4 Medieval Variations on a Cosmic Theme

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Introduction

All Neoplatonic musical cosmologies, from Antiquity to modern times, are grounded in the Pythagorean notion of a mathematically organized, sounding cosmos as it came to be articulated in the cosmogonic and mythical accounts of Plato's *Timaeus* and *Republic*: namely, the conceptually intertwining yet analytically distinct notions of world harmony (*harmonia mundi*) and the 'music of the spheres'. On the one hand, the Timean world harmony develops from a complex set of mathematical proportions, which are in turn apparent in the configurations of the cosmos and are often conceived as being analogous to musical *symphoniae*, i.e. musical intervals associated with arithmetic ratios. On the other hand, the music of the spheres is often understood as a particular case or a localized expression of world harmony. That is to say, it pertains to a universe in which each planet produces a distinct sound in its revolution, and these sounds, in turn, collectively produce a well-defined musical scale.[1]

Beginning with the Carolingians, the epistemological trajectories along which the medieval reception of the Neoplatonic theme unfolded were contingent not upon a generative philosophical agenda, but rather upon methodologies born at the crossroads of empirical observation, contemporaneous scientific paradigms, and astronomical models, as well as shifts in cosmological conceptions. The process has not been uneventful, particularly in those moments when the deep investment that generations of scholars had in maintaining the notion of a cosmic sounding *harmonia* faced diverse philosophical, mathematical, astronomical, and aesthetic challenges. The thinkers who found themselves at these conceptual crossroads had to adjust the particulars of their cosmic music to fit, for example, current astronomical observations and cosmic models, or even the underlying mathematical corroboration.

The present essay will explore some aspects of the various conceptual negotiations, strategies of transformation, and cultural contingencies woven into the scholastic reception of the Neoplatonic music of the spheres during the thirteenth and fourteenth centuries. More specifically, it will highlight some of the challenges this notion encountered during the period, as well as some of the elegant solutions contemporaneous thinkers devised in response to them.

The Challenge of Philosophy: The Sounding yet Inaudible Cosmic Music

The medieval reception of the Neoplatonic notion of *harmonia* was punctuated by epistemological, methodological, and philosophical challenges, among which none were more powerful than those faced by thirteenth-and fourteenth-century thinkers. In particular, the introduction to the West of the Latin translation of Aristotle's *On the Heavens*, sometimes in the late twelfth century, and the subsequent assimilation of Aristotelian natural philosophy and Greco-Arabic astronomy into the Latin cosmological models, led some thirteenth-century scholars to challenge the very notion of a Neoplatonic sounding cosmos.[2]

In a famous passage in his *On the Heavens,* Aristotle argues that:

> Melodious and poetical as the [Pythagorean] theory is, it cannot be true on account of the facts. There is not only the absurdity of our hearing nothing, the ground of which they try to remove, but also the fact that no effect other than sensitive is produced upon us. Excessive noises, we know, shatter the solid bodies even of inanimate things: the noise of thunder, for instance, splits rocks and the strongest of bodies. But if the moving bodies are so great, and the sound which penetrates to us is proportionate to their size, that sound must needs reach us in an intensity many times that of thunder, and the force of its action must be immense. Indeed the reason why we do not hear and show in our bodies none of the effects of violent force is easily given: it is that there is no noise.[3]

In the scholastic era, just as in Antiquity, such Aristotelian arguments for a soundless cosmos challenged the dominant Neoplatonic paradigm of a sounding world harmony.[4] Indeed, from the late thirteenth century onwards, the music of the spheres lost some of its philosophical appeal, particularly in the realm of music theory: for instance, Jerome of Moravia and Johannes de Grocheio invoked Aristotle and determined that cosmic music did not exist.[5] Any discussion about the fate of the Neoplatonic cosmic music in the scholastic milieu, however, should range beyond theoretical writings about music, which in the thirteenth and fourteenth centuries increasingly focused on notational procedures within an overwhelmingly Aristotelian philosophical context.[6] With several notable exceptions, fourteenth-century music theorists expressed little interest in exploring Neoplatonic *harmonia*. By contrast, notwithstanding their clear Aristotelian framework, medieval scientific writings present us with richer, more complex, and more dynamic intellectual discussions on the topic. As is generally known, the Aristotelian *scientia* had two major components: (1) the exact sciences, and (2) natural philosophy, also known as natural science, and occasionally as physics. The exact sciences were mathematical sciences of astronomy, optics, and statics, and of course, mathematics (i.e. arithmetic and geometry) itself. Natural philosophy was the study of change and motion in the physical world; all physical changes other than those studied by the exact sciences formed part of the recognized domain of natural philosophy, which Edward Grant described as 'the womb from which all the new sciences—physics, chemistry, biology, geology and all their subdivisions and branches—were born during the seventeenth to nineteenth century'.[7] It is precisely within the context of writings on Aristotelian 'science'—in particular *Quaestiones* and commentaries on Aristotle's *On the Heavens*—that scholastic speculations on the Neoplatonic notions of cosmic sound and music thrived, albeit scattered in works that were largely composed at the medieval universities by members of the arts and theology faculties. In this *materia scientiae*, scholastics often found innovative ways to negotiate between seemingly contradictory Neoplatonic and Aristotelian music-cosmological doctrines, and reached acceptable compromises. These strategies of conceptual negotiation were often contingent on contemporaneous theories of sound and light production and propagation, theories of motion and impetus, as well as other scientific and theological doctrines.[8] In view of the considerable extent to which these medieval scientific interpretative strategies resonate through Renaissance debates on world harmony, they merit in depth examination here.

In scholastic discourses on natural philosophy, neither conflict nor harmonization adequately characterizes the complex negotiation through which these two opposing models were brought together into an uneasy co-existence without ever resolving the fundamental contradictions between them. In this regard, two attempts to preserve the Neoplatonic fabric of the cosmic music in the face of the Aristotelian challenges are particularly notable: one is offered by the anonymous author of a treatise found in a late thirteenth-century manuscript, which is now in the Barberini collection of the Biblioteca Apostolica Vaticana (*Barberinus Latinus* 283, fols. 37r–42v),[9] and the other is offered by Nicolas Oresme (*c.* 1320/25–1382), in his commentary that accompanies his French translation of Aristotle's *On the Heavens*.[10] Both authors engage with the notion of sound as a product of planetary revolutions, and attempt to deal with one of the most vexed problems of the Neoplatonic *harmonia*, i.e. the human inability to hear the sound of the cosmos.[11]

The author of the Barberini treatise adopts a conceptual system that is heavily dependent on al-Kindī's doctrine of rays in *De radiis ('On Rays'),* and therefore succeeds in neutralising the main argument offered by Aristotle in *On the Heavens*: namely, that there is no noise in the heavens, because we do not hear it, and, as quoted above, 'no effect other than the sensitive is produced upon us'. By conceiving the inaudible sounds of the planets as sounding composite rays of light that participate in the celestial influence upon the sublunar world he implicitly rejects the Aristotelian critique of the doctrine of the music of the spheres as follows:

> Moreover, those very projections of rays, as said above, borrow their strength from music [i.e., the musical ratios in the zodiac]. Therefore, if philosophers establish that these musical projections of the rays, which are known as aspects, constitute the effects of the planets, far more the celestial harmony, once it has become known, will fully reveal the secret councils (of these effects).[12]

Having made this point about musical rays and astrological aspects, the author of the Barberini treatise then continues his argument with an explanation of the possible effects of celestial causation, heightened as it were by the 'musical' component of the light rays:

> Accordingly, the rays of the sun, when refracted by the Moon and reverberating in sublunar objects, have various effects, such as on the brain and bone marrow, with which physicians are concerned; on seas, shells, and even the varieties of wind, with which seafarers are concerned; on herbs, arbours, infirmities, and many other matters, with which the unlearned and the common people are concerned. ... Although these rays are potent they are made far more powerful by *musica*. The planets do not operate less where they illuminate than where they do not illuminate. The moon rising at 90° of longitude equally raises the ocean in India and in Britain, granted that it illuminates the former while it does not illuminate the latter. Sound can penetrate even the most solid objects; the ray [of light] cannot.[13]

While the doctrine of 'sounding rays' had some currency in the late Middle Ages,[14] the Barberini treatise represents the most cogent, detailed, and systematic exposition of certain theories associated with this doctrine.[15] It skilfully undermines Aristotle's authoritative argument by describing the nature of the cosmic sound as a composite phenomenon that acts on the sublunar world through light and celestial influence, as opposed to a distinct celestial phenomenon that is inaccessible to our sense of hearing for a number of physical reasons.

Around the end of the fourteenth century, Nicolas Oresme, in his commentary on Aristotle's *On the Heavens*, similarly attempts to establish an acceptable compromise between the Aristotelian and Neoplatonic positions regarding cosmic music. As the following passage illustrates, Oresme draws on notions of sound production found in Aristotle's *On the Soul* (2.8), and argues that the factors producing audible sounds do not operate in the celestial realm:

Oresme's *Le livre du ciel* (ii.18, fols. 125a–b)[16]

[Oresme's] reference to arguments from Aristotle's *On the Soul*	[Oresme's] commentary on these arguments in celestial contexts
Audible sound is produced by violence (*On the Soul* 2.8.419b 9–13)	The eternal heavenly movements are without violence
Bodies capable of resonance tremble and quiver (like bells) (*On the Soul* 2.8.419b 9–11)	Celestial bodies cannot tremble because they move with strictly circular motion
When bodies move with circular motion and create a sound—it is due to the air or other substance that is enclosed between them (*On the Soul* 2.8.419b 33–420a 26)	Between the heavenly spheres there is no intermediate substance—they are contiguous
If two contiguous bodies come in contact, they can resonate only if they are rough and rub against each other—if we apply a lubricant, the sound diminishes or stops (*On the Soul* 2.8.419b 33–420a 26)	The heavenly spheres are smooth and polished—with no friction between them—therefore they pass each other silently and noiselessly

Oresme, then, draws on the explanation of sound production set out in *On the Soul* to demonstrate the impossibility of sound production in the heavens. In the conclusion to this segment, Oresme slightly modifies the meaning of Aristotle's original text. Even though this variation appears minor, it has important conceptual implications. Oresme states:

> Therefore, we can say that celestial motion produces no *perceptible* sound. Perhaps some of the ancient thinkers who held that there is a celestial harmony did not mean that the heavens produce such a sound, but rather that there is a kind of music in the heavens to be found in the ratios between the quantity and quality of the motions, the forces, and the influences of the heavenly bodies. Accordingly, we could say that... *perceptible sounds are of a sort and kind different from celestial sounds, which are imperceptible*.[17] [emphasis mine].

In this passage, Oresme introduces a distinction, which is not present in Aristotle, between perceptible and imperceptible sounds. Aristotle maintained that the production of sound is necessarily followed by sensory perception. Here Oresme claims that there exist imperceptible sounds. Given that these imperceptible sounds, while not heard by the human ear, are however 'heard' by the inner ear of the human mind, the Aristotelian argument becomes moot. In Aristotle's view, the absence of audible sound proved that the Pythagoreans were wrong in assuming that the motions of the heavenly bodies produce a symphony. For Oresme, however, the absence of perceptible sound does not preclude the existence of an imperceptible sound, or the possibility of heavenly bodies 'continuously producing new but imperceptible music: a *canticum novum*, a new song, such as never existed before.'[18]

Thus, Oresme establishes a harmony between the Aristotelian and the Neoplatonic models by stating that perceptible and imperceptible sounds are two manifestations of one unique phenomenon: cosmic *harmonia*. By accepting the notion that celestial spheres cannot produce perceptible sound, Oresme remains committed to the Aristotelian model; by positing the existence of imperceptible cosmic sounds, he nevertheless preserves a Neoplatonic conceptual framework.

The Challenge of Astronomy: The Dynamic Model

Another fascinating example of the medieval adjustments to the concept of the music of the spheres is the way in which particular details were changed to conform to recently adopted models of planetary astronomies. This specific medieval reformulation of the Neoplatonic doctrine led to the development of new parameters that were radically different from the late antique models transmitted by Martianus Capella, Macrobius, Calcidius, and Boethius. Moreover, it produced a cosmic music that was dynamic rather than static, and thus allowed for a theoretically infinite collection of pitches rather than a set forming a well-defined scale. Recent studies have shown that the new, dynamic music of the spheres was not a model typical to the Renaissance, but originated in Carolingian times with Johannes Scotus Eriugena (815–*c.* 877).[19] It had a pervasive presence throughout the Middle Ages, and culminated many centuries later in the works of Johannes Kepler (1571–1630).

This dynamic model, which postulates the existence of a theoretically infinite set of planetary pitches, developed in parallel to, and coexisted harmoniously with, late antique static models, which were based on finite collections of pitches. As a valid epistemological alternative, it exhibited manifold versions, which were contingent on several factors: empirical observations, mathematical corroborations, and contemporaneous musical techniques. Nevertheless, the most critical factor that caused systemic adjustment in the configuration of planetary sounds was the espoused astronomical model. For example, in his tract *De armonia caelestium motuum siderumque sonis* ('On the Harmony of the Celestial Motions and the Sounds of the Stars'), which forms part of his commentary on Martianus Capella's *On the Marriage of Philology and Mercury*, Eriugena contends that the 'pitches of the planets are moved according to the lengths of their apsides' and the planets 'do not always approach each other by the same interval of sound but according to the altitude of their apsides.'[20] Here, Eriugena adopts the astronomical notion of planetary apsides—the far and near points on the eccentric planetary circles with respect to earth. His cosmos, therefore, is mapped onto the Plinian model as transmitted by Carolingian excerpts of Pliny's *Natural*

History.[21] In their eccentric revolutions, planets find themselves in continuously variable configurations, and at continuously variable distances from earth. Consequently, the ever-changing sound configurations that they produce generate a music that exceeds any possible earthly counterpart. Indeed, he argues:

> One should believe that with the eight sounds of the heavenly spheres all possible musical consonances can be made, not only through the three genera [i.e. different divisions of the tetrachord resulting in different scales], I mean, diatonic, chromatic, and enharmonic—but also in other genera, which are beyond human reasoning.[22]

It is, then, because it adopts Plinian apsidal planetary model and thus envisions variable planetary and cosmic musical intervals, that Eriugena's system of celestial sound becomes necessarily dynamic (Figure 4.1).

If the espousal of Plinian planetary astronomy conditions a dynamic music of the spheres, so does the model adopted by the anonymous author of the Barberini treatise. The Barberini author conceives of a nine-sphere cosmos that moves uniformly from east to west under the impetus of the starless ninth sphere, which functions as the Aristotelian *primum mobile*. The planetary motion follows three special coordinates:

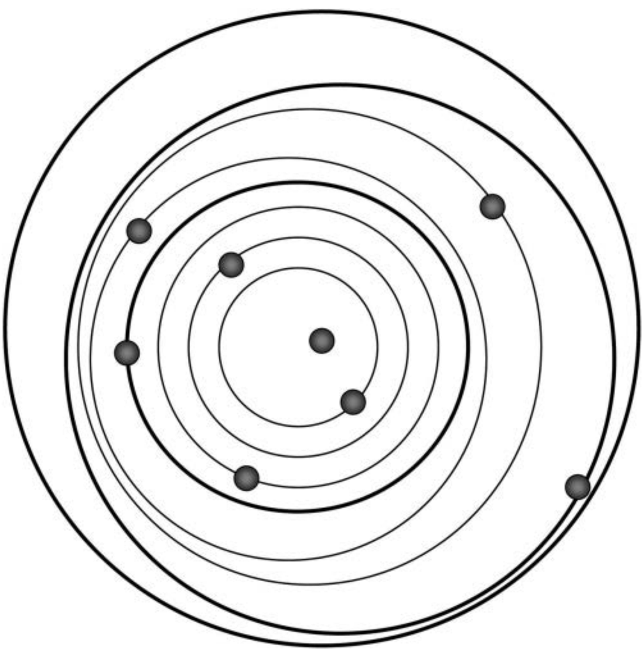


Figure 4.1 Plinian planetary apsides.

by longitude, that is, around the zodiac; by latitude, that is, between the tropics; and by altitude, that is, towards and away from earth. The author declares that altitudinal motion is dependent on a system of eccentrics and epicycles; that one single planet can produce different pitches at different moments in time; and that the ratio between two of these pitches is contingent on the compound ratios derived from the planet's motions and elongations at two separate points in time. In other words, the author's planetary astronomy follows the Ptolemaic model of eccentrics and epicycles and the version of cosmic music that this engenders is necessarily dynamic (Figure 4.2).

The rival cosmological system that was introduced in the West in the late twelfth and early thirteenth centuries was the Aristotelian model, which is described briefly in the *Metaphysics*.[23] Here, Aristotle assumes that the planets move around in a system of fifty-five spheres, which share a common centre that is identified as both the geometric centre of the cosmos and the centre of the Earth. From the thirteenth century onwards, many scholastic thinkers subscribed to the so-called 'three orb system'. This theory represented a compromise between the perfectly concentric orbs of Aristotle, which had crucial implications in the realm of natural philosophy, and Ptolemy's system of eccentrics and epicycles, which accounted more precisely for observed celestial motions (Figure 4.3).[24]

One of the most complex scholastic versions of the Neoplatonic cosmic music that is interpreted in terms of the 'three-orb' model arises from the writings of Nicolas Oresme. Although many aspects of his cosmic musical system remain to be explored, his adherence to

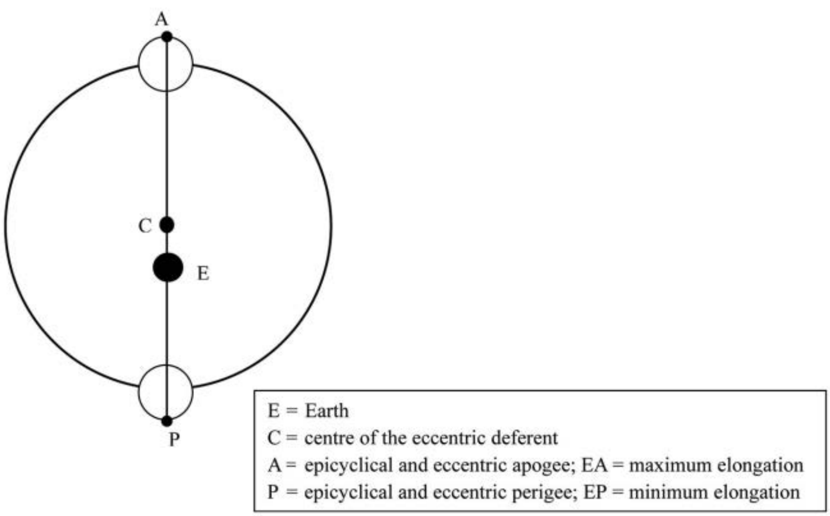


Figure 4.2 Ptolemaic system of eccentrics and epicycles.

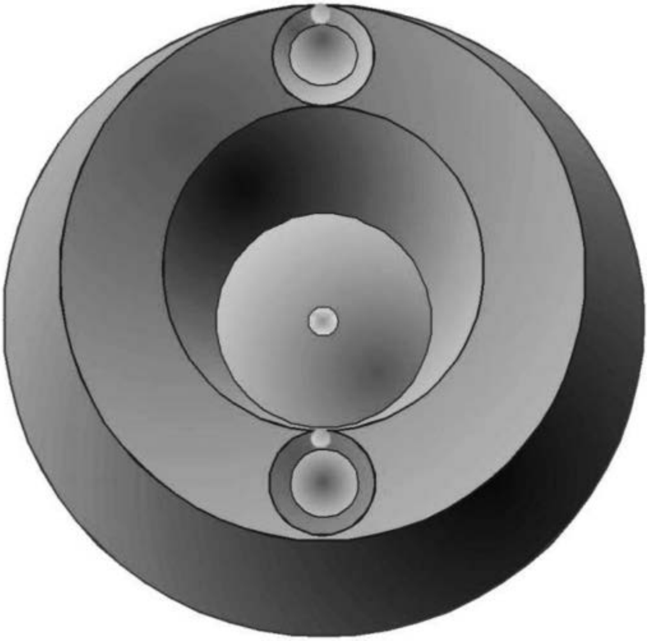


Figure 4.3 The 'three-orb system'.

the 'three orb-system' and incommensurability of celestial motions necessarily entails 'that the heavenly bodies are continually and always in new positional relationships with one another so that it is naturally impossible that these position ever repeat themselves again' and 'that these heavenly bodies … are continuously producing new … music.'[25]

All three planetary models discussed above engender different kinds of dynamic cosmic music; each admits a theoretically infinite set of pitches and potential scalar configurations that differ from case to case, which occur coincidental to only one possible planetary alignment in the corresponding kinetic cosmic scheme. From a philosophical standpoint, none of these dynamic solutions actually abandon the foundational Neoplatonic static model altogether, but rather encompass it as a limiting case. Moreover, they are not just original, pre-modern adaptations of the Neoplatonic doctrine of the music of the spheres, but also harbingers of the famous Keplerian vision. Thus, they embody the connective threads that weave together the medieval and Renaissance receptions of the Neoplatonic *harmonia*.[26]

The Challenge of *Translatio Studii* and Astrology: The Vernacularization of Zodiacal Musical Mathematics

In late fourteenth-century Paris, the notion of the sounding cosmos moved beyond the confines of university learning and made its way into the courtly circles via vernacular literature. There was a gradual shift from a type of learning dominated by, and in many ways limited to, the world of the University, to one marked by a dialogue between scholars active both at the University and the royal court. In this context, university learning was refashioned, adjusted, and often clothed in the rhetorical, literary, and artistic forms of the vernacular. [27] Through conversations and lively debates, which remain largely unrecorded, and a massive programme of *translatio studii* (i.e. the state-sponsored translations and vernacular commentaries patronized by King Charles V of France),[28] the worlds of the University and the court entered into a dialectical relationship that transformed both and created an exchange of scientific ideas.

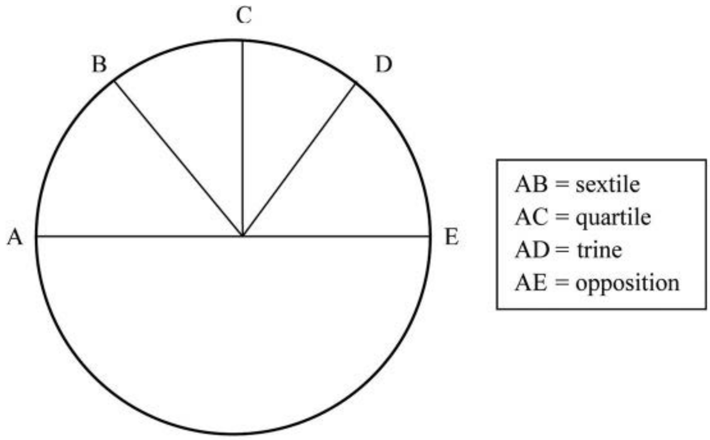
Notions pertaining to the Neoplatonic notion of cosmic music were part and parcel of this intellectual exchange. Here the Neoplatonic notion of *harmonia* came to be increasingly linked to astrological lore and zodiacal divisions, as found in *Les eschez amoureux moralisés* (before 1405), which is attributed to Évrart de Conty,[29] and Oresme's *Le livre du ciel* (1377). It is well known that Évrart de Conty and Oresme were scholars active in both the University and courtly circles. Oresme was grand master of the College of Navarre until the 1360s and was closely associated with the courtly milieu of his royal patron, Charles V, until his death in 1377. Moreover, he was famous for his contribution to mathematics and natural philosophy, as well as his forays into economics and astrological debates. Similarly, Évrart de Conty was both a member of the faculty of medicine at the University of Paris, where he held the post of grand master between 1353 and 1403, and a physician in the service of Charles V from 1363–1380. As such, the two authors were not only contemporaries, but moved in the same circles; therefore, it is likely that they knew each other.

Both Évrart de Conty and Oresme introduce the notion that there is a clear and mathematically precise relationship between planetary aspects and musical intervals. Their accounts are part of a tradition that seems to have gradually developed in the thirteenth century, according to which zodiacal configurations reflect the same mathematical ratios as musical intervals and, together, they participate in the celestial causation, i.e. the medieval belief that celestial bodies have a controlling influence over the terrestrial region. This tradition derived great authority from Ptolemy's *Tetrabiblos* (or the *Quadripartitum*, as it was known during the Middle Ages) as well as from Aristotle's *On the Heavens* and his other writings on natural philosophy. Works such as these provided the intellectual basis for the notion that the incorruptible celestial substance excelled, and therefore influenced the behaviour of, corruptible bodies in the sublunar realm. In particular, Ptolemy's *Tetrabiblos* offered a brief account of the manner in which musical proportions are constantly being produced among the aspects of the zodiac (opposition, trine, quartile, and sextile). It should be noted, however, that only the *diatessaron* (4:3) and the *diapente* (3:2) are mentioned with any degree of specificity.[30] Medieval adaptations of such zodiacal and musical analogies develop towards the late thirteenth century, as witnessed in the anonymous Barberini treatise.[31] In this text, the author maintains that:

> The ratio between the degrees of the trine aspect to those of the quartile produces the *diatessaron*, between the degrees of the quartile to those of the sextile aspect produces the *diapente* and between those of the trine and of the sextile aspect, the *diapason*. Similarly, the opposition makes the *diapason* to the quartile, the *diapente* to the trