Dungal, *Epistola de duplici solis eclipsi*...An Analysis

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Keywords: *Dungal*; *Charlemagne*; *the year 810*; *eclipses of sun*; *superstition*

In chapter 25 of *Vita Karoli Magni*, Eginhard features Charles as an inquisitive spirit, concerned with more or less anything related to the broadening of his knowledge horizon. “He paid the greatest attention to the liberal arts”, the biographer says, by studying “rhetoric and dialectic, and especially astronomy” from Alcuin, who had written about both rhetoric and dialectic, and about an astronomy treatise titled *De cursu et saltu lunae ac bissexto*. “He learnt, too”, Eginhard continues, “the art of reckoning, and with close application scrutinised most carefully the course of the stars”. This natural curiosity of his would have been probably enough to justify the request addressed by the emperor to Dungal in 811, to be explained the reason why in the previous year (810) there had been two eclipses of sun. It was addressed “To Dungal”, given that Alcuin, his main interlocutor on this topic, had died a few years prior, in 804. I say “probably”, because the sovereign’s request could have also been related, at least to a certain extent, to superstition, considering that in chapter 32 of *Vita Karoli Magni*, Eginhard mentions the following: “There were many prodigies to show that his end drew near, and he as well as others understood the meaning of their warnings. During all the three last years of his life there were constant eclipses of sun and moon, and a black-coloured spot appeared in the sun for the space of seven days”.

Annales Regni Francorum (which, starting with the year 801, is not different from *Annales qui dicuntur Eginhardi*) – a fundamental source for the period studied here – also makes a short mention of the astronomic events. Upon analysing the pages related to the years 806–813, it is worth noting that the astronomic events condensed by the biographer in the three years that preceded the emperor’s death occurred – at least according to the author/authors of the *Annals* – in a time frame of almost a double length. And it may be assumed that Eginhard, upon following the model of Augustus’ biography, only dramatised by giving course to a highly resistant superstition, according to which the cosmic phenomena influence or at least predict people’s lives. They would also predict the comets, the eclipses or the emergence of meteorites, all of them signs foretelling important events, most of the times tragic.

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„Philologica Jassyensia”, an XV, nr. 2 (30), 2019, p. 203–222

With strict reference to the year 810, we deduce from the *Annals* that two eclipses of Moon[1] and two of Sun[2] had occurred. Not all of them were visible in the same region of the Earth, in Western Europe, but the mere fact that they occurred was very surprising for anyone who heard of them. More reason for Charlemagne to contact an expert and to ask for explanations through a letter that was not preserved. However, Dungal's reply was preserved, which – though based on fragments taken over from the famous *In Somnium Scipionis* by Macrobius –provide a good picture of what people thought about eclipses and about the universe in general during the Carolingian period. As suggested in the introductory part of the letter, the emperor wanted to know whether it was scientifically possible to have two eclipses of the sun in one year. Behind this interrogation, there is a superstitious and fearful attitude of Charles who – just like many contemporaries – must have seen a connection between the eclipse and the death of his children Rotrude and Pepin.

1. Sources

Through a letter sent to Abbot Waldo concerning this topic, Dungal was requested to provide an answer; this friar had chosen reclusion[3] as an expression of his consecrated life. Not highly trained in the matter, constantly advised by Waldo to give a reply, Dungal uses whatever source available – small, modest and succinct books. He warned that he would have had a more comprehensive and scholarly answer, had he been able to access more complex and more systematic books written by astronomers, especially those dealing with the study of eclipses. In the next paragraph, he mentions explicitly the work that he consulted in order to formulate his answer: Macrobius, *In Somnium Scipionis*. To be fair, this is not some "little book", but fragment I, 14, 21 – II, 9, where Macrobius deals with the description of the universe (*mundus*) and with the outline of astronomic phenomena, circulated in the Middle Ages as an autonomous text. Dungal may have very well referred to such an "edition", because he uses it massively. He only changes the order of the presentation made by Macrobius and he adapts it to the needs imposed by the very punctual topic of solar eclipse frequency and by the sequence of his own argumentation. The loans from *In Somnium Scipionis* include even what Macrobius had quoted from Virgil (*Georg.*, I, 217–218; II, 478; *Æn.*, III, 284), a book that he invokes as *auctoritas*.

Of course, given his religious background, it is no wonder that he used biblical references (Jac., 1, 17; Ephes., 6, 9; Rom., 2, 11, and a possible reference to Sap., 10, 17), invoked not so much as part of his scientific argumentation, but rather in connection with the difficulty of the topic and to his relationship – clearly defined by the self-ascribed adjective *famulus* – with the sovereign. Besides them, the plural

[1] The first on June 21, while the second on December 15.

[2] One on June 7 and another one on November 30 (*Eo anno sol et lunabisdefecerunt, sol VII. Idus Iun. et II. Kal. Decembr.*). The same year records the death of Rotrude, the daughter of Charlemagne, on June 6 (*Hruodtrud filia imperatoris, quae natu maior erat, VII. Idus Iun. diem obiit*) and the death of Pepin, the king of Italy, on July 8 (*...et Pippinum filiu meius, regem Italiae, VIII. Idus Iulii de corpora migrasse... narratur*).

[3] This type of consecrated life entailed total reclusion in a chamber, which could be situated on the premises of a monastery (most often in the suburban area), for a long period, for meditation and prayer exclusively. John Cassian (*Collationes*, XVIII, 8) or Isidore of Seville (*Regula Monachorum*, V) criticised this *modus vivendi* that was positively appraised by Gregory the Great (*Dialogi*, III, 16).

“little books” within the phrase “small, modest and succinct books” (*Secundum simplices tamen et leves compendiososque libellos, qui inter manus sunt...*) must be clarified somehow, because it appears that Dungal had the possibility of accessing more literary sources, not just the Macrobian text.

The argumentation comprises certain contexts featuring excerpts from Pliny the Elder, *Nat. hist.* (II, 56; II, 57; the reference to the division into twelve lines of the zodiac width, an idea present in II, 66–67) and that Macrobius fails to feature in the text. This would not be intriguing if Dungal did not assert at the end of the letter not having been able to access Pliny’s work (*Plinius enim Secundus et alii libri... non habentur*). Therefore, these excerpts could not have been reprised in any other way but indirectly, from one of the small, modest and succinct books that he mentioned at the beginning of the letter.

Alcuin’s letter, *De cursu et saltu lunae...*, did not treat the issue of eclipses and, on a general note, during the reign of Charlemagne, little had been written about astronomy. What had been written was based on the syntheses by various encyclopaedists, such as Pliny or Isidore. As a recluse, Dungal could only access the sources provided by Waldo, the abbot of Saint-Denis in 805, and the living conditions imposed the consultation of rather synthetic sources, easy to handle. It may be assumed that, as an Irishman, he was updated with and he had more confidence in the works of his “fellow nationals” and from among them, concerning astronomy, one may see as modest and succinct *De natura rerum* and *De ratione temporum* by Bede the Venerable. *De natura rerum* even has a special chapter (*XXII*) dedicated to eclipses and in many instances, he cites abundantly from Pliny. It is worth highlighting that, before discussing the eclipses, Bede studies the celestial circular reference points (the Milky Way included), the orbital movement and the order of mobile stars, the zodiac – namely, more or less the same topics to be approached by Dungal before discussing the solar eclipses per se. Upon analysing subsequently where Dungal places the Pliny citations, it becomes obvious that the manner is similar to the way Bede quotes from the renowned naturalist[4]. *De natura rerum* by Bede is a highly synthetic work, for teaching purposes, and in the preface for *De ratione temporum* (developed to the same end), Bede himself characterised both his works (*De ratione temporum* and *De natura rerum*) as “little books” that are more succinct and more synthetic than even his students would have wished (*dicebanteos [libellos] brevius multo digestos esse quam vellent*). Maybe this was Dungal’s inspiration when he called his biography “small, modest and succinct books”. Beyond any doubt, Waldo gave him these books, as he also must have provided an edition (integral or fragmentary) of *In Somnium Scipionis*. Why is there no explicit mention of Bede’s works? Because Dungal’s declared intent

