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Evagations Diagrams in Medieval *Computus*

Diagramas de Evagações Planetárias em *Computus* Medievais
Resumo
Os diagramas de evagações são visualizações de padrões de movimentos cíclicos de objectos celestes (que podiam ser medidos por observação, e alguns calculados usando diferentes métodos, mas que se baseavam em conceitos difíceis de apreender somente a partir dos textos) que se desenvolveram como uma tradição visual medieval. Com o seu uso, pretendia-se uma fácil compreensão das informações complexas do texto por meio de uma tradução imagética de fenómenos que, de outra forma, só seriam visíveis por meio de longas e repetidas observações do céu. A sua frequente presença em *computus* transformou-os num receptáculo gráfico (ou modelo de design) para diferentes conhecimentos relacionados com o percurso dos planetas, como elongações, altitudes, latitudes e longitudes, fundamentais para compreender como o mundo funcionava, e para determinar a utilidade desse conhecimento.

Partindo do manuscrito Bern Cod. 347, produzido na segunda metade do século IX na região de Auxerre, este artigo irá fornecer uma visão global da transmissão de diagramas de latitudes (movimento em latitude dos planetas: em relação à eclíptica do sol ao longo do zodíaco), em manuscritos reunidos e copiado principalmente para escolas beneditinas, nos períodos carolíngio e pós-carolíngio, explorá-los como representações pictóricas de um conceito visual estabelecido, composto de uma mistura de dados reais e imaginários, e indagar sobre as como estas composições foram usadas para transmitir conhecimentos cosmográficos.
Palavras-chave: Representação Visual; Filosofia Natural; *Computus*; Cosmografia; Latitudes.

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Abstract
Evagations diagrams are visualisations of patterns of cyclical movements of celestial objects (that could be measured by observation and calculated using different methods, but which were difficult to grasp purely from texts), that developed as a medieval visual tradition. Its design was intended to assist the reader in making sense of complex information (presented in circulating manuscripts) through an imagetic translation of those phenomena – that are otherwise only visible through long-term sky observations. Their frequent presence in *computus* turned them into graphical receptacles (or templates) for different concepts related to the paths of planets, such as elongations, altitudes, latitudes and longitudes, which were key to understanding how the world worked, and to determining the usefulness of that knowledge.
Starting with manuscript Bern Cod. 347, a composite manuscript produced in the second half of the ninth century in the region of Auxerre, this article will provide an overview on the transmission of diagrams of latitudes (planetary wanderings in relation to the ecliptic of the sun through the course of the zodiac) in manuscripts assembled and copied mainly for Benedictine schools, in the Carolingian and post-Carolingian periods; exploring them as pictorial representations of an established visual concept, made up of a mixture of real and imaginary data, and will inquire about the ways in which these compositions were used to convey cosmographical knowledge.
Keywords: Visual Representation; Natural Philosophy; *Computus*; Cosmography; Latitudes.

Introduction

Evagations diagrams were developed to represent the patterns of stellar movements through the course of time. These astronomical diagrams were like drawing a picture of a series of pictures. The exercise was to feed the «mind's eye» and the memory with clear, simplified, and ordained information that corresponded to data from a multiplicity of objects, including their location over long periods. Three-dimensional positions were compressed to two-dimensional renderings, but objects' movements seem to be considered within dubious timelines in some cases[1].

Diagrams were go-to resources for most creations of encyclopaedic collections and computistical textbooks, whose texts were mostly available for educational purposes, at abbeys' libraries and cathedral schools in central and northern Europe, mostly from the eight to the twelfth century, and they continued being a reference well into the early modern period.

The calendric calculations necessary for the fulfilment of the Benedictine

1 The variation found in the horizontal axis of the diagrams of latitudes, for example, makes it difficult to establish the units and scale used. For more see: S. C. McCluskey, *Astronomies and cultures in early medieval Europe*. Cambridge University Press, Cambridge 2000.

rule and for the agricultural activities that were part of monastic life, to some large extant involved astronomical knowledge; in line with the ever-present influential texts of Isidorus and his diagrams (many of which focused on cosmology), and with the place given to the Liberal Arts during the Carolingian Renaissance.

Calcidius' translation of Plato, and Macrobius' commentary on Cicero, were part of the required reading list for astronomical studies for a thousand years, as were the works of Plinius Secundus and Martianus Capella. In them, we find diagrams that serve both the function of clarifying the texts and of exploring concepts for the readers. Even though most authors did not originally include descriptions (or drawing instruction) of diagrams in their texts, some shapes and meanings were soon embraced as natural phenomena of didactic texts to the point that some visual standards were adopted and transmitted across time and place. Various works were often bound together, cut, combined, and commented in compilations that travelled hundreds of miles.

1. Evagations Diagrams

Figure 1 is an example of a Plinian absides diagram, from a *computus* produced in Limoges, in central France: it is a beautiful design, we can almost see it moving, like a clock work mechanism, each planet positioned/labelled at its apogee, on its own eccentric circular line that represents the absides: the farthest and nearest distances from the Earth. Figure 2 is located among a series of other diagrams associated to a Calcidian text, but it is a diagram of zodiacal configurations (like Figure 4), under one sign and under successive signs' orders, which Macrobius names as the Platonic order of the planets. Figure 3 presents Martianus Capella' geo-heliocentric system, providing diagrammatic renderings for the heliocentricity involving Mars and Venus, based on different possible interpretations of the text.

In Plinius' *Naturalis Historia*, it is common to find a set of four diagrams: planetary order, harmonic intervals, absides and latitudes. In computistical miscellanies since the early Carolingian period and in textbooks such as the ones developed at the Abby of Fleury in the turn of the first millennium, these diagrams would sometimes leave their place in the text and move to a dedicated quire(s) together with various other diagrams from different authors. Sometimes, they stood alone as the sole necessary representatives of concepts. There, they were all redesigned be the hand of scribes to form graphical unities of representation, depending on expertise, available drawing materials, original sources, or purpose.

2. Planetary Latitutes

As it often happens in the process of designing information, some shapes are preferred and corrected over others, as they get refined in their communicative effectiveness.

Manuscript Cod 347[2] (Figure 5) is a very early example of the presence of the diagram of latitudes in its two historical shapes/versions (and in this case, also, in a Plinian excerpt): a circular and a rectangular one. They are defined by two characteristic elements: thirteen lines representing and delimiting the constellations the Sun moves by; and lines that represent the cyclic variation of latitude of each planet (or its eccentricity). In the circular version (that appears in second in this manuscript: a layout choice) the first lines are concentric, spaced evenly, and the second are eccentric circles that intercept the zodiac. In the rectangular version the two types of lines exist but they form what we would call a line chart: the zodiac is represented along the vertical axis and the cyclic patterns along the horizontal axis; the latitude lines run like zigzags up and down the chart, starting on the farthest point of each orbit in relation to the Earth. The illustrative elements for the planets, along with name labels, are present in both and will continue to be used until the very last examples of the latitudes diagram, specially for the Sun and Moon. In both shapes, the ecliptic is placed in the middle of the zodiac; and the Sun, Pliny tells us, moves unevenly in the middle, in a serpentine path[3]. Venus and the Moon have the most extreme angles of latitude, and Mercury, Mars and Jupiter have smaller ones, Saturn's coincides with the Sun's angle. Manuscript Latin 5239[4] (Figure 7), made in the following century, contains a very similar diagram, this time in a vertical position (but misses the apsides diagram, quite more complicated to copy).

In the *computus* manuscript Berlin 138[5] (Figure 6) – a compilation from

2 Bern, Burgerbibliothek, Cod. 347, 9th century, France. *Composite manuscript: Macrobius, Plinius, Nonius Marcellus: excerpts*, Latin. URL = https://www.e-codices.ch/en/list/one/bbb/0347, consulted on 2021.12.20.

3 B. Eastwood, G. Graßhoff, «Planetary Diagrams for Roman Astronomy in Medieval Europe, ca. 800-1500», *Transactions of the American Philosophical Society*, 94(3) (2004) 35–38. https://doi.org/10.2307/20020363

4 Bibliothèque nationale de France, Latin 5239, 10th century, France, Limoges. *Varia de computo*. Latin. URL = https://manuscrits-france-angleterre.org/ark:/12148/btv1b105419933, consulted on 2022.01.10.

5 Staatsbibliothek zu Berlin, Berlin 138 (Ms. Phill. 1833), 10th century, France. *Varia scripta arith-*

the tenth century, in the middle of a series of diagrams associated to Calcidius, Isidorus and Bede, among others, there are also two versions of the Plinian latitudes diagram (with slightly different representations of the latitudinal values). First, the older circular version, that looks like a top view of the solar system but that, it is not: it is sort of stereographical projection that required a more time-consuming visual calculation to learn the degrees of latitude variation regarding the ecliptic. Here it expresses more concentric lines for the planets closest to the ecliptic in the diagram, and absides' lines are less symmetrical and therefore more visually complex, than in the previous example. In addition, the Sun is not a wavy line, making matters of legibility even more complicated. And bellow, the rectangular shape that was later singly adopted. This one rapidly transmitted the idea of the quantitative data in the text and of passing of time, using a more realistic point of view for the observer, as if looking from the Earth.

One particular manuscript, Ms. R.15.32[6] (Figure 8), also a compilation of astronomical and computistical texts, tables and diagrams, contains an orphan latitudes diagram, fully labeled: titled «De Curso VII Planetarum Per Zodiacum Circulum», the vertical bar reads «Latitudo Constans XII Partib[us]» with the following order for the planets, from top to bottom: Venus, Mercury, Sun, Saturn, Mars, Jupiter and Moon; and the horizontal bar reads «Longitudo Zodiaci Constans CCCLXV Partis» and contains also the information regarding the *Armonia* in the distance between planets. Like that from Berlin 138, but more legible and whole, this diagram contains a block of information that can be called a mark of the productions from the Abbey of Fleury, where it also sometimes rested as the sole diagram for Plinius' excerpts.

The rectangular latitudes diagram itself developed in different visual variants and rarely did it correspond to the actual text, often it provided inaccurate and contradictory data. More than trying to record numbers on latitudinal limits for a better memorisation of the location of the planets according to Plinius, these diagrams were more like abstract interpretations; a sum of still frames of the sky, or

metica et chronologica, Latin. URL = https://digital.staatsbibliothek-berlin.de/werkansicht/?PPN=PPN83017379X), consulted on 2022.01.10. For more on the content of this manuscript, visit: https://ptolemaeus.badw.de/jordanus/ms/3150.

6 Trinity College, Cambridge, Ms. R.15.32, early 11th century. Winchester, UK. *Astronomical and Computistical miscellany*. Latin and Old English. URL = https://mss-cat.trin.cam.ac.uk/manuscripts/uv/view.php?n=R.15.32&n=R.15.32#?c=0&m=0&s=0&cv=0&xywh=-1095%2C268%2C2571%2C1448, consulted on 2022.01.12.

compressed wave lengths, in order to quickly show, in one lesson, something that takes a lot of time to observe, sometimes disregarding the fact that planets' orbital cycles are very different in length, in favour of "communicative aesthetics". A good example of this is manuscript Madrid 9605[7] (Figure 9), where accuracy of numerical values and associated information was replaced with pure symmetry (even with respect to the column for the names of the planets): the aesthetics of the geometrical pattern mirrors fundamental concepts, such as order and repetition, but says little about the individual behaviors of the planets.

By the twelfth century, the most visible influence for the design of latitudes diagrams was being spread through copies manuscripts from Fleury (such as MS17[8] – Figure 10), whose multiple manuscript productions circulated for the fantastic length of about four centuries, and that better transpire a desire to compress (by addition) as much information as possible into one diagram.

