia (dating from the second century A.D., sixteen centuries later than Leitz's date for the *Calendar*) is a simple statement of the fact that this date is separated from III *prt* 6 by 290 days. It says: "If it [a star] goes to the netherworld on <III> *prt* <6>,<sup>105</sup> it will rise on IV *ʒht* 26 to I *prt* 6."<sup>106</sup> The text is highly corrupt at this point, such that the dates of the phases are all curiously reversed.<sup>107</sup> The reconstructed addendum which mentions *phwy-dʒt*, proves nothing for the Ramesside *Calendar*.

<sup>102</sup> I am not making this up.

<sup>103</sup> Leitz, 1994, p. 184.

<sup>104</sup> Berggren, 1992.

<sup>105</sup> Neugebauer and Parker's reconstruction of this date follows the formula being used repeatedly in the text.

<sup>106</sup> See Neugebauer and Parker, *EAT*, p. 90.

<sup>107</sup> See Neugebauer and Parker, *EAT*, p. 90, n. 3.

- (2) and (3) The association of Horus of Letopolis with the decan Knumis is hardly a matter of incontrovertible fact. It is rather a supposition of Hermann Junker's based on (a) the coincidence of an image of Horus in Ombos with a mention of Knumis in the text beside it and (b) the fact that a separate text, *according to Junker's reconstruction*, states that Knumis was worshipped in Letopolis.<sup>108</sup> This is hardly a clear association of Knumis with Horus of Letopolis.
- (4) The 170-day difference between two instances of *sr*, once in the plural, once in the singular, is in all likelihood nothing more than simple and unremarkable coincidence. A look at the actual content of the two passages, as quoted above, shows that they do not seem to have anything else in common than the use of this not unusual noun. Moreover, Leitz's emphasis on the significance of the last ten days of a decan's work seems to be based on nothing in the Egyptian sources. The fact that Leitz needs to add an extra ten days to the decan's 90 days in the west and its 70 days in the underworld in order to obtain a 170-day interval does not justify the assertion that the end of the first hour of night was seen to be significant by the Egyptians. Indeed, apart from Leitz's reconstruction of the secret message of the *Calendar*, I know of no other special mention of it.
- (5) Leitz's argument that the word "nobles" being used in the plural signifies the plurality of stars in a decan surely needs no refutation. I note, however, the curious use of the singular at II *šmw* 16. Leitz's attempt to deal with this discrepancy is, not surprisingly, wildly speculative.
- (6) The fact that the word *sriw*, "rams," which in Middle Egyptian happened to resemble the word *srw*, "nobles" (discounting the unknown vowels, of course), and the fact that by Roman times the word "ram" (Coptic εϥοϥ) was used as a pun on the word "star" (Coptic ϥιοϥ) do not together prove that the word "nobles" resembled the word "stars" enough to be a recognizable pun in the Ramesside period. Indeed, "nobles" kept its strong *r* right into Coptic times (ME *sr* became Coptic ϥιοϥϥ). In any case, the mere

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<sup>108</sup> See Junker, 1917, p. 42-44.

possibility of a pun is far from sufficient demonstration of the hidden subtext Leitz conjectures.

Likewise the loose string of association which allows Leitz to interpret the entry at II 3*ht* 11: "The front part of the bark of Re is attached on this day. Life and dominion<sup>109</sup> are before him, stability and honour<sup>110</sup> are established behind him. Everything is good on this day" as being a coded reference to the midnight culmination of Rigel ( $\beta$  Orionis), is equally fantastic.

We can see, then, that these attempts to connect the *Calendar's* omina with celestial events fail dramatically. There are no astronomical phenomena of any note in the *Calendar*, and so nothing resembling astrometeorology of any kind. The most we can say is that the Egyptians had been thinking about the possibility of calendrical weather prediction since perhaps as early as the fourteenth century B.C. The evidence from this early period indicates that weather patterns were associated with calendar dates rather than with decanal phases or any other astronomical phenomena, and that the weather predictions themselves were of a very different form than those found later in the *Šaft el-Henna* text.

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<sup>109</sup> Leitz declines to translate these words for some unknown reason.

<sup>110</sup> *P. Cairo* has a lacuna here. *P. Sallier* has two *Qed* columns ("stability") followed by a lacuna. Thus Leitz restores the *Qed* columns to *P. Cairo* and the *sps* sign ("honoured") to *P. Sallier*. Again, he curiously declines to translate the *Qed* columns.

*Conclusion*

There is no evidence for properly astrometeorological texts in Egypt until the early fourth century B.C., long after both the Babylonians and the Greeks had been predicting weather according to certain astronomical phenomena. This is, however, two centuries earlier than Neugebauer had supposed the Egyptian tradition to date from.

I do not wish to argue that the practice of astrometeorology only began in Egypt at this late date, however. A tradition of astronomical weather prediction, either textual or oral, may well have been established in Egypt before the time of the *Ṣaṭṭ el-Ḥenna naos*. Certainly some raw ingredients congenial to such a development (i.e., calendrical omnia on the one hand and decanal observation on the other) were established many centuries before. But tins of flour do not make a cake, and we cannot do more than speculate on whether Egyptian astrometeorology did or did not predate the fourth century B.C. Certainly Leitz's claims are untenable.

In any case, we have good reason to believe that Ptolemy's reports of the predictions "according to the Egyptians" may have derived from this Egyptian tradition of decanal weather forecasting.



## *Chapter Nine*

# Conclusion

An interest in weather prediction can be found across the cultures of the ancient Mediterranean and Near East, and across several millennia. Although such prediction is sometimes differently realized in the various cultures, there are also remarkable similarities in some of the signs they used for prediction: Stellar phases show up in Egyptian, Greek, Roman, and Babylonian sources as seasonal indicators generally, and also as more specific weather indicators. These phases were, in all these cultures, closely tied to the regulation of the agricultural year, for which the respective calendars used in the various places were, to a greater or lesser extent, unsuitable.