[4] I will provide only one fragment in his respect, where the words in italics are identical with the text by Pliny: *lunae defectum aliquando quinto mense a priore fieri, solis vero septimo, eundem bis in XXX diebus super terras occultari, sed ab aliis hoc cerni [...] nam ut XV diebus utrumque sidus quaereretur* (Pliny the Elder, *Nat. hist.*, II, 57); et *lunae defectum aliquando quinto mense a priori*, *solis vero septimo* fieri. *Eumdem bis in triginta diebus super terras occultari*, *sed ab aliis hoc cerni*; quondam in *quindecim diebus utrumque sidus* defecisse (Bede the Venerable, *De rerum natura*, XXII); *Lunae* autem *defectum aliquando quinto mense a priori, solis vero septimo eundem bis in XXX diebus super terras occultari*, necnon *ab aliis* visum esse, quondam in XII *diebus utrumque sidus* deficere (Dungal, *...de solis defectione anno 810 bis facta*).

was to give the emperor a detailed and justified answer, almost a demonstration (*vobis plenius et eruditius de inquisitis respondere*) not so much founded on syntheses, but as the outcome of ample and thorough research (*libri compositiores et diligentiores*). Hence, among the titles available, he cites only the one that met his own demands to the highest extent.

2. Structure

Paolo Zanna (Zanna, Sigismondi 2004: 187–295) notices that the structure of the letter fully observes the one of a discourse: *exordium*, *narratio*, *argumentatio* and *perroratio* (or *epilogus*). Furthermore, P. Zanna mentions, there are intended correspondences between some elements in the beginning and at the end of the letter, such as the appeal to the sovereign's mercy (should the answer be less than satisfactory) or the symmetrical presentation of Waldo. This is a character who in the beginning of the letter is depicted as conveying to Dungal the emperor's request, and in the end as the one to hand over to Charlemagne his reply. Moreover, as a rule of the epistolary genre, the salutation (the first sentence of the letter) that has the role of *exordium* is symmetrical with the last sentence of the text, a vow and a salutation at the same time. Hence, *exordium* and *epilogus* (the latter structured on the topics: auctorial evasion, also featured in *narratio*; a *laus regia*; a new presentation of the characters: Charlemagne, Waldo, Dungal) is a framework delimiting the *narratio*, very brief (featuring the issue and the objective or subjective difficulties of providing not that much an answer, as a well-documented answer) and a rather long *argumentatio*. This argumentation often does not focus on the main topic – for instance, considerations regarding the cosmic year could have been avoided given that they are not related to the answer requested: can two solar eclipses occur in one year?

The most comprehensive part of the letter – the *argumentation* – includes the cosmology elements that Dungal deems necessary or can invoke (given that he did not have any other sources available but Macrobius) to prove that two solar eclipses in one year may be argued rationally and scientifically (by the standards of the time). Therefore, it would be ideal to study the *argumentation* from the perspective of the field, by pointing out the main elements of the Macrobian cosmological synthesis filtered by Dungal.

3. Argumentatio

3.1. The coordinates of the system

Like Macrobius or Bede, Dungal believes it is necessary to outline the geometrical pattern of the universe, based on which he may explain (and make clear) what happens when an eclipse occurs. The universe is not infinite: it has a spherical shape[5] and the outer limit thereof is the sphere of fixed stars crossed by the Milky Way (γαλαξίας – the only visible reference point among the afore mentioned curves) and the zodiac. The last is not a mere circle on the surface of the sphere, but a band

[5] In the preface to his work, Diogenes Laertius (*Vit. phil.*, I, 11) ascribed this belief to the Egyptians, which went on to be assimilated by most of the Greco-Roman world.

surrounding it, delimited mainly[6] by three curves: two outer curves comprise the constellations of the zodiac, and a median curve called *ecliptic* that only the Sun crosses constantly. The name ecliptic comes from the fact that, when the Moon (crossing the entire width of the zodiac) finishes its rotation at the level of this median, the crossing with the ecliptic and the celestial equator define the equinoctial and solstice points. The five parallel circles, the celestial Equator, the Tropics and the Polar Circles, are not necessary to explain the eclipses, but Dungal notes them thoroughly, like the astronomers or the encyclopaedists who had featured the spherical pattern of the universe in the centre of which the spherical Earth is situated. These curves – rather imagined than seen – are joined by the last reference points: the *meridian* and the *horizon*, variable circles by the position of the observation point.

These are the coordinates included by Dungal without further details. They define the spherical pattern of the universe, as the Greek thought had outlined it for centuries.

3.2. The theory of spheres

The school of Miletus and the Elatic school had focused on the idea of the constitutive elements of the universe: earth, water, air, fire, aether. Despite the observations, simply insufficient (Dreyer 1977: 31), on which they based their suppositions, these schools hold the merit of having imagined the universe as a sphere, which practically led to the idea of the geometric pattern described by the concentric spheres based on which one may describe and approximate the path of the divine bodies and may predict astronomic phenomena. Philolaus (and the school of Pythagoras in general) believed that in the centre of the universe there was the central fire (not the Sun) around which, on their own orbits, the planets gravitated (the Earth included) in a circular motion, opposite to the sphere of fixed stars. The central fire was not visible due to the interposition of the Anti-Earth[7] – a supposed planet that the Pythagoreans had introduced in the system because of the belief that 10 was the perfect number –, and to the fact that it was situated on the opposite side of the discovered world. According to Philolaus, the Earth did not revolve around its own axis.

Whereas Plato was not highly interested in physics in general and in cosmography in particular, the great philosopher did utter a well-articulated opinion in his work concerning the shape and composition of the universe. Spherical, "ensouled, rational living being" (*Tim.*, 30c), copy of a rational model, agent and patient of all its actions (*Tim.*, 28b; 33d), the universe is based on four constitutive elements – earth, water, air, fire (*Tim.*, 53b; aether was considered "the brightest part": *Tim.*, 58d) – and it divides into a Hyperuranion ("place beyond heaven") and Infrauranion (*Phaidr.*, 246d–248e). The divine bodies (that measure time: *Tim.*, 38d) have fraction-like patterns (in geometrical progression: 1, 2, 4, 8 and 1, 3, 9, 27 – the importance provided to the number has a Pythagorean origin), and among the movements, the rotation one being specific. It has different speeds according to the "spindle of Necessity" by eight distinct orbits "wheels": the sphere of fixed stars,

[6] Dungal warns in another instance that certain philosophers see the width of the zodiac as divided into twelve curves. They should not be mistaken for the twelve zodiacal signs, segmenting the length of the zodiac.

[7] The interposition of the Earth and the Anti-Earth also explained the higher frequency of Moon eclipses compared to Sun eclipses.

Saturn, Jupiter, Mars, Mercury, Venus, the Sun and the Moon. For Plato, *Aplanes* ("the identical" whose dominant motion is manifested at the level of all the divine bodies) –the sphere of fixed stars – revolves in a motion opposite to the one of the other divine bodies, and their revolution is accompanied by the song of the Sirens (another Pythagorean idea reprised by Plato) and continued by Moire (*Republica*, 614b–621c). The Earth is immobile, spherical and huge, situated in the centre of the universe (*Phaid.*, 109a–113d). The geometrical model, however – where the rotation of the divine bodies around the Earth seems to be the fundamental element of the universe described by Plato (Dreyer 1977: 63) – had to account not only for the apparent movements of the divine bodies as they may be seen from a certain point of our planet, but also they had to provide the framework for more pragmatic purposes. I refer here to an explanation for the irregularities of the paths based on which one may predict the astronomic events.

He was the first to propose the four-year solar cycle (three of 365 days, one of 366 – adopted by Julius Caesar in 46 BC), but Eudoxus of Cnidus still believed that the movement of the "wandering stars" may be explained through[8] concentric spheres (the Earth being situated in the centre). Namely, all divine bodies are located on the equator of a sphere that revolves evenly around its own axis. The poles of this sphere are on the internal surface of another sphere revolving reversely around its own axis, inclined in relation to the axis of the first sphere, etc, reason for which the movement of any body is the result of combining the three (or four) rotation movements. Eudoxus imagined 27 such spheres: three for the Moon and Sun, four for each planet (Mercury, Venus, Mars, Jupiter, Saturn) and one for the sphere of fixed stars. From among them, the outer one reproduced the movement of the sphere of fixed stars, from the East to the West (the diurnal movement of divine bodies). The second one had a 20° and 30' inclination (its equator being in the plane of the ecliptic) and it provided the "annual" movement of all the "planets" (respecting "the year" specific for each "planet", namely the period of its complete revolution around the Earth), from the West to the East, in opposition to the movement of the sphere of fixed stars. The others were meant to describe the particularities (accelerations, decelerations, precession, retrocession) of the motion specific to each "planet". Thus, all the divine bodies revolve around the Earth, situated in the centre of the universe, independently from one another and from the sphere of fixed stars.

Callippus of Cyzicus – a student of Eudoxus – attempted to eliminate the inaccuracies related to the longitudinal and latitudinal movements inherent to the system, thus imagining a larger number of concentric spheres, with the help of which he managed, for the movement of the Sun, to determine the duration of seasons, with an approximation of less than a day[9].

Whereas the universe according to Callippus had 33 spheres (among which, for instance, five for the Sun and five for the Moon), the one imagined by Aristotle comprised 55 (for instance, nine for the Sun, five for the Moon) by adding 22 additional spheres that revolve in a motion contrary to the spheres of Eudoxus and

[8] *Plac. phil.*, II, 16, attributes to Anaximander the idea that stars move along with the spheres or circles where they are situated. Given that the uniform circular motion failed to depict the real motion of the mobile stars, Eudoxus proposed to combine several rotations as a solution.

[9] In *Metaphysics*, XII, 8, Aristotle provides a description of the system imagined by Eudoxus and Callipus.

Callipus (*Metaphysics*, XII, 8). Eternal and divine, spherical (specific configuration because "clearly they have no movement of their own […] nature has bestowed upon them no organ appropriate to such movement" – *De caelo*, II, 11), the stars comprise a matter (for which the movement of rotation is natural) that is not earth, nor water, nor air, nor fire. Moreover, warmth and light that proceed from them are caused by the friction set up in the air by their motion (*De caelo*, II, 7). According to Aristotle, the most ample and rapid sphere – the sphere of fixed stars – is directly influenced by the higher divine cause and it has a circular and uniform motion; the other divine bodies have a reverse rotation, and their compound motion becomes simpler ("have fewer movements" – *De caelo*, II, 12) as it gets closer to the centre. In fact, not of the divine bodies, but of their own spheres on which they are at rest (*De caelo*, II, 8), as the Earth is at rest (*De caelo*, II, 3) situated in the centre of the universe (*De caelo*, II, 14). Thus, the concentric spheres of Eudoxus and Callippus are no longer a mathematical model, but a physical representation of the cosmos (Dreyer 1977: 110), material and finite (for "outside the farthest circumference there is neither void nor place": *De caelo*, II, 4), for it could not make a full rotation in a finite period otherwise. As for the shape of the Earth, the depiction of the eclipse in *De caelo*, II, 14 suggests that, because the shadow of the Earth described an arc on the Moon disc, its shape is necessarily spherical.

This model, which made the sphere (the assertion "The shape of the heaven is of necessity spherical; for that is the shape most appropriate to its substance and also by nature primary" in *De caelo*, II, 4, is followed by four arguments) the fundamental element of the cosmic structure, of its elements and of the description of their motions – though it had become ever more complicated – managed to remain rather easy to use. It also managed to approximate in a satisfactory manner the observable phenomena. However, as long as it was based on the uniform rotation of concentric spheres, it failed to account for the luminosity variations of the "planets" (Dreyer 1977: 129; Kuhn 2000: 76) – as they were closer or farther away from the Earth. It also failed to account for their movement (orbital or "annual") seemingly retrograde in certain instances, or for the uneven character of the angular motion speeds. These shortcomings were partially solved by Apollonius of Perga and by Hipparchus, who replaced the spheres associated to each "planet" with epicycles, deferents (for Venus and Mercury) and mobile eccentric circles (for Mars, Jupiter and Saturn)[10], solutions subsequently adopted by Ptolemy, who added the "equants" (< lat. *aequans*).

When Macrobius wrote his work, the view and theories uttered by Ptolemy were already classic, but it must not be forgotten that Macrobius comments on a Cicero's text and, as such, he focused on interpreting *Scipio's Dream* according, probably, to the most authoritarian and reliable view of the cosmos in Arpinate. Thus, of course that the theory of concentric spheres – which had become outdated –was

[10] The epicycles and mobile eccentric circles were the expression of another level of abstraction: their centres no longer coincided with the position of divine bodies, as with the model of concentric spheres. Schiaparelli (1926, vol. II: 132–133) demonstrates that both the epicycles and the mobile eccentric circles were "diverse forms of the same construction, and the calculation of the planet's position remains essentially the same". However, the epicycles had the advantage "of being applied to inferior planets, too" (Venus and Mars), reason for which the Greek geometry experts preferred them to mobile eccentric circles.

invoked in early 9th century, reprised from a written text of the 5th century. Naturally, in this theory, the term *sphaera* is used generically (in some contexts synonymous with *orbis*, "orbit, trajectory, revolution" or *circulus*), not concerning the particular structures imagined by Eudoxus, Callipus or Aristotle.

3.3. Ordo Chaldeorum – Ordo Ægyptiorum

Within the universe whose outer limit was the sphere of fixed stars, the order of the mobile divine bodies was also a controversial topic. Macrobius (that Dungal cites selectively this time) talks about a *Chaldean order* and an *Egyptian order* of "planets", the difference between them being related, among others, to the position of the Sun in the system. These two orders accounted for the empirical observations made over time and they tried to provide an answer for the reciprocal positions of the planets Venus and Mercury in relation to the Sun. There was also the issue of the luminosity of the planets, especially those situated beyond the Sun (if they received their light from the Sun or not), an issue for which Antiquity also provided several answers.

In the myth of Er within the *Republic*, Plato – of whom Macrobius (*In Somn. Scip.*, I, 19, 5) says that he follows the *ordo Ægiptiorum* – proposes the following structure: the sphere of fixed stars, Saturn, Jupiter, Mars, Mercury, Venus, the Sun, the Moon. *Ordo Chaldeorum*, on the other hand, as Macrobius calls it, adopted by Archimedes and Cicero and accepted by several others, was the following: Saturn, Jupiter, Mars, Sun, Mercury, Venus, the Moon, with the Sun in median position. Hence, the difference would consist only in the position of the Sun, Venus and Mercury, of which Plato said, "overtake and are overtaken by one another" (*Tim.*, 38d). Through this statement, he tried to explain the very close trajectories (the duration of their own "years", implicitly) and the irregularities noticeable in the movement of the three bodies, and not so much the fact that sometimes Venus and Mercury seemed to be visible on one side or the other of the Sun. This idea led Heraclides Ponticus to the ingenious solution of the semi-heliocentric system: the Sun, just as the other divine bodies revolve around the Earth situated in the centre of the universe, but around the Sun, as its satellites, revolve Venus and Mercury. Practically, for Heraclides, both the Chaldean order (the Earth, the Moon, Venus, Mercury, the Sun...) and the Platonic order (the Earth, Moon, the Sun, Venus, Mercury...) were correct, but alternatively – according to the position, as seen from the Earth, of Mercury and Venus on their orbital path on one side or the other of the Sun. Aristotle may not have known of this solution, given that he fails to mention it in *De caelo*. There (II, 10), he states that – while the mobile stars move contrary to the sphere of fixed stars – the latter makes the movement of the first slow down as they are closer to the Earth. Therefore, the calculation "of the years" for each "planet" also determines their order: Moon, Mercury, Venus, Sun, Mars, Jupiter, Saturn, the sphere of fixed stars[11] – practically, a version of *ordo Chaldeorum*, found in Hipparchus,

[11] Cf. Aristotle, *De caelo*, II, 10 (See also the Romanian translation cited: 388, nn. 3–4). The same was the order noted by Pliny in *Nat. hist.*, II, 6, where the naturalist listed the durations of their own "years": the Moon, 27 days and a third; Mercury, 340 days; Venus, 348 days; the Sun, 365 days and a fourth; Mars, "around two years"; Jupiter, 12 years; Saturn, 30 years.