3. Conclusion

A growing interest in accurate calculations – inquires, observations and predictions – of time and location drove to progresses in astronomy, such as improved astronomical tables, instruments adapted to different terrestrial latitudes or the dissemination of translations and commentaries on previously unknown classical works from the twelfth century onwards, such as the *Almagest* of Claudius Ptolemaeus, or many of Aristotle and Plato's works; and some of these progresses came through the Islamic world, especially from *al Aldalus*. But that was not the case with these diagrams: created more as interpretations of original texts/ideas, and less as proper astronomical instruments, they did not evolve to become more accurate or truer to the information provided by authors, yet many people kept investing time and resources reimagining and redesigning them. Variations include three main versions of 12x30, 12x12 and 12x24 cells, the use of symmetry for artistic purposes only, and the choice between using free-hand or orthogonal lines. They also include peculiar numbers of cells (other than the mentioned above) and

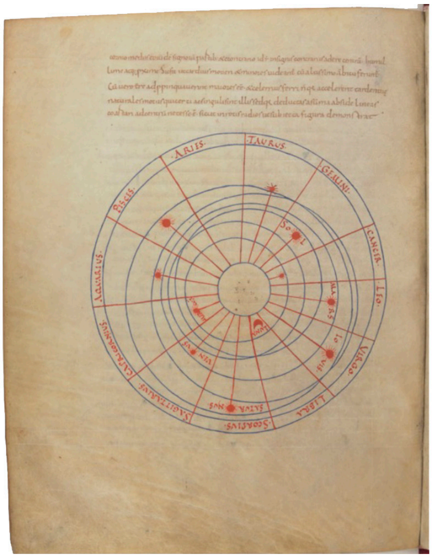
7 Biblioteca Nacional de Espana, Madrid, MSS/9605, 1026. France. *Tratados varios del cómputo eclesiástico.* Latin. URL = http://bdh.bne.es/bnesearch/detalle/bdh0000054177, consulted on 2022.04.29.

8 St John's College, Oxford, MS17, ca. 1110. Thorney Abbey, Cambridgeshire. Latin. URL = http://digital.library.mcgill.ca/ms-17, consulted on 2022.04.20.

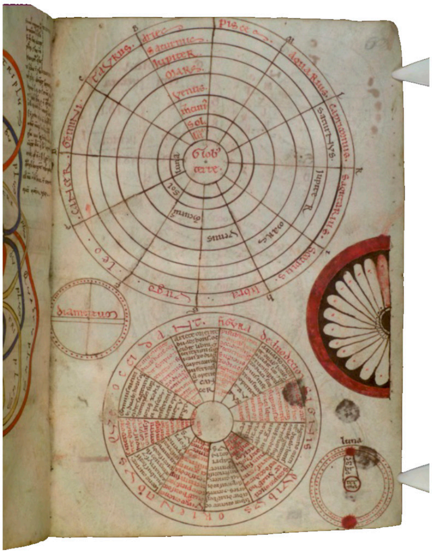
different planets' order, location in the manuscript and orientation on the page; variation even occurs in the number of planets and decoration.

I will conclude this article by proposing that both students, teachers, and copyists were aware and made use of the fact that (in the context of providing a general understanding of how the heavens work) one can still communicate complex knowledge without accurate data; some visual formulas can reveal the core idea well enough. In this case, the formula is a wavy line, used to represent the path drawn by the changing latitudes of each planet while going around in their orbits, in relation to the ecliptic. They were not, therefore, instruments to be used regularly, such as calendars, or for example the *horologium* diagrams – that contained fixed, go-to data for calculations; and eventually, they were used less and less. Despite this fact, line chart diagrams are still with us and are highly representative and the ecliptic is still represented as a wavy line against a sky of constellations in modern astronomy.