Towards the later end of the time period we have surveyed—I am thinking here of the ephemerides (140 A.D. and after)—these weather predictions were being used in combination with a host of other signs and predictions, such as lunar days and general hemerological predictions. The latter were derived from a complex interplay of lunar, planetary, and calendrical factors. So also in the *al-Bīrūnī parapegma*, we find hemerological prediction combined with astrometeorology. This coming together of weather omnia and hemerological omnia represents the unification of two closely related technological traditions: the Roman astrological and the Greek astrometeorological *parapegmata*. At the other end of the time scale,

in one of the earliest texts we have looked at, the Babylonian omen series *Enuma Anu Enlil*, there is a complex intertwining of weather omina with all sorts of other omina. This is also the case with the powers of the decans in the *Şaft el-Henna* naos. It is only in the middle period, in the classical astrometeorological *parapegmata*, that we see the subject of astrometeorology being treated as strictly independent from other types of omina. This is not to say that astrometeorology was seen as separate from other types of astrology or divination, however. Rather, the texts in which we find it were but one type of astrological tool for facilitating a very specific set of predictions based on simple annual cycles. While all these cycles are temporal, not all of them are calendrical, and this distinction is an important one. Zodiacal signs are not zodiacal months, just as lunar days are not necessarily lunar dates.

While the zodiacal signs in Geminus and Miletus I have been interpreted as betraying a zodiacal calendar, I have argued at length against this. Another generally-accepted theory about the *parapegmata* that I have questioned is the assumption that the authors cited in the *parapegmata* were themselves authors of *parapegmata*. Instead, I have claimed that the attributions to these early authors, such as Meton, Euctemon, Callippus, and Democritus, may well have been culled from various types of sources by the authors of the later attributive *parapegmata*. This would best explain the disagreements in dates, predictions, and day differences between the various attributive *parapegmata*.

This being said, it would be worthwhile to sketch what I see as a possible history of the development of fixed-star astrometeorology in the ancient world. I would underline that what follows is in many ways speculative, but does at least fit the body of evidence we have at present.

The earliest classical literature (Hesiod, seventh or eighth century B.C.) shows that the Greeks were using stellar phases in the regulation of agricultural and navigational seasons. At about the same time as this, the Babylonians were keeping careful dated observations of astronomical and meteorological phenomena (among other things) in the *Diaries*. But this may have been related to the older tradition of weather and other omnia, as found in *Enuma Anu Enlil*, and to the schematic dating of stellar and meteorological events in MUL.APIN. MUL.APIN's intercalation schemes have no parallel in the Greek literature, however. I have argued that the astrolabes, and in particular *Astrolabe B*, were not intercalation devices, but were probably used for the determination of omnia. And this highlights how the Babylonian material differs most notably from the classical: it shows a close connection with omnia which tend to be topically much more diverse than the types of predictions derived from stellar phases in the classical world. So also in Egypt, we find many types of omens connected with the astronomical decans, and with the calendrical year. This contrast nicely highlights a preference in the classical world for organizing the signs of omnia in a particular way, such that astronomical protases were treated, or at least organized and listed, distinctly from other kinds of signs.

The heliacal rising of a single star, Sirius, had for millennia been used by the Egyptians as an annual marker of the beginning of the Nile flood (it heralded the rising of the Nile in the earliest Egyptian texts), an event of supreme agricultural importance in Egypt. So also in the Babylonian *Diaries*, Sirius alone among the fixed stars has its heliacal rising recorded. The rising of Sirius had also been one of the dated events (the only dated stellar event) in the Uruk scheme (fifth century). This contrasts with Greece and Rome, where a *multitude* of stellar phases was used for timing agricultural activity from the earliest literary records right through to the middle ages and beyond. In particular, the Greeks connected weather and seasonal markers with stellar phases. Hesiod has scattered such rules of thumb throughout his *Works and Days*, and I suspect that similarly scattered astrometeorological rules and predictions could be found in works by later writers such as Euctemon, Meton, Eudoxus, and Callippus. By the third century B.C. at the latest (*P. Hibeh 27*), these rules and predictions were being collected in *parapegmata* proper, and some of these *parapegmata* were explicit in crediting predictions to the earlier authors. Perhaps shortly after *P. Hibeh*, the Geminus *parapegma* also incorporated zodiacal signs into its schema, and these turn up also in the late second century or early first century Miletus I. While the earliest extant astrometeorological *parapegma* (*P. Hibeh 27*) is literary, it may have been an adaptation of an earlier inscriptional type of *parapegma*. The earliest extant inscriptional *parapegma*, the Ceramicus *parapegma*, was almost certainly neither astrometeorological nor astronomical. Whatever the

purpose of the Ceramicus parapegma, the idea of marking cyclical events with a movable peg was later adapted to astronomy and astrometeorology, if not before the *P. Hibeh* parapegma, then soon after it (Miletus I and II). This view contrasts with the generally accepted picture of the development of parapegmata (Rehm, van der Waerden, Neugebauer, Bowen and Goldstein, Toomer), which saw full-blown parapegmata being erected as early as the fifth century B.C.

As for the types of parapegmata, in the Greek tradition we find both inscriptional and literary astrometeorological parapegmata, but in Rome there is only one attested inscriptional astrometeorological parapegma (the Puteoli parapegma). The other Latin inscriptional parapegmata were used for tracking hebdomadal, lunar, and nundinal cycles. The hebdomadal and lunar cycles were used for the determination of good and bad-luck days, and the lunar cycle alone for regulation of agricultural and other activities. The nundinal cycle would track the local market day. I do not think the nundinal cycle had any astrological or ominous significance. The fact that these astrological parapegmata turn up in graffiti leads me to believe that they were fairly common in late republican and early imperial Rome.

As near as we can tell from the available evidence, the Greek inscriptional parapegmata did not incorporate calendars. This point differs from previous ideas on the history of parapegmata which saw combined astrometeorological and calendrical parapegmata being publicly erected by Meton, Euctemon, and others. I have argued that although it is clear that Meton and Euctemon inaugurated a 19-year cycle in 432 B.C., this was possibly used for the schematic

determination of solstice dates in a lunar calendar, and that these solstice dates may then have been used for the calibration of an astrometeorological cycle, one which later found itself enshrined in attributive *paraepgmata* such as Ptolemy, Geminus, and Miletus II.

The core of the *paraepgma* tradition is centred on a need to regulate seasonal activities such as agriculture, navigation, and perhaps also warfare. These activities are so universal that it comes as no surprise that we find apparently independent traditions in Mesopotamia, Egypt, and Greece. The Roman tradition is difficult to disentangle from the Greek, but there are elements of Roman agricultural practice that are indigenous.<sup>1</sup> By the time of the composition of ephemerides, the Roman interest in hemerology was being united with Greek astrometeorology.