Ptolemy or in the Latin authors Pliny, *Nat. hist.*, II, 6, 32–36, or Bed the Venerable, *De rer. nat.*, XIII (cf. Macrobius 2007: 630, n. 350).

However, Macrobius innovates: what he calls *ordo Ægiptiorum* is actually the order featured by Plato united (*In Somn. Scip*, I, 19, 6–7) with the semi-heliocentric theory of Heraclides Ponticus[12]. Dungal, on the other hand, carefully avoids the paragraphs where Macrobius exposes the idea of Heraclides. For him, *ordo Ægiptiorum*, which he prefers (invoking, like Macrobius, that only the divine bodies on the other side of the Sun may receive sunlight), is none other than *ordo Platonis*, as it had been exposed by the *Republic* and *Timaeus*: the Earth, Moon, Sun, Venus, Mercury, Mars, Jupiter, Saturn, the sphere of fixed stars. On the other hand, in this case, it is worth asking what made Dungal dissociate from the option uttered by Macrobius[13] and what explanation will be provided to the transit of the planet Mercury in front of the Sun in the spring of 807, an event noted in the *Annales Regni Francorum* and that was visible for seven days. Perhaps, considering that the solar eclipses and the Moon eclipses involve only the relation between them and the Earth, he opted for that order exempting him from additional explanations regarding the interpositions of Venus and Mercury. Thus, a "didactic" option to make himself understood better? Or an error of compilation, given that, below, Dungal reprises without any criticism the fragment *In Somn. Scip.*, I, 19, 14–17, where Macrobius had featured Cicero's opinion, as he was an adept of *ordo Chaldeorum*[14]?

3.4. The centrality and immobility of the Earth

The semi-heliocentric model of Heraclides Ponticus was not a denial of centrality of the Earth in the system. Nonetheless, there was only a step to the heliocentric theory by Aristarchus of Samos[15]. Before him, the Pythagorean School had proposed a model where the divine bodies, the Earth included (and the Anti-Earth), rotated around the central fire that – like the Anti-Earth – could only be seen from the inhabited side of the world. This model contrasted with some previous opinions (of the Miletus or Eleatic school) that saw the centrality of the Earth not only in terms of Spatiality but also – down to its last consequences – placed it at the origin of certain cosmic phenomena. For Heraclitus of Ephesus, the Sun and the Moon were like two bowls that, the concave side facing our direction, captured the moist exhalations of the Earth, and this "fuel" lit up at sunrise and set down at sunset (Aristotle, *Meteor.*, II, 2, 355a; *Plac. phil.*, II, 28); for Anaxagoras of Clazomenae, the

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[12] An analysis of this aspect is available in Dreyer 1977: 117–118.

[13] Though Macrobius is in favour of the order of mobile stars (*In Somn. Scip*., I, 19, 8: *Perspicacior tamen observatio veriorem ordinem deprehendit*... – an observation also reprised by Dungalus) and he even invokes in this respect the planets that receive or not sunlight, it must be stated that in the presentation made *In Somn. Scip.*, I, 12, 13–14, he follows constantly *ordo Chaldeorum*.

[14] An attempt to explain this inconsistency, in Eastwood 1994: 129–130. According to Eastwood, Dungal would have followed *the Chaldean order*, accepted by most.

[15] Schiaparelli, upon analysing a fragment of Simplicius (Διὸ καὶ παρελθώντιςφησὶνἩρακλείδης ὁ Ποντικὸςὅτι καὶ κινουμένης πωςτῆςγῆς, τοῦ δ΄ ἡλίουμένοντός πως, δύναται ἡ περὶτὸνἥλιον φαινομένηἀνωμαλία σώζεσθαι – Simplicius 1882: 292) who in his turn reprises a fragment from Geminus of Rhodes, *Meteorologica*, deduces that Heraclides Ponticus had launched (or at least he could have) even the idea of the Earth revolving around the Sun. See Schiaparelli 1926, vol. II, chap. VI, "Il sistema planetario eliocentrico considerato come ipotesi geometrica possibile", especially p. 159–164; See also Schiaparelli 1873: 31, 55.

stars were fragments set off the Earth that remained in space only due to the rotation of aether (*Plac. phil.*, II, 13).

For Aristarchus however, in the centre of the universe there was the Sun, a visible point of reference and a subject of the most common astronomic events, the eclipses. Consequently, compared to the theory of the central fire specific to the Pythagorean School, the one uttered by Aristarchus – no matter how puzzling for his time – could be confronted with the direct observation of the phenomena. Unfortunately, no accurate presentation of Aristarchus' theory was preserved, which may have allowed us to understand his cosmological ideas correctly. The very brief presentation made by Archimedes in *Arenarius* (I, 4–5) shows that the Earth makes an orbital movement around the Sun, immobile in the centre of the universe, around which revolves the sphere of fixed stars. We find out nothing about the movements of the other bodies. However, whereas the Moon was considered throughout Antiquity and the Middle Ages not a satellite of the Earth, but a "planet", like the others, than by seeing the Sun as the centre of the universe, it should have moved in an orbit around the centre, just like the other planets. Or, in this case, the new model would have been in obvious contradiction with the direct observations related to the most studied celestial body. However, given that the Moon rotated, as per Aristarchus, too, around the Earth, this would have generated similar difficulties with the ones of the semi-heliocentric theory by Heraclides – two divine bodies (the Sun and the Earth) around which revolve other divine bodies –, but at least it could have allowed the correct explanation of the eclipses. Or, for Aristarchus, the solar eclipse was due to the inclination of the Earth – at least this may be deduced from the brief enumeration of opinions concerning the solar eclipse, in *Plac. phil.*, II, 24. However, if – as stated by Schiaparelli – with the system of Tycho Brahe (the Earth revolves around its own axis; the Moon is a satellite of the Earth; the other planets – Venus, Mercury, Mars, Jupiter, Saturn – have as centre of their orbits the Sun, along with which they revolve around the Earth) they agreed even during the times of Heraclides Ponticus[16] and if Aristarchus only assumed that the Earth revolves around the Sun just like the other planets, then the statement (rather late, of the 1st–2nd century AD) made in *Plac. phil.*, II, 24 is at least bizarre.

Diogenes Laertius (*Vit. phil.*, IX, 21) ascribed to Parmenides the idea of the centrality of the Earth, which may have also been based on the Earth as being the only observation point for the sky. Except for the Pythagorean School, the assertion of the spherical model of the universe also imposed the thesis that the Earth is immobile, because in a sphere that revolves only the centre stays still and because if something moves permanently, something else must always stay still (Aristotle, *De caelo*, II, 3).

The idea of the centrality and immobility of the Earth survived the theses by Aristarchus[17] and he symbolical thought of the first Christian centuries, thus crossing the entire Middle Ages. Thus, it may be found in Cassiodorus, Isidore of Seville, Bede (reprised through Pliny the Elder) or Dungal (reprised from Macrobius). Th. Kuhn – based on an ample passage (which he cites) from Aristotle, De caelo (II, 14) –

[16] The author may have been even Heraclides Ponticus or a contemporary: See Schiaparelli 1926, vol. II: 126.

[17] Or, as Pliny synthesised in *Nat. hist.*, II, 4, 11: "thus <the Earth> being alone motionless with the universe revolving round".

considers that such opinions as those uttered by the Pythagoreans or by Heraclides or by Aristarchus, though astronomically persuasive, could not be accepted and he provides an explanation. The reason is that they were in opposition with the beliefs pertaining to an explanation for the movement of the bodies and for the order of the elements, with astronomy and with the knowledge subjected to physics, as they were not distinct fields[18].

3.5. The movement of the sphere of fixed stars and of the divine bodies

In *Timaeus* (34a–40b), Plato describes the relative movements of the divine bodies: besides the movements around their own axes[19], the sphere of fixed stars (the movement of the identical) revolves from the left to the right, namely from the West to the East (a diurnal motion; cf. *Plac. phil.*, II, 10). He also describes the planets (the movement of the different) from the right to the left, namely from the East to the West (orbital or annual movement, according to an inclined plane compared to the rotation plane of the identical), the Earth only participating in the movement of the identical. The difference between the movements "of the planets" is that – being situated at various distances from the Earth around which they revolved – they fulfilled their revolutions in various periods: Saturn, in 30 "solar years", the Sun, in one year, the Moon, in almost 30 days, etc.

According to Aristotle, the sky is moved evenly (*De caelo*, II, 6.), in a circular pattern (a noble movement, without contrary, specific to the aether – *De caelo*, II, 4–5) from the right (local determination more noble than the left) to the left (noble direction – *De caelo*, II, 5). Hence, the visible pole is actually "the lower side" of the sky, and the visible pole is the "upper side" of it (*De caelo*, II, 2). "The planets", on the other hand, fixed on their own spheres, also have a circular motion, but contrary to the rotation direction of the sphere of fixed stars. In case of these trajectories, it is necessary to reverse the poles to the "upper side" and "the lower side" of the sphere of fixed stars (*De caelo*, II, 2). This is how the Stagirite features the diurnal movement (dominant, like according to Plato) of the sphere of fixed stars and the orbital movement of the planets. Martianus Capella (*De nuptiis Philologiae et Mercurii*, VIII, 853) also notes another thesis of the Peripatetic School, according to which "the planets" have an orbital motion not contrary to the sphere of fixed stars, but in the same sense, only slower. Macrobius, closely followed by Dungal, reacts to this thesis by presenting the relative movement of the planets to the zodiacal constellations.

Anaxagoras, Democritus or Cleanthes, according to whom the stars move from the East to the West (Plac. phil., II, 16), also feature versions of the same idea according to which they would all revolve around the Earth. The same may be found

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[18] Cf. Kuhn 2000: 108–111. Th. Kuhn also cites the answer (*ibidem*: 111), equally relevant for this statement, by Ptolemy of *Almagesta* to the theory uttered by Heraclides, according to which the sphere of fixed stars is immobile, and the Earth would revolve around its own axis from the West to the East. Earlier in the book, in the conclusions to the volume *Scritti sulla storia della astronomia antica* (1926, vol. II: 173), Schiaparelli believed that rejecting the hypotheses of Heraclides and Aristarchus also came after the success of "mathematical astrology", arrived to Greece from Asia Minor through Berosus the Chaldean. To support Schiaparelli's statement, Ptolemy himself was known for both *Almagesta* (an astronomy treatise) and *Tetrabiblos* (an astrology treatise).

[19] See also *Timaios*, Romanian translation cited: 244–245, n. 87.

in “Alcmaeon and mathematicians”, who pinpointed that they moved from the west to the East in relation to the sphere of fixed stars (*Plac. phil.*, II, 16).

They were the only possible explanations for the relative movements “of the planets” compared to the stars considered fixed, starting from the same belief that the Earth was also motionless, namely not moving around its own axis, and not describing an orbital motion.

The hypothesis that the Earth, though in the centre of the universe, would revolve around its own axis from the West to the East (as an explanation for the diurnal movement of the sphere of fixed stars), does not have – according to the sources – a definite author and is not given much credit, being rejected by Ptolemy. Diogenes Laertius (*Vit. phil.*, VIII, 85) ascribes to Philolaus the opinion that the Earth revolves in a circle (κατάκύκλον), a vague expression, but which – corroborated with the idea of the central fire being invisible and with the mention that it revolves in a circle (κύκλῳ περιφέρεσθαι) around the fire, as per an oblique orbit (κατάκύκλονλοξὸν), the same as the Sun and the Moon, stated in *Plac. phil.*, III, 13 – only allows one interpretation. Namely, the solely orbital movement (around its own axis) of the Earth made the central fire remain invisible (and the Anti-Earth of the Pythagoreans). Diogenes Laertius (*Vit. phil.*, IX, 30) ascribes to Leucippus the idea that the Earth, shaped like a tambour, revolves around the centre, but it is unclear whether he refers to the orbital movement or to the one around its own axis. Concerning the latter, Cicero (*Acad. Priora*, II, 39, 123) is far more explicit: supporting Theophrastus, he believed that Icetus of Syracuse would have launched the opinion that the diurnal movement of the sphere of fixed stars is only apparent, as a consequence of the rotation of the Earth around its own axis[20]. On the other hand, *Plac. phil.* (III, 13) credits Heraclides Ponticus and Ecphantus with this belief. Naturally, the rotation direction of the Earth was from the West to the East, if the constellations were considered motionless. Upon invoking the scarcity of sources, but also the deductions made by H. Martin (Martin 1881), Schiaparelli believes that Heraclides Ponticus had in common with the Pythagorean School the idea of the movement of the observation point around the centre of the universe. Along with Icetus and Ecphantus, he agreed with the thesis according to which the sky would not revolve around the Earth, but the Earth around its own axis, the only original hypothesis being the one of the orbital movements of Venus and Mercury around the Sun (Schiaparelli 1926, vol. II: 121–122). It is unclear what Heraclides thought about the orbital movement of the Moon and of the planets situated on the other side of the Sun; they probably revolved around the Earth with an orbital motion from the West to the East. The great novelty was that the Earth alone was not the centre of the orbits of the divine bodies.

The orbital movement of the Earth around the Sun, as a solution for the apparent annual motion “of the planets”, is attributed to Aristarchus, an opinion featured regrettably briefly (and not supported) by Archimedes. The vague formulation by Archimedes in *Arenarius* led to the idea that Aristarchus could have presented mathematically (and graphically: τινῶν ὑποθέσεων ἐξέδοκεν γραφάς) a thesis already in circulation (Schiaparelli 1926, vol. II: 168). In any case, according to the model

[20] This makes Dreyer (1977: 46) assume that Icetus, a Pythagorean, did not share the idea of the central fire, which – in case of the Earth’s rotation around its own axis – would be visible. Cf. also Diogenes Laertius, *Vit. phil.*, VIII, 85.

attributed to him, the orbital movement of the planets around the Earth may be explained and described mathematically through the orbital movement of the Earth and of all the other planets around the Sun. To this view, we should probably add the rotation of the Earth around its own axis. The model proposed by Aristarchus was very soon abandoned and mathematical solutions were advanced to explain the movements, and these solutions were based on the centrality[21] and immobility of the Earth: the epicycles and the deferents modelled the orbits of Venus and Mercury, while the eccentrics[22] featured the movement of the planets situated on the other side of the Sun.

Macrobius adopts the system of Heraclides, from which he excludes the rotation of the Earth around its own axis. The Earth is fixed and it is the centre of the universe; around it revolve the sphere of fixed stars (from the East to the West) and the Moon, the Sun and the planets situated on the other side of it (with an orbital motion from the West to the East), while around the Sun revolve Venus and Mercury. The orbital motion velocities are equal, the year of each divine body depending only on the size of the trajectory for each of them. From this model, Dungal only denounces the satellites of the Sun, while his insistence on the movements of the divine bodies and on the way they are depicted has a very simple explanation: it is the cause of the phenomenon to describe, namely of the solar eclipse. To make himself understood easier, Dungal prefers to detail some aspects related to the orbital movement, thus adhering, like Macrobius, to the most reliable thesis that had earned the highest number of adepts.

3.6. The Sun and Moon eclipses

The explanation for Sun and Moon eclipses was not always based on the orbital movement of the divine bodies, but a reasonable description of this phenomenon emerged when hypothetically the certain one was the orbital movement "of the planets". The invocation of the shadow cone of the Earth and the interposition of the Moon were the correct explanations, within the limits of the geocentric system. They are found in Pliny, Martianus Capella or Isidore, and later in Bede or Dungal reprised not from Ptolemy, according to Cassiodorus, but from encyclopaedists.

For Macrobius, in other words from Dungal, the Moon eclipse is explained by its position in the shadow cone of the Earth. Geometrically, the total moon eclipse occurs when it is full, enlightened by the Sun situated at the other end of the line connecting the Moon, the Earth and the Sun. However, the entrance in the shadow cone is not due to the rotation of the Earth around the Sun, like in the Copernican system, but to the rotation of the Sun and Moon around the fixed centre – the Earth – of the universe.

The Sun, with little variations, executes the orbital movement along the ecliptic that is the median of the Zodiac, which the ancients imagined as a band, because it had to comprise the zodiacal constellations. The orbital movement of the Moon deviated from this course (because in its path, it crosses "from top to bottom" the

[21] Schiaparelli believes that precisely this process of mathematical modelling that tried to save at all cost the centrality of the Earth actually slowed down the evolution of astronomy.

[22] The use of eccentrics introduced a new principle: the centre of the eccentric no longer had physical materiality, becoming only an ideal point, an exclusively mathematical reality.

entire width of the Zodiac), and when it was at the level of the ecliptic, it interposed between the Earth and the Sun, leading to the solar eclipses. And whereas the revolution period of the Moon is approximately 30 days, then once every 15 days there is an eclipse, of the Moon or of the Sun, though not always visible due to the spherical shape of the Earth and to the inclination of the zodiacal circle. Furthermore, the geometrical calculation of the trajectories shows that a Moon eclipse can be visible from the same side of the Earth every five months, while a solar eclipse, every seven months: the first during the Full Moon, the other during the New Moon.

3.7. Annus magnus

Up to this point, Dungal had already explained both what happens when an eclipse is verified and the fact that eclipses occur rather regularly, that they are not always visible; when they are, they cannot be seen by everybody in the same place or at the same time. Thus, Dungal seems to suggest, the issue is not whether two solar eclipses may occur in one year, but whether from the same point of the Earth one may observe, in one year, two solar eclipses.

Ismaël Boulliau (Bullialdus) justly believes that Dungal was not an expert in astronomy, but he is wrong to state that his letter does not clarify what it should have clarified[23]. Dungal not only answers the question punctually, but he insists on proving to Charlemagne that the regularity of the astral movements makes the astronomic events able to be calculated and predicted long before. Hence, his ideas concerning *annus magnus* were a concept easy to understand but hard to calculate. In the geocentric system, the year of each divine body is defined as the time when the "planet" revolves completely following its own orbit around the Earth. Thus, the year of the Sun comprises 365 days and 8 hours – an important reference point for defining the duration of the years in case of the other planets. Compared to these years, *annus magnus/annus mundanus* is defined as the duration necessary for all the divine bodies to realign in the same configuration that they had at a certain moment that may be determined arbitrarily (and Cicero, cited by Macrobius and Dungal, chooses as reference point the moment of Romulus's apotheosis). Even the divine bodies in the sphere of fixed stars, whose orbital movements, because of the distances, are seen as so slow that no man can live that long as to notice their movement through an uninterrupted observation. This shows how difficult it is to calculate it. *Plac. phil.* (II, 32) provides several "approximations" for *annus mundanus*: 8, 19 or 59 "solar" years are the lowest and the most surprising values; then 18,000 "solar" years" (Heraclides); 18,000 X 365 "solar" years (Diogenes) and finally 7,777 "solar" years which should probably be interpreted from the perspective of symbolical values.

Macrobius (*In Somn. Scip.*, II, 11) believes that the value of this duration is 15,000 years; not the very different value is surprising, but the fact that, from the perspective of eclipse depiction, he fails to mention the *saros*, a concept reprised from the Greek thought from the Chaldeans. Pliny, in *Nat. hist.*, II, 56[24], defines it as an interval of 223 months, according to which the Earth, the Sun and the Moon come

[23]His opinion is included in the notes for *Epistola de duplici solis eclipsi anno 810*, ed. L. Dacherius, PL 105, coll. 447–488. The same opinion is featured in Eastwood 1994: 122.

[24] To be exact, the duration of a *saros* is 18 years, 11 days and 8 hours, namely 223 synodic months (a synodic month counting 29.530 days).

back to the same relative positions, reason for which eclipses are verified under around the same circumstances. I remind Pliny here because it has already been noted that Dungal reprised two passages from the work of the great encyclopaedist, passages that are not found in Macrobius. We have assumed that they could be borrowed from Bede the Venerable whose work *De natura rerum* is abundantly inspired by Pliny. From such perspective, it is no surprise that neither Bede nor Dungal referred to *saros*. However, it is obvious that, besides the small excerpts from Pliny, Dungal explains the cosmic year using chapter 11 of the second book by Macrobius in order to highlight that the cosmic events are not fortuitous, but repetitive, subordinated to laws that one may discover using reason[25], that they may be predicted long before the actual event.

4. The Christian perspective on astronomy

Isidore of Seville (*Etymologiarum libri*, II, 24, 8) states that, from a certain point of view, just like the doctrines taught in philosophical schools, Christian teachings also involve ethics and logic. As the basic books of the Christians were the Old and the New Testament, for physics Isidore referenced the Genesis and the Ecclesiastes. Especially the Genesis was highly problematic for the first Christian thinkers who tried to reach an agreement between the text of the scripture, more precisely the literal side thereof, and what people thought back then about the Earth, the cosmos, the movements of the divine bodies, etc. When Isidore wrote his *Etymologies*, the interpretation tradition (highly influenced probably by Philo the Alexandrine who, by using allegorical interpretations of the sacred text, had begun to find a consensus between Judaism and diverse Hellenistic schools of thought: Pythagoreans, Platonists, Stoics) for the book of Genesis from an astronomic perspective had already reached its limit through the theory advanced by Cosmas Indicopleustes. The last was contemporary (or lived a little earlier) with the Hispanic bishop. Within this series of interpreters of the Old and the New Testament, Clement of Alexandria (*Stromata*, V, 6; cf. Clement of Alexandria 1982: 329–324) is the first to see the tent of alliance (Ex., 26) as an allegorical image of the universe (interpreting in this respect the verse Isaiah, 40, 22). He also sees the precious stones on the attire of the chief priest as symbols of the planets, the cherubim on the lid of the ark (Ex., 25) as a representation of the two terrestrial hemispheres or, through the twelve wings (six for each) symbolising the zodiac, as an image of the material world, and the menorah as a depiction of the planetary system. The Sun in the middle, "the planets" (including the Moon and excluding the Earth, considered fixed), three on each side[26]. Largely, in the beginnings of the Bible hermeneutics (especially the Genesis), for the issue in question here, two are the topics that were discussed the most: the shape of the Earth and the two water bodies (Dreyer 1977: 195–200) mentioned by the author of the Genesis (I, 6). From Lactantius who in *Divinae institutiones* (III, 24) rejects the idea of the spherical Earth because he could not imagine a sky lower than the Earth[27], to Basil the Great who had no opinion concerning the shape of the Earth, given that Moses failed to mention this aspect and others (eclipses included) that we should not

[25] In the text, Dungal discusses the *sensus internus*.

[26] As it may be seen, this allegory is based on the *ordo Chaldeorum* of the "mobile stars".

[27] The statement made by Lactantius probably also has an axiological connotation.

necessarily learn (*Homiliae in Hexaemeron*, IX, 1; I, 9–10). As for the waters above the firmament, he considered them necessary for extinguishing the celestial fire sent to burn the universe that is not necessarily spherical, though from the Earth it may be seen as concave (*Homiliae in Hexaemeron*, III, 5). Ambrosius of Milan likewise believed it was not useful to find out details concerning the nature and the position of the Earth, the elements comprised in the celestial sphere (in fact, the heavens: *quia plurimos caelos scriptura testificatur – Hexaemeron*, II, 3 –, according to Basil the Great[28]), whose upper regions are protected from the ethereal fire by the waters above, supported by the firmament. Jerome considered the two cherubim (*Commentaria in Ezechielem*, I; V) on the lid of the ark the two hemispheres of our planet, in the centre of which there was Jerusalem. Augustine, on the other hand, in *De Genesi ad litteram*, without issuing any opinion concerning the shape of the sky (II, 9), whose spherical characters he does not reject, but which he attempts to coordinate with passages within Ps. 103, 2 and Is. 40, 22, states that concerning the waters above the firmament, one must admit the authority of the Scripture (*ibidem*, II, 5). Regarding the movement of the heavens or only of the stars, Augustine is persuaded that such a laborious research could represent, for him or for others, a waste of time, which could be used for salvation and for the good required by the Holy Church (*ibidem*, II, 10). Ultimately, it is enough to know that time, "trace of eternity", is measured in years, seasons and days, because of the Sun's rotation along the zodiac (*De Genesi ad litteram, liber incompletus*, 13, 38). Furthermore, whereas astronomy is a useful field in itself, as it may help predict the motion of the divine bodies, "as it is closely related to the very pernicious error of the diviners of the fates, it is more convenient and becoming to neglect it" (*De doctrina christiana*, II, 29, 46).

Cosmas Indicopleustes (6th century) in *Topographia christiana* outlines a representation of the cosmos according to the alliance tent described in Exodus. The sky is not spherical, but it comprises four perpendicular walls on top of which the sky is shaped like a semi-cylinder. On these tent walls or on its roof, angels move the divine bodies. If the Earth were not flat, it could have emerged from the waters, like in Genesis (I, 9–10), and it could have been completely covered by waters, as it occurred during the times of Noah? Like the meal in the alliance tent, the Earth is flat, taller in the North and West (which explains the seasons, the Sun movements, but also the different stream of rivers, slower or more rapid), surrounded by the Ocean, in its turn surrounded by another earth where the terrestrial heaven would be located. As it is also very heavy, the Earth is at rest in the lowest point of the universe. Despite his sailing experience and the fact that he was an exponent of the clergy, Cosmas strived, just like the Fathers preceding him, to determine a genuine row of symbolical correspondences in order to develop based on the Exodus some sort of *imago mundi*.

About in the same period, in Italy, Cassiodorus recommended in his *Institutions* (II, VII, De Astronomia) the reading of Ptolemy's work (*Major Astronomy* had already been translated by Boethius) to understand the cosmic phenomena. The utility of such an endeavour (for navigation, agriculture, etc) is preceded by the definition of fundamental concepts for the field – the movement of the divine bodies, the precession, the orbital number (*numerous circularis*), the eclipses, the hemispheres of

[28] In flagrant opposition with what the Greek philosophy had asserted through Plato (*Timaios*, the last sentence) or Aristotle (*De caelo*, I, 9), for instance.

the Earth (the southern one being not accepted, nor rejected: *Institutiones*, II, VII, 2) – and the warning that the cosmic laws are not actually immutable, but subjected to the Creator's will. This was one way of explaining certain biblical passages (Joshua, 10, 22; Mt, 2, 2; Lk, 23, 44) to which an express reference is made. At the end of the *Institutions*, Cassiodorus concludes that it is much more useful to read the Apocalypse, given that at the end of the world, there will be a new heaven and a new earth.

A rather expositive stance is displayed by Isidore of Seville in both *Etymologies* and *De rerum natura*, where, according to Ambrosius, considers that the firmament supports the upper waters protecting from fire our universe (chap. XIII–IV), while the order of the planets (chap. XXIII) is the one associated with the menorah: Moon, Mercury, Venus, Sun, Mars, Jupiter, Saturn (the median position of the Sun being justified by the fact that it had to provide light for all the other divine bodies). Without assuming the opinions having earned credit in the Greco-Roman world (*...philosophi dicunt...*), he does mention them without any criticism in *Etymologiarum libri,* XIII and XIV: the spherical and immobile Earth is in the centre of the universe, which is spherical and mobile, populated by *astra*, *stellae* and *sidera*, among which Isidore makes a difference (III, 60). Likewise, he features an articulated opinion inspired by the Greco-Roman thought in the third book of the *Etymologies*, in the section dedicated to astronomy: on the sphericity of the universe, on the movements of the divine bodies (*aut feruntur, aut moventur...* III, 63) on the Moon phases and eclipses, generally with accurate depictions (however, the revolution of the Moon comprises, according to Isidore, 30 days), on the solar eclipses (a rather relative explanation in chap. 58).

The opinions did not change a century later: in *De rerum natura*, Bede the Venerable follows closely the synthesis made by Pliny the Elder, but unlike him, he excludes the existence of antipodes (*De temporum ratione*, XXXIV) and he places "the waters above" (Gn., 1, 6–7) on the immediate outskirts of our spherical universe. Dungal may have had the same opinions, borrowed from Macrobius, though the punctuality of the argument approached in the letter does not allow us to understand the Irishman's opinion on the "heavens" and "the waters above".

Fortunately, these opinions did not remain constitutive elements of the dogma and later, despite the fame of their supporters, made it easier to impose the allegorical cosmology (specific mostly to the first patristic centuries). The return to the spherical model of the "pagans" must have been due, among others, to the needs imposed by the compute, for they determined the cardinal holidays (Easter and Christmas) of the liturgical year by astronomic conditionings: Christmas had replaced a pagan holiday, *Dies Solis Invicti*, celebrated on the winter solstice, while for determining the date of Easter, starting with the Council of Nicaea, they had to identify the first Sunday after the first full moon following the spring equinox. However, this required a functional geometrical and algorithm-based model of calculation that the pagan Antiquity had used successfully and to which the allegorical model by Clement of Alexandria or Cosmas Indicopleustes could not even hope. Hence, it should not be surprising that, concerning the specific elements of Christian allegorical cosmology, Dungal fails to make even an allusion.

Conclusions

The relationship between astronomy and astrology created enough problems for Patristic thought. Whereas the first was seen as a useful field for agriculture and sailing mostly, the second one was justly considered a reminiscence of pagan religions and a proof of not trusting the Providence. As regards the thorough research of the sphere of fixed stars or asters, such laborious research was considered a waste of time, to be used for salvation and for the good required by the Holy Church[29]. It was recommended to have minimal knowledge to correlate with elements of the Genesis (heavens, in the plural, the waters above the heavens) or of other biblical books (Joshua, 10, 22; Mt, 2, 2; Lk, 23, 44).

Thus, famous names such as Lactantius, Basil the Great, Ambrosius of Milan, Augustine, Cassiodorus, etc, could not help themselves when it came to interpreting allegorically the universe created, when they did not completely ignore it, by seeing it as a transitory setting and by invoking the famous Apocalypse verse “a new heaven and a new earth”. Though sometimes (Cassiodorus or Bede the Venerable, for instance) they used the Greco-Latin thought (Ptolemy, Pliny the Elder) to understand the cosmic phenomena, the failure of the allegorical cosmic model (initially proposed by Clement of Alexandria, but whose inaccuracy compared to the reality is visible in Cosmas Indicopleustes) determined a reassessment of the cosmological model provided by “pagan” astronomy. Starting with Isidore, the ancient texts concerning this subject where read again carefully and then discussed (and ultimately accepted). The spherical character of the universe, the centrality, the sphericity and immutability of the Earth, the antipodes, the explanation for eclipses, etc, elements of a mathematical model that, unlike the allegorical model, allowed the calculation of astronomic determinations necessary to establish the liturgical calendar. In the letter by Dungal, which fails to mention the allegorical model of patristics, it is shown that in the Carolingian period, they already used the ancient, pre-Christian cosmological model (a proof that they were in full Renaissance, the first European Renaissance), the difference being that astronomy was, for dogmatic reasons, clearly separated from astrology. This was a consequence of the efforts made by patristics. In addition, when, upon associating astronomic phenomena with sad events of the personal life, Charlemagne tried to find a “scientific” ground for his fears and thus to legitimise a superstition with a long tradition, the answer that he receives highlights an attitude towards authentic knowledge different from the one characteristic to patristics. Whereas the Hippo bishop believed it to be more convenient and becoming to neglect astronomy[30], “as it is closely related to the very pernicious error of the diviners of the fates” (astrology), Dungal’s lesson is somewhat the opposite of Augustine’s advice: study astronomy because –precisely by understanding the rationality and predictable regularity of cosmic phenomena –we can let go of the superstitions.