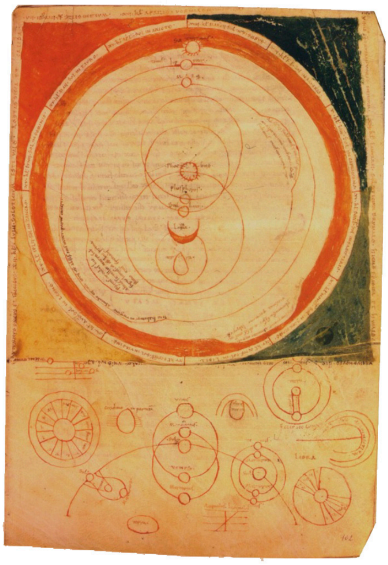
Figures:



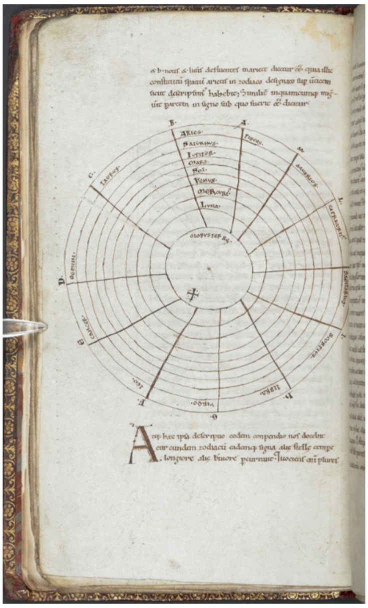
1. Bibliothèque Nationale de France, Latin 5239, f. 125. 10th century. *Naturalis Historia*. (Plinius) – Image in public domain.



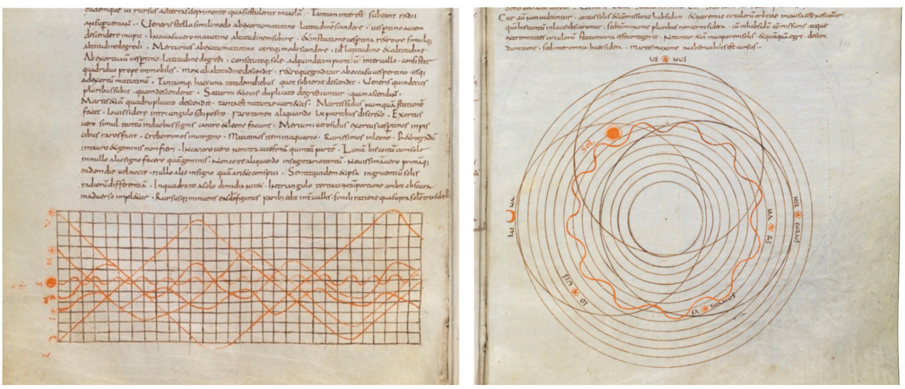
2. Bodleian Libraries, University of Oxford, Digby 23a, f. 52r. 12th century. *Timaeus*. (Calcidius) – Terms of use: CC-BY-NC 4.0



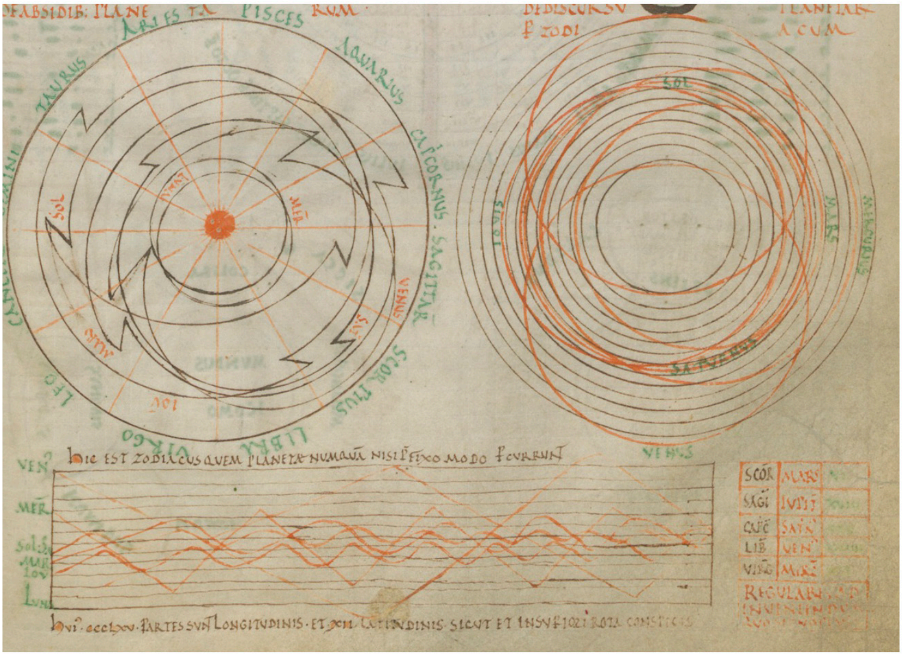
3. Biblioteca Medicea Laurenziana, San Marco 190, f. 102r. 11th/12th century. *De nuptiis Philologiae et Mercurii*. (Martianus Capella) – Image in public domain.



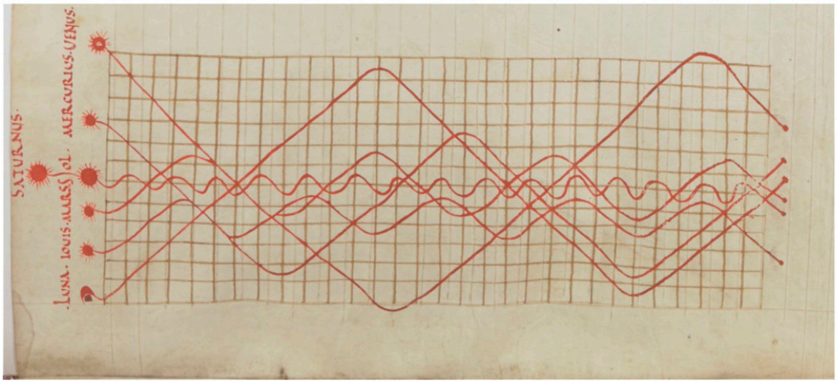
4. The British Library, Harley MS 2652, f. 31v. Late 11th century. *Somnium Scipionis.* (Macrobius) (Printed with pemission.)



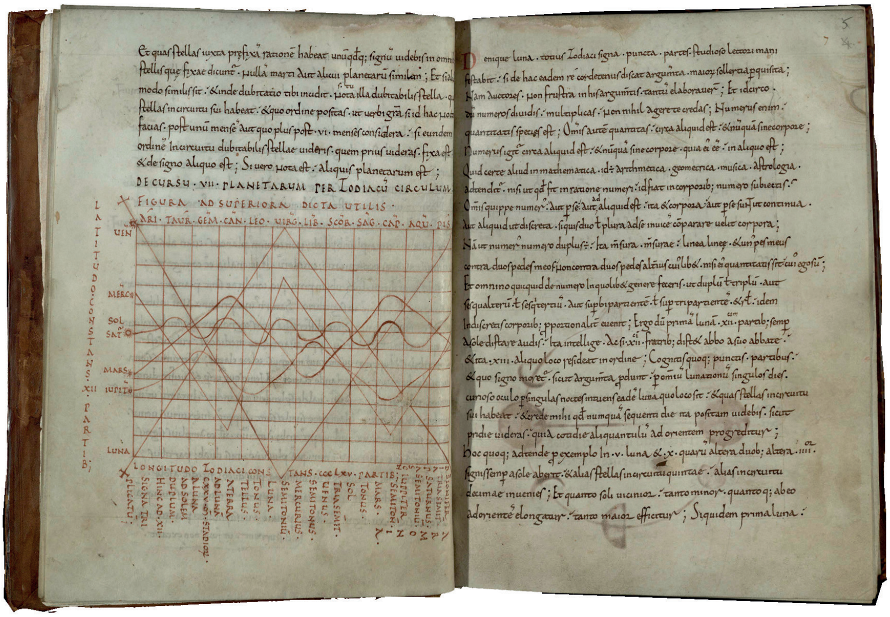
5. Bern, Burgerbibliothek, Cod. 347, f. 24v-25r. Second half 9th century. *Naturalis Historia.* (Plinius). France [Auxerre] – Terms of use: CC-BY-NC 4.0



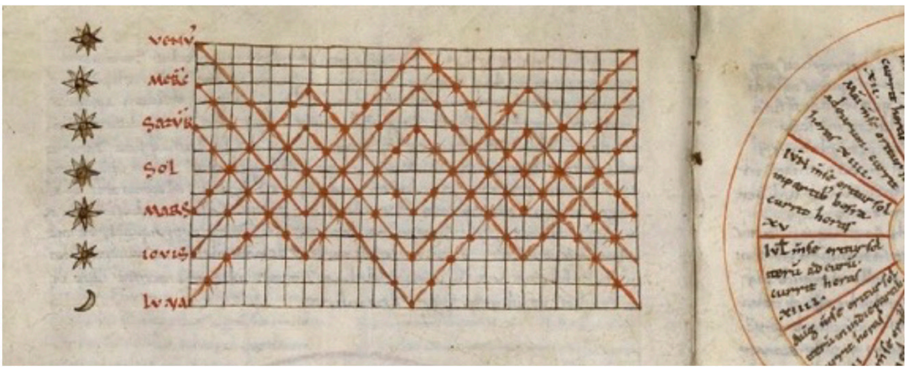
6. Staatsbibliothek zu Berlin, Ms. Phill. 1833, f. 38r – [Calcidius]. 10th century. *Varia scripta arithmetica et chronologica*. Fleury, France – Image in public domain.



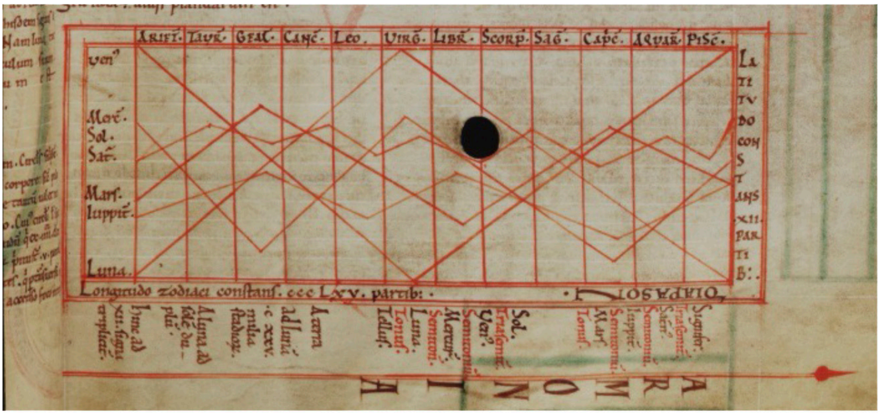
7. Bibliothèque Nationale de France, Latin 5239, f. 39r – [Plinius]. 10th century. *Varia de computo*. Limoges – Image in public domain.



8. Trinity College, Cambridge, Ms. R.15.32, p. 6. [Abbo Floriacensis]. Early 11th century. *Astronomical and Computistical miscellany*. Winchester – Terms of use: CC-BY-NC 4.0



9. Biblioteca Nacional de España, Madrid 9605, f.12v. 1026 AD. *Tratados varios del cómputo eclesiástico.* West of France (or Aviñon) – Image in public domain.



10. Oxford, St John's College, MS17, f. 38r. [Abbo Floriacensis]. 1102-1113. *Computus*. Thorney Abbey, England. (Printed with permission)