The *paraepgmata* are fundamentally astrological rather than calendrical or astronomical. It is their nature as predictive tools and their application for practical ends such as the regulation of cyclical activities which aligns them with the hemerologies and with planetary astrology. The *paraepgmata* and their related texts and instruments are part of a world which is really quite different from our own, one in which signs in the heavens were watched, awaited, and predicted as part of everyday life for kings, estate owners, astronomers, and farmers alike.

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<sup>1</sup> For an attempt at distinguishing this, see Wenskus, 1998.

*Tables of Correspondence of Parapegmata*

Lehoux: A) Astrometeorological Parapegmata; B) Astrological Parapegmata; C) Astronomical Parapegmata; D) Other Parapegmata; E) Reports of Parapegmata; F) Related Texts and Instruments; G) Dubia

Rehm: A) Inscriptional Parapegmata; B) Literary Parapegmata; III) Inauthentic Parapegmata

Lehoux	Rehm	Degrassi	Lehoux	Rehm	Degrassi
A.i	B 3		C.lv	B 8	XIII.2.6
A.ii	—		C.v	—	
A.iii	A 2		D.i	A 3	
A.iv	A 4	XIII.2.57	D.ii	III 10	XIII.2.40
A.v	B 1		D.iii	III 1	
A.vi	B 4		D.lv	—	XIII.2.54
A.vii	B 5		D.v	—	XIII.2.51
A.viii	B 20, B 6		D.vi	—	XIII.2.50
A.ix	B 2		E.i	—	
A.x	B 12	XIII.2.43	E.ii	III 2	
A.xi	B 11		E.iii	B 15	
A.xii	B 7b		E.lv	—	
A.xiii	B 13		F.i	—	
A.xiv	B 7a		F.ii	—	
A.xv	B 10		F.iii	—	
A.xvi	B 9		F.lv	B 24	
A.xvii	—		F.v	B 23	
A.xviii	B 21		F.vi	B 23	
A.xix	—		F.vii	B 16	
A.xx	B 14		F.viii	B 18	
A.xxi	—		F.ix	B 19	
B.i	III 6	XIII.2.56	F.x	—	
B.ii	III 8		F.xi	—	
B.iii	III 5	XIII.2.49	F.xii	B 25	
B.iv	—	XIII.2.59	F.xiii	—	
B.v	III 3	XIII.2.55	F.xiv	III 12, III 13	
B.vi	—	XIII.2.58	F.xv	III 11	
B.vii	—	XIII.2.53	F.xvi	B 22	
B.viii	III 4	XIII.2.52	G.i	—	
B.ix	III 14		G.ii	B 17	
B.x	III 15		G.iii	—	
B.xi	III 16		G.iv	—	
B.xii	—		G.v	—	
B.xiii	III 7		G.vi	—	
C.i	—		G.vii	—	
C.ii	A 1		G.viii	—	
C.iii	—		G.ix	III 9	
			G.x	—	

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Rehm: A) Inscriptional Parapegmata; B) Literary Parapegmata;  
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Parapegmata; C) Astronomical Parapegmata; D) Other  
Parapegmata; E) Reports of Parapegmata; F) Related  
Texts and Instruments; G) Dubia

Rehm	Lehoux		Rehm	Lehoux
A 1	<i>C.ii</i>		B 20	<i>A.viii</i>
A 2	<i>A.iii</i>		B 21	<i>A.xviii</i>
A 3	<i>D.i</i>		B 22	<i>F.xvi</i>
A 4	<i>A.iv</i>		B 23	<i>F.v, F.vi</i>
B 1	<i>A.v</i>		B 24	<i>F.iv</i>
B 2	<i>A.ix</i>		B 25	<i>F.xii</i>
B 3	<i>A.i</i>		III 1	<i>D.iii</i>
B 4	<i>A.vi</i>		III 2	<i>E.ii</i>
B 5	<i>A.vii</i>		III 3	<i>B.v</i>
B 6	<i>A.viii</i>		III 4	<i>B.viii</i>
B 7a	<i>A.xiv</i>		III 5	<i>B.iii</i>
B 7b	<i>A.xii</i>		III 6	<i>B.i</i>
B 8	<i>C.iv</i>		III 7	<i>B.xiii</i>
B 9	<i>A.xvi</i>		III 8	<i>B.ii</i>
B 10	<i>A.xv</i>		III 9	<i>G.ix</i>
B 11	<i>A.xi</i>		III 10	<i>D.ii</i>
B 12	<i>A.x</i>		III 11	<i>F.xv</i>
B 13	<i>A.xiii</i>		III 12	<i>F.xiv</i>
B 14	<i>A.xx</i>		III 13	<i>F.xiv</i>
B 15	<i>E.iii</i>		III 14	<i>B.ix</i>
B 16	<i>F.vii</i>		III 15	<i>B.x</i>
B 17	<i>G.ii</i>		III 16	<i>B.xi</i>
B 18	<i>F.viii</i>			
B 19	<i>F.ix</i>			



*Index of Parapegmata by Name:*

Aëtius	A.xv	<i>Iudicia</i>	A.xvii
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Alésia Disk	F.xiv	Miletus I	C.ii
Allifæ Nundinal Lists	D.vi	Miletus II	A.iii
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<i>C. Marcianus 335</i>	A.xx	<i>P. Iriarte</i>	A.xiii
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Columella	A.vii	Phaseis	A.ix
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Dijon Disk	F.xv	Polemīus Silvius	A.x
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Diodorus Siculus	E.iii	Pompeii Calendar Medallions	G.iv
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Eschenz Object	G.x	Soulosse Hebdomadad P.	B.xi
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Eudoxus Papyrus	F.vii	Termæ Traiani	B.i
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## References

- Aelian, *Claudii Aeliani varia historia*, M. R. Dilts, ed., Leipzig, 1974
- Aetius, *Doxographi graeci*, H. Diels, ed., Berlin, 1879
- al-Biruni (1879) *The Chronology of Ancient Nations*, C.E. Sachau, trans., London
- Al-Rawi, F. N. H. and A. R. George (1991) 'Enuma Anu Enlil XIV and Other Early Astronomical Tables,' *Archiv für Orientforschung*, 38/39, p. 50-1
- Alexander of Aphrodisias, *Præter commentaria scripta minora*, I. Bruns, ed., Berlin, 1892, vol. II.ii
- Aratus, *Arati phaenomena*, E. Maass, ed., Berlin, 1893
- Aristotle, *Opera*, I. Bekker, ed., Oxford, 1837
- Aujac, G., ed. (1975) *Géminos, Introduction aux phénomènes*, Paris
- Aulus Gellius, *The Attic Nights of Aulus Gellius*, J. C. Rolfe, ed., Cambridge, MA, 1928
- Bakir, A. M. (1966) *The Cairo Calendar No. 86637*, Cairo
- Barton, T. (1994) *Ancient Astrology*, New York
- Becatti, G. (1954) 'I Mitrei,' *Scavi di Ostia*, Rome
- Berggren, J. L. (1992) 'Review of W. Knorr's 'Textual Studies in Ancient and Medieval Geometry,' *Ancient Philosophy*, 12, p. 522-28
- Bianchi, L. (1914) 'Der Kalender des sogenannten Clodius Tuscus,' in F. Boll, ed., 'Griechische Kalender,' *Sitzungsb. d. Heidelberger Akad. d. Wiss., Phil.-Hist. Kl.*, IV, Heidelberg
- Blass, F. (1997) 'Eudoxi ars astronomica qualis in charta ægyptiaca superest,' reprinted in *Zeitschrift für Papyrologie und Epigraphik*, 115, p. 79-101
- Böckh, A. (1863) *Über die vierjährigen Sonnenkreise der Alten, vorzüglich den Eudoxischen*, Berlin

- Boll, F. (1893-) 'Dodecaeteris,' in *Paulys Realencyclopädie der classischen Altertumswissenschaft*, Stuttgart
- Boll, F. (1893-) 'Fixsterne,' in *Paulys Realencyclopädie der classischen Altertumswissenschaft*, Stuttgart
- Boll, F. (1910a) 'Das Kalendarium des Antiochos,' in F. Boll, ed., 'Griechische Kalender I,' *Sitzungsb. d. Heidelberger Akad. d. Wiss., Phil.-Hist. Kl.*, Heidelberg
- Boll, F. (1910b) 'Der Kalender der Quintilii und die Überlieferung der Geoponica,' in F. Boll, ed., 'Griechische Kalender II,' *Sitzungsb. d. Heidelberger Akad. d. Wiss., Phil.-Hist. Kl.*, Heidelberg
- Bottero, J. (1974) 'Symptômes, signes, écritures en Mésopotamie ancienne,' in J. P. Vernant, ed., *Divination et rationalité*, Paris
- Bowen, A. and B. R. Goldstein (1988) 'Meton of Athens and Astronomy in the Fifth Century B.C.,' in E. Leichty et al., ed., *A Scientific Humanist: Studies in Memory of Abraham Sachs*, Philadelphia
- Brind'Amour, P. (1983) *Le calendrier romain*, Ottawa
- Broughton, A. L. (1936) 'The Menologia Rustica,' *Classical Philology*, 31, p. 353-56
- Brown, M. (1997) 'Thinking About Magic,' in S. D. Glazier, ed., *Anthropology of Religion*, London, p. 121-136
- Brückner, A. (1931) 'Mitteilungen aus dem Kerameikos V,' *Mitteilungen des Deutschen Archäologische Instituts, Athenische Abteilung*, 56, p. 1-97
- Brugsch, H. K. (1883-91) *Thesaurus inscriptionum aegyptiacarum*, Leipzig
- Buchner, E. (1982) *Die Sonnenuhr des Augustus*, Mainz
- Burnett, C. (1993) 'An Unknown Latin Version of an Ancient Parapégma: The Weather-Forecasting Stars in the *Iudicia* of Pseudo-Ptolemy,' in R. G. W. Anderson, J. A. Burnett and W. F. Ryan, eds., *Making Instruments Count*, Aldershot
- Cagirgan, C. (1985) 'Three More Duplicates to Astrolabe B,' *Türk Tarih Kurumu, Belleteri*, 48, p. 404-5
- Calcidius, *Timæus, a Calcidio translatus commentarioque instructus*, J. H. Waszink, ed., London, 1962

- Cato, M. Porcius, *De agri cultura*, W. D. Hooper and H. B. Ash, eds., Cambridge MA, 1935
- Censorinus, *De die natali*, N. Sallmann, ed., Leipzig, 1983
- Cicero, 'Ad Atticum,' in L.-A. Constans and J. Bayet, eds.
- Cicero, *Academica*, O. Plasberg, ed., Leipzig, 1922
- Cicero, *De divinatione*, W. A. Falconer, ed., Cambridge MA, 1923
- Cicero, *De natura deorum*, H. Rackham, ed., Cambridge MA, 1933
- Clagett, M. (1995) *Ancient Egyptian Science*, Philadelphia
- Clermont-Ganneau, C. (1906) *Recueil d'archéologie orientale*, Paris
- Cohen, M. E. (1993) *The Cultic Calendars of the Ancient Near East*, Bethesda, MD
- Columella, *Rei rusticæ*, H. B. Ash, E. S. Forster and E. H. Heffner, eds., Cambridge MA, 1948-55
- Constans, L. A. and J. Bayet, eds. (1969) *Cicéron, Correspondance*, Paris
- Corpus inscriptionum latinarum*, Berlin, 1863
- Cramer, F. H. (1954) *Astrology in Roman Law and Politics*, Philadelphia
- Cumont, F., et al., ed. (1898-1953) *Catalogus codicum astrologorum Græcorum*, Brussels
- Curtis, H. D. and F. E. Robbins (1935) 'An Ephemeris of 467 A.D.,' *Publications of the Observatory of the University of Michigan*, 6. 9, p. 77-100
- Degrassi, A. (1963) *Inscriptiones italiæ*, Rome
- Della Corte, M. (1927) 'Pompei,' *Notizie degli scavi di antichità*, 6.3, p. 98
- Depuydt, L. (1997) *Civil Calendar and Lunar Calendar in Ancient Egypt*, Leuven
- Depuydt, L. (1998) 'Ancient Egyptian Star Clocks and Their Theory,' *Bibliotheca Orientalis*, p. 5-44
- Dessau, H. (1904) 'Zu den Milesischen Kalendarfragmenten,' *Sitzungsb. d. königl. Preuss. Akad. d. Wiss., Philos.-Hist. Kl.*, 23, p. 266-268

- The Dictionary of Scientific Biography*, C. C. Gillispie, ed., New York, 1970-
- Diels, H. and A. Rehm [1904] 'Parapagmenfragmente aus Milet,'  
*Sitzungsb. d. königl. Preuss. Akad. d. Wiss., Philos.-Hist. Kl.*, 23, p.  
92-111
- Dillon, J. (1996) *The Middle Platonists*, Ithaca NY
- Diocles of Carystus, 'Letter to King Antigonus,' in W. Jaeger, ed., *Diokles  
von Karystos*, Berlin, 1938, p. 75-78
- Diodorus Siculus, *History*, C. H. Oldfather, ed., Cambridge MA, 1933
- Diogenes Laertius, *Lives of the Eminent Philosophers*, R. D. Hicks, ed.,  
Cambridge MA, 1925
- Dionysius Halicarnassensis, *Antiquitatum romanorum quæ supersunt*, K.  
Jacoby, ed., Stuttgart, 1967
- Dölger, F. J. (1950) 'Die Planetenwoche der griechisch-römischen Antike  
und der christliche Sonntag,' *Antike und Christentum*, Munich, vol.  
VI, p. 202-238
- Donbaz, V. and J. Koch (1995) 'Ein Astrolab der dritten Generation:  
NV.10,' *Journal of Cuneiform Studies*, 47, p. 63-84
- Douglas, M. (1984) *Purity and Danger*, New York
- Dozy, R. (1961) *Le calendrier de Cordue*, Leiden
- Drower, M. S., E. W. Gray, et al. (1996) 'Europus,' in S. Hornblower and  
A. Spawforth, eds., *The Oxford Classical Dictionary*, Oxford
- Duval, P. M. (1953) 'Les dieux de la semaine,' *Gallia*, XI, p. 282-293
- Duval, P. M. and G. Pinault (1986) 'Les calendriers (Coligny, Villards  
d'Héria),' *Recueil des inscriptions gauloises*, Paris, vol. III
- Ebeling, E. (1915) *Keilschrifttexte aus Assur religiösen Inhalts*, Leipzig
- Eco, U. (1984) *Semiotica e filosofia del linguaggio*, Turin
- Erikkson, S. (1956) 'Wochentagsgötter, Mond und Tierkreis,' *Studia  
Græca et Latina Gothoburgensia*, III
- Ernesti, J. A., ed. (1810) *M. Tulli Ciceronis opera omnia*, Oxford
- Espérandieu, É. (1907-) *Recueil général des bas-reliefs, statues et bustes de  
la Gaule romaine*, Paris

- Espérandieu, É. (1933) 'Séance du 13 Octobre,' *Comptes rendus des séances de l'année de l'Académie des inscriptions et belles-lettres*, p. 383-385
- Evans, J. (1999) 'The Material Culture of Greek Astronomy,' *Journal for the History of Astronomy*, 30, p. 237-307
- Evans-Pritchard, E. E. (1937) *Witchcraft, Oracles and Magic among the Azande*, Oxford
- Fantham, E., ed. (1998) *Ovid Fasti, Book IV*, Cambridge
- Faraone, C. (1999) *Ancient Greek Love Magic*, Cambridge, MA
- Ferrua, A. (1985) 'Il giorno del mese,' *Rivista di archeologia cristiana*, p. 61-75
- Field, J. V. and M. T. Wright (1985) 'Gears from the Byzantines: a Portable Sundial with Calendrical Gearing,' *Annals of Science*, 42, p. 87-138
- Flammant, J. (1984) 'L'année lunaire aux origines du calendrier pre-julien,' *Mélanges d'archéologie et d'histoire de l'École française de Rome*, 96, p. 175-193
- Frazer, J. G. (1900) *Golden Bough*, London
- Frede, M. (1980) 'The Original Notion of Cause,' in M. Schofield, M. Burnyeat and J. Barnes, eds., *Doubt and Dogmatism: Studies in Hellenistic Epistemology*, Oxford, p. 217-249
- Galen, *Claudii Galeni opera omnia*, D. C. G. Kühn, ed., Leipzig, 1821
- Gaspari, A. and S. Cernuti (1997) *L'astronomia dei celti*, Aosta
- Geminus, *Gemini elementa astronomiae*, C. Manitius, ed., Leipzig, 1898
- Geoponica*, H. Beckh, ed., Leipzig, 1895
- Germer-Durand, J. (1901) 'Inscriptions d'Abougoch, Esdoud, Naplouse, et Beisan,' *Echos d'Orient*, V, p. 73-76
- Gibbs, S. L. (1976) *Greek and Roman Sundials*, New Haven
- Ginzler, F. K. (1914) *Handbuch der mathematischen und technischen Chronologie*, Leipzig

- Gjerstad, E. (1961) 'Notes on the Early Roman Calendar,' *Acta Archaeologica*, 32, p. 193-214
- Goessler, P. (1928) 'Ein gallorömischer Steckkalender aus Rottweil,' *Germania*, XII, p. 1-9
- Goldstein, B. R. and A. C. Bowen (1991) 'The Introduction of Dated Observations and Precise Measurement in Greek Astronomy,' *Archive for History of Exact Sciences*, 43, p. 93-132
- Grafton, A. T. and N. Swerdlow (1988) 'Calendar Dates and Ominous Days in Ancient Historiography,' *Journal of the Warburg and Courtauld Institutes*, 51, p. 14-42
- Grenfell, B. P. and A. S. Hunt (1906) *The Hibe Papyri*, London
- Habachi, B. and L. Habachi (1952) 'The Naos With the Decades (Louvre D 37) and the Discovery of Another Fragment,' *Journal of Near Eastern Studies*, 11, p. 251-263
- Heath, T. L. (1913) *Aristarchus of Samos, the Ancient Copernicus*, Oxford
- Hellmann, G. (1916) 'Aegyptische Witterungsangaben im Kalender von Ptolemaios,' *Sitz. der Akad. Ber.*, p. 332-341
- Hellmann, G. (1917) 'Die Witterungsangaben in den griechischen und lateinischen Kalendern [Beiträge zur Geschichte der Meteorologie],' 'Beiträge zur Geschichte der Meteorologie,' *Veröffentlichen des Königlich Preußischen Meteorologischen Instituts*, 296, Berlin
- Hesiod, *Works and Days*, H. G. Evelyn-White, ed., Cambridge MA, 1914
- Hippocrates, *Œuvres complètes*, E. Littré, ed., Paris, 1839-61
- Hitz, H. R. (1991) *Der gallo-lateinisch Mond- und Sonnen-Kalender von Coligny*, Dietikon
- Hjelmslev, L. (1961) *Prolegomena to a Theory of Language*, F.J. Whitfield, trans., Madison, WI
- Holleman, A. W. J. (1978) 'Les calendriers préjuliens à Rome,' *L'antiquité classique*, 47, p. 201-206
- Homer, *Odyssea*, T. W. Allen, ed., Oxford, 1908
- Horowitz, W. (1996) 'The 360 and 364 Day Year in Ancient Mesopotamia,' *Journal of the Ancient Near Eastern Society*, 24, p. 35-44
- Huber, P. J. (1982) *Astronomical Dating of Babylon I and Ur III*, Malibu

- Hunger, H. (1976) 'Astrologische Wettervorhersagen,' *Zeitschrift für Assyriologie und vorderasiatische Archäologie*, 66, p. 234-260
- Hunger, H. (1992) 'Astrological Reports to Assyrian Kings,' *State Archives of Assyria*, VIII, Helsinki
- Hunger, H and D. Pingree (1989) *MUL.APIN: An Astronomical Compendium in Cuneiform*, Horn
- Hunger, H. and D. Pingree (1999) *Astral Sciences in Mesopotamia*, Leiden
- Hunger, H. and E. Reiner (1975) 'A Scheme for Intercalary Months from Babylonia,' *Wiener Zeitschrift für die Kunde des Morgenlandes*, 67, p. 21-28
- Inscriptiones græcæ*, Berlin, 1863-
- Jenks, S. (1983) 'Astrometeorology in the Middle Ages,' *ISIS*, 74, p. 185-210
- Johnson, V. (1963) 'The Prehistoric Roman Calendar,' *American Journal of Philology*, 84, p. 28-35
- Jones, A. (1994) 'An Astronomical Ephemeris for A.D. 140: P. Harris I.60,' *Zeitschrift für Papyrologie und Epigraphik*, 100, p. 59-63
- Jones, A. (1999a) *Astronomical Papyri from Oxyrhynchus*, Philadelphia
- Jones, A. (1999b) 'Geminus and the Isia,' *Harvard Studies in Classical Philology*, 99, p. 255-267
- Jones, A. (2000) 'Calendrica I: New Callippic Dates,' *Zeitschrift für Papyrologie und Epigraphik*, 129, p. 141-158
- Junker, H. (1917) *Die Onurislegende*, Vienna
- Kamal, A. B. (1906) 'Rapport sur Quelques Localités de la Basse-Egypte,' *Annales du Service des Antiquités de l'Egypte*, 7, p. 232-240
- Koch-Westenholz, U. (1995) *Mesopotamian Astrology*, Copenhagen
- Krchnák, A. (1963) 'Die Herkunft der astronomischen Handschriften und Instrumente des Nicholas von Kues,' *Mitteilungen und Forschungsbeiträge der Cusanus-Gesellschaft*, 3, p. 109-80
- Kroll, W. (1930) *Die Kosmologie des Plinius*, Breslau



- Kubitschek, W. (1893-) 'Meton,' *Paulys Realencyclopädie der classischen Altertumswissenschaft*, Stuttgart
- Kubitschek, W. (1928) *Grundriss der antiken Zeitrechnung*, Munich
- Kuhn, T. S. (1970) *The Structure of Scientific Revolutions*, Second, ed., Chicago
- Labat, R. (1939) *Hémérologies et ménologies d'Assur*, Paris
- Labat, R. (1965) *Un calendrier babylonien des travaux des signes et des mois*, Paris
- Labat, R. (1988) *Manuel d'épigraphie akkadienne*, 6e ed., Paris
- Lalonde, M. (1996) *La reconnaissance du temps*, Montreal
- Lanciani, R. (1878) 'Ostia,' *Notizie degli scavi di antichità*, p. 67
- Langdon, S. (1935) *Babylonian Menologies and the Semitic Calendars*, London
- Lehmann, P. (1930) 'Mitteilungen aus Handschriften II,' *Sitzungsber. der Bayer. Akad. der Wiss., Philos.-hist. Abteilung*, 2
- Leitz, C. (1994) *Tagewählerei*, Weisbaden
- Leitz, C. (1995) *Altägyptische Sternühren*, Leuven
- Linderski, J. (1996) 'Divination, Roman,' in S. Hornblower and A. Spawforth, eds., *The Oxford Classical Dictionary, Third Edition*, Oxford
- Long, C. R. (1992) 'Pompeii Calendar Medallions,' *American Journal of Archaeology*, 96, p. 477-501
- Luck, G. (1985) *Arcana Mundi*, Baltimore
- Luck, G. (1990) *Magie und andere Geheimlehren in der Antike*, Stuttgart
- Lydus, Johannes Laurentis, *Ioannes Laurentii Lydi liber de ostentis et calendaria græca omnia*, C. Wachsmuth, ed., Leipzig, 1897
- Maaß, E. (1902) *Die Tagesgötter in Rom und den Provinzen*, Berlin
- MacNeill, E. (1928) 'On the Notation and Chronology of the Calendar of Coligny,' *Ériu*, X, p. 1-67
- Macrobius, *Saturnalia*, J. Willis, ed., Leipzig, 1963