[29]Augustine, *De Genesi ad litteram*, II, 10.
[30] Augustine, *De doctrina Christiana*, II, 29, 46.

Bibliography

Annales Regni Francorum inde ab a. 741 usque ad a. 829, qui dicuntur *Annales Laurissenses maiores et Einhardi*, post editionem G.H Pertzii, recognovit Fridericus Kurze, *Scriptores rerum Germanicarum* in usum scholarum ex MGH separatim editi, Hannovrae, Impensis Bibliopolii Hahniani, 1895.

Archimede 2017: Archimede, *Arenarius*, a cura di Heinrich F. Fleck, Quaderni di Scienze Umane e Filosofia Naturale – 2, 1, Gennaio, 2017, Pubblicazione elettronica aperiodica, www.heinrichfleck.net.

Aristotle 2005: Aristotel, *Despre cer*, introductory study, bibliography, translation from Old Greek, analytical summary, notes and indices by Şerban Nicolau, Bucureşti, Paideia.

Aristotle 2007: Aristotel, *Metafizica*, translation, commentary and notes by Andrei Cornea, second edition revised and annotated, București, Humanitas.

Augustin 1865: Augustinus, *De doctrina Christiana; De Genesi ad litteram libri duodecim; De Genesi ad litteram, liber imperfectus,* in Augustini Hipponensis Episcopi *Opera omnia,* accurante J.P. Migne, PL, vol 34, coll. 15–122, 245–486, 219–244, Parisiis, apud Gaume fratres.

Barbero 2000: Alessandro Barbero, *Carlo Magno. Un padre dell'Europa*, Laterza, Milano.

Cassiodor 2015: Cassiodor, *Instituțiile*, bilingual edition, translation, introductory study and notes by Vichi Eugenia Ciocani, Iași, Polirom.

Clement of Alexandria 1982: Clement Alexandrinul, *Stromatele*, translation, foreword, notes and indices by Pr. D. Fecioru, in PSB, vol. V, Bucureşti, EIBMBOR.

Diogenes Laertius 2005: Diogene Laerzio, *Vite e dottrine dei più celebri filosofi*, testo greco a fronte, a cura di Giovanni Reale, con la collaborazione di Giuseppe Girgenti e Ilaria Ramelli, Milano, Bompiani.

Dreyer 1977: J.L.E. Dreyer, *Storia dell'astronomia da Talete a Keplero*, Feltrinelli, Milan (*History of the Planetary Systems from Thales to Kepler,* Cambridge University Press, Cambridge. 1906).

Dungal 1608: *Dungali Reclusi Epistola de duplici solis eclipsi anno 810*, edidit P. Masson, Paris (reprised in *PL* 105, coll. 447–458).

Dungal 1895: *Dungalus Reclusus S. Dionysii Parisiensis Carolo I imperatori exponit secundum Macrobium de solis defectione anno 810 bis facta*, Ernst Dümmler [ed.], *Monumenta Germaniae Historica*, *Epistolarum tomus IV*, *Epistolae Karolini aevi tomus* II, Berlin, Weidmann, pp. 570-578.

Eastwood 1994: Bruce Stansfield Eastwood, "The astronomy of Macrobius in Carolingian Europe: "Dungal's letter of 811 to Charles the Great", in *Early Medieval Europe*, 3, pp. 112–134.

Eastwood 2007: Bruce Stansfield Eastwood, *Ordering the Heavens: Roman Astronomy and Cosmology in the Carolingian Renaissance* (History of Science and Medicine Library, 4; Medieval and Early Modern Science, 8), Leiden and Boston, Brill.

Eginhard 1911: Eginhard, *Vita Karoli Magni*, in *Scriptores rerum Germanicarum* in usum scholarum ex MGH separatim editi, Hannovrae, Impensis Bibliopolii Hahniani.

Ganz 2004: David Ganz, "Dúngal (*fl. c.*800–827)", in *Oxford Dictionary of National Biography*, Oxford, Oxford University Press, pp. 297–298.

Isidore of Seville 1857: Isidori Hispalensis Episcopi, *De rerum natura liber*, Gustavus Becker edidit, Berolini, Typis Caroli Scultii.

Isidore of Seville 1911: Isidori Hispalensis Episcopi, *Etymologiarum sive originum libri XX*, t. I-II, recognovit brevique adnotatione critica instruxit W.M. Lindsay, Oxonii, e Typographeo Clarendoniano.

Kuhn 2000: Thomas S. Kuhn, *La rivoluzione copernicana. L'astronomia planetaria nello sviluppo del pensiero occidentale*, Torino, Einaudi (*The Copernican Revolution*.

Planetary Astronomy in the Development of Western Thought, Harvard University Press, 1957).

Macrobius 2007: Macrobio, *Commento al Sogno di Scipione*, testo latino a fronte, saggio introduttivo di Ilaria Ramelli, traduzione, bibliografia, note e apparati di Moreno Neri, Milano, Bompiani.

Martin 1881: Th.-H. Martin, "Mémoires sur l'histoire des hypothèses astronomiques chez les Grecs et les Romains", cap. V, §§ 3–4, in *Mémoires de l'Acadèmie des inscriptions et belles lettres*, Vol. XXX, 2° partie.

Plato 1986: Platon, *Republica*, translation, interpretation, preliminary clarifications, notes and annex by Andrei Cornea, in Platon, *Opere*, vol. V, București, Editura Științifică și Enciclopedică.

Plato 1993: Platon, *Timaios*, translated by C. Partenie, in Platon, *Opere*, vol. VII, București, Editura Științifică și Enciclopedică.

Pliny the Elder 2011: Plinius Maior, *Naturalis historia*, vol. I, translated by Ioana Costa and Tudor Dinu, edition, preface and notes by Ioana Costa, index and linguistic notes by Tudor Dinu, Iași, Polirom (C. Plinii Secundi, *Naturalis historiae libri XXXVII*, edidit Carolus Mayhoff, vol. I, libri I-IV, Leipzig, Teubner, 1906).

Plutarch 2017: Plutarco, *Placita philosophorum*, in *Tutti i Moralia*, prima traduzione italiana completa, testo greco a fronte, coordinamento di Emanuele Lelli e Giuliano Pisani, Milano, Bompiani.

Schiaparelli 1873: Giovanni V. Schiaparelli, *I precursori di Copernico nell'antichità*, Ulrico Hoepli, Milan-Naples.

Schiaparelli 1926: Giovanni V. Schiaparelli, *Scritti sulla storia della astronomia antica*, parte prima: scritti editi, tomo secondo, Nicola Zanichelli Editore, Bologna.

Venarable Bede 1862: Beda Venerabilul, *De natura rerum, De ratione temporum,* in Venerabilis Bedae, *Opera omnia*, accurante J.P. Migne, PL, vol. 90, coll. 187–278, 293–578, Parisiis, apud Gaume fratres.

Zanna, Sigismondi 2004: Paolo Zanna, Costantino Sigismondi, "Dungal Letterato E Astronomo. Note di stilistica e di astronomia sulla Lettera a Carlo Magno circa le eclissi di sole dell' 810", in *Archivum Bobiense*, 26, pp. 187–295, also available at https://www.academia.edu/2425667/Dungal_Letterato_E_Astronomo._Note_di_stilistica_e_di_astronomia_sulla_Lettera_a_Carlo_Magno_circa_le_eclissi_di_sole_dell810.

Abstract

In the letter through which Dungal demonstrates to Charlemagne the mathematical rationality of the two eclipses of sun of 810 there is no reference to the allegorical model of the universe promoted in patristics from Clement of Alexandria to Cosmas Indicopleustes. Inspired by *In Somnium Scipionis*, where Macrobius synthesises the astronomic knowledge of the Greco-Roman world, it shows that during the Carolingian period the pre-Christian cosmological model, which proves that we are in mid first European Renaissance. The originality of the letter consists in the simple answer of actuality that Dungal suggests to the emperor: the predictable periodicity of the astronomic events proves that their association with tragic moments of the personal life is related to superstition, namely to pseudo-science. In the following lines, I propose an analysis of the text of this letter from the perspective of the sources, of structure and of pre-Christian cosmology elements.