- Malinowski, B. (1948) *Magic, Science and Religion*, New York
- Manicoli, D. (1981) 'Un calendario astrologico al Museo della Civiltà Romana,' *Bollettino dei Musei comunali di Roma*, 28-30, p. 18-22
- Mauss, M. (1902-3) 'Esquisse d'une théorie générale de la magie,' *L'année sociologique*,
- McCluskey, S. C. (1998) *Astronomies and Cultures in Early Medieval Europe*, Cambridge
- Meyboom, P. G. P. (1978) 'Un monument énigmatique "Dusari sacrum" à Pouzzoles,' in M. B. d. Boer and T. A. Edridge, eds., *Hommages à Maarten J. Vermaseren*, Leiden, p. 782-790
- Michels, A. K. (1967) *The Calendar of the Roman Republic*, Princeton
- Mingazzini, P. (1928) 'Pozzuoli. - Frammento di calendario perpetuo,' *Notizie degli scavi di antichità*, 6.4, p. 202-205
- Mommsen, T. (1859) *Die römische Chronologie bis auf Caesar*, Berlin
- Nemesius, *De natura hominis*, C. F. Matthaei, ed., Halle, 1802
- Neugebauer, O. (1955) *Astronomical Cuneiform Texts*, London
- Neugebauer, O. (1975) *History of Ancient Mathematical Astronomy*, New York
- Neugebauer, O. and R. Parker (1969) *Egyptian Astronomical Texts*, Providence, RI
- Newlands, C. (1995) *Playing with Time: Ovid and the Fasti*, Ithaca
- Nilsson, M. P. (1920) *Primitive Time-Reckoning*, Oxford
- Nilsson, M. P. (1952) 'Zur Frage von dem Alter des vorcäsarischen Kalendars,' *Opuscula Selecta*, Lund, vol. II, p. 979-87
- Olmstead, G. (1992) *The Gaulish Calendar*, Bonn
- Ovid, *Fasti*, J. G. Frazer, ed., Cambridge MA, 1931
- The Oxford Classical Dictionary*, third edition, S. Hornblower and A. Spawforth, eds., Oxford, 1996
- The Oxyrhynchus Papyri*, London, 1898-

- Palladius, *Opus agriculturæ*, R. H. Rodgers, ed., Leipzig, 1975
- Parisot, J. P. [1985] 'Les phases de la lune et les saisons dans le calendrier de Coligny,' *Études indo-européens*, 13, p. 1-18
- Parker, R. [1950] *The Calendars of Ancient Egypt*, Chicago
- Parker, R. [1959] *A Vienna Demotic Papyrus on Eclipse and Lunar-Omina*, Providence, RI
- Paulys Realencyclopädie der classischen Altertumswissenschaft*, Stuttgart, 1893-
- Pausanias, *Description of Greece*, W. H. S. Jones, ed., Cambridge MA, 1959-61
- Pedroni, L. [1998] 'Ipotesi sull'evoluzione del calendario arcaico di Roma,' *Papers of the British School at Rome*, 66, p. 39-56
- Peel, J. D. Y. [1969] 'Understanding Alien Belief Systems,' *British Journal of Sociology*, 20, p. 69-84
- Pellat, C., ed. [1986] *Cinq calendriers Égyptiens*, Cairo
- Petronius Arbiter, *Satyricon*, M. Heseltine, ed., Cambridge MA, 1913
- Pfeiffer, E. [1916] *Studien zum antiken Sternnglauben*, Leipzig
- Philodemus, *De signis*, P. H. De Lacy and E. A. D. Lacy, eds., Naples, 1978
- Pingree, D. [1976] 'The Indian and Pseudo-Indian Passages in Greek Latin Astronomical and Astrological Texts,' *Viator*, 7, p. 141-195s
- Pliny, *Naturalis historæ*, H. Rackham, ed., Cambridge MA, 1938
- Plotinus, *Enneades*, A. H. Armstrong, ed., Cambridge MA, 1984
- Polybius, *Polybii historæ*, T. Buettner-Wobst, ed., Stuttgart, 1889-1904
- Price, D. de Solla [1974] 'Gears from the Greeks,' *Trans. Am. Phil. Soc.*, NS 64.7
- Pritchett, W. K. and B. L. van der Waerden [1961] 'Thucydidean Time-Reckoning and Euctemon's Seasonal Calendar,' *Bulletin de correspondance Hellénique*, 85, p. 17-52
- Pritchett, W. K. and O. Neugebauer [1947] *The Calendars of Athens*, Cambridge, MA

- Proclus, *Procli Diadochi in Platonis rem publicam commentarii*, G. J. Kroll, ed., Leipzig, 1899
- Ptolemy, 'Phaseis,' in Heiberg, ed., *Claudii Ptolemaei opera quae exstant Omnia*, Leipzig, 1907, vol. II
- Ptolemy, *Almagest*, in Heiberg, ed., *Claudii Ptolemaei opera quae exstant Omnia*, Leipzig, 1898, vol. I
- Quine, M. V. (1953) 'Two Dogmas of Empiricism,' *From a Logical Point of View*, Cambridge, Mass.
- Reallexikon der Assyriologie und vorderasiatischen Archäologie*, Berlin, 1928-
- Rehm, A. (1893-) 'Episemasiai,' *Paulys Realencyclopädie der classischen Altertumswissenschaft*, Stuttgart
- Rehm, A. (1893-) 'Parapegma,' *Paulys Realencyclopädie der classischen Altertumswissenschaft*, Stuttgart
- Rehm, A. (1904) 'Weiteres zu den milesischen Parapegmen,' *Sitzungsb. d. königl. Preuss. Akad. d. Wiss., philos.-hist. Kl.*, 23, p. 752-759
- Rehm, A. (1913) 'Das Parapegma des Euktemon,' in F. Boll, ed., 'Griechische Kalender,' *Sitzungsb. d. Heidelberger Akad. d. Wiss., Phil.-Hist. Kl.*, Heidelberg, p. 2-38
- Rehm, A. (1927) 'Der römische Bauernkalender und der Kalender Caesars,' *Epitymbion Heinrich Swoboda dargebracht*, Reichenberg, p. 214-228
- Rehm, A. (1941) *Parapegmastudien*, Munich
- Reiner, E. and D. Pingree (1975-1998) *Babylonian Planetary Omens*, Malibu and Groningen
- Ricci, S. de (1898) 'Le calendrier galois de Coligny,' *Revue celtique*, XIX, p. 213-223; Pl. I-VI
- Ricci, S de (1900) 'Le calendrier celtique de Coligny,' *Revue celtique*, XXI, p. 10-27
- Ritner, R. K. (1993) *The Mechanics of Ancient Egyptian Magical Practice*, Chicago

- Rochberg-Halton, F. (1988) 'Aspects of Babylonian Celestial Divination: The Lunar Eclipse Tablets of Enuma Anu Enlil,' *Archiv für Orientforschung, Beiheft 22*
- Rochberg-Halton, F. (1992) 'Calendars, Ancient Near East,' *Anchor Bible Dictionary*, New York
- Rostovtzeff, M. I., A. R. Bellinger, et al., eds. (1936) *The Excavations at Dura-Europus, Sixth Season, 1932-1933*, New Haven
- Sachs, A. (1948) 'A Classification of the Babylonian Astronomical Tablets of the Seleucid Period,' *Journal of Cuneiform Studies*, 2, p. 271-290
- Sachs, A. (1952) 'Sirius Dates in Babylonian Astronomical Texts of the Seleucid Period,' *Journal of Cuneiform Studies*, 6, p. 105-114
- Sachs, A. and H. Hunger (1988) *Astronomical Diaries and Related texts from Babylonia*, Vienna
- Salonen, A. (1968) *Agricultura mesopotamica*, Helsinki
- Samuel, A. E. (1972) *Greek and Roman Chronology*, Munich
- Saussure, F. de (1916) *Cours de linguistique générale*, Paris
- Schroeder, O. (1920) *Keilschrifttexte aus Assur verschiedenen Inhalts*, Leipzig
- Sebeok, T. A., ed. (1986) *Encyclopedic Dictionary of Semiotics*, Amsterdam
- Sextus Empiricus, *Adversus mathematicos*, R. B. Bury, ed., Cambridge, MA, 1933
- Shackleton-Bailey, D. R. (1968) *Cicero's Letters to Atticus*, Cambridge
- Slotsky, A. L. (1997) *The Bourse of Babylon*, Bethesda, MD
- Snyder, W. F. (1936) 'Quinto nundinas Pompeis,' *Journal of Roman Studies*, 26, p. 12-18
- van Soldt, W. H. (1995) *Solar Omens of Enuma Anu Enlil: Tablets 23 (24) - 19 (30)*, Istanbul
- Stobæus, Joannes, *Ioannis Stobaei Anthologii*, C. Wachsmuth, ed., Zurich, 1974
- Swerdlow, N. M. (1989) 'Ptolemy's Theory of the Inner Planets,' *Journal for the History of Astronomy*, 20, p. 29-60

- Swerdlow, N. M. (1998) *The Babylonian Theory of the Planets*, Princeton
- Tavener, E. (1918) 'The Roman Farmer and the Moon,' *Transactions and Proceedings of the American Philological Association*, XLIX, p. 67-82
- Theodosius, *De habitationibus liber, de diebus libri duo*, R. Fecht, ed., Göttingen, 1927
- Theophrastus, 'De signis,' in A. Hort, ed., *Inquiry Into Plants*, Cambridge MA, 1926, vol. II
- Thureau-Dangin, R. (1922) 'Tablettes d'Uruk,' *Textes Cuneiformes*, VI, Paris
- Thorndike, L. (1923) *History of Magic and Experimental Science*, New York
- Toomer, G. J. (1974) 'Meton,' *Dictionary of Scientific Biography*, New York
- Toomer, G. J. (1984) *Ptolemy's Almagest*, London
- Toomer, G. J. (1996) 'Meton,' in S. Hornblower and A. Spawforth, eds., *The Oxford Classical Dictionary*, Oxford
- Turner, E. G. and O. Neugebauer (1949) 'Gymnasium Debts and Full Moons,' *Bulletin of the John Rylands Library*, 32, p. 80-96
- Tyler, E.B. (1871) *Primitive Culture*, London
- Tyrell, R. Y. and L. C. Purser, eds. (1890) *The Correspondence of M. Tullius Cicero*, London
- Urner-Astholz, H. (1942) 'Die römerzeitliche Keramik von Eschenz-Tasgetium,' *Thurgauer Beiträge*, 78, p. 90 f.
- Urner-Astholz, H. (1960) 'Der Wochensteckkalender von Eschenz-Tasgetium und die Verehrung der Wochengötter,' *Jahrbuch der schweizerische Gesellschaft für Urgeschichte*, 48, p. 44 f.
- Varro, *De lingua latina*, P. Flobert, ed., Paris, 1985
- Varro, *Rerum rusticarum*, W. D. Hooper and H. B. Ash, eds., Cambridge MA, 1935
- Vergil, *Georgics*, H. R. Fairclough, ed., Cambridge MA, 1916
- Versnel, H. S. (1996) 'Magic,' in S. Hornblower and A. Spawforth, eds., *Oxford Classical Dictionary*, Oxford
- Virolleaud, C. (1908-1912) *L'astrologie chaldéenne*, Paris

- Wachsmuth, C. (1897) *Ioannis Laurentii Lydi liber de ostentis et calendaria græca omnia*, Leipzig
- van der Waerden, B. L. (1949) 'Babylonian Astronomy II: The Thirty-six Stars,' *Journal of Near-Eastern Studies*, 8, p. 6-26
- van der Waerden, B. L. (1960) 'Greek Astronomical Calendars and their Relation to the Athenian Civil Calendar,' *Journal of Hellenic Studies*, 80, p. 168-180
- van der Waerden, B. L. (1984a) 'Greek Astronomical Calendars I. The Parapegma of Euctemon,' *Archive for History of Exact Sciences*, 29, p. 101-114
- van der Waerden, B. L. (1984b) 'Greek Astronomical Calendars II. Callippus and his Calendar,' *Archive for History of Exact Sciences*, 29, p. 115-124
- van der Waerden, B. L. (1984c) 'Greek Astronomical Calendars III. The Calendar of Dionysius,' *Archive for History of Exact Sciences*, 29, p. 125-130
- van der Waerden, B. L. (1985) 'Greek Astronomical Calendars IV. The Parapegma of the Egyptians and their "Perpetual Tables",' *Archive for History of Exact Sciences*, 32.2, p. 95-104
- Weidner, E. F. (1915) *Handbuch der babylonische Astronomie*, Leipzig
- Weidner, E. F. (1928-) 'Fixsterne,' *Reallexikon der Assyriologie und Vorderasiatischen Archäologie*, Berlin
- Weidner, E. F. (1935-6) 'Aus den Tagen eines assyrischen Schattenkönigs,' *Archiv für Orientforschung*, 10, p. 1-52
- Wenskus, O. (1998) 'Columellas Bauernkalender zwischen Mündlichkeit und Schriftlichkeit,' in W. Kullmann, J. Althoff and M. Asper, eds., *Gattungen wissenschaftlicher Literatur in der Antike*, Tübingen
- White, K. D. (1970) *Roman Farming*, London
- Winstedt, E. O., ed. (1928) *Cicero, Letters to Atticus*, London
- Witte, J. de (1877) 'Les divinités des sept jours de la semaine,' *Gazette archéologique*, 3, p. 50-57; Pl. 8-9
- Worp, K. A. (1991) 'Remarks on Weekdays in Late Antiquity,' *Tyche*, VI, p. 221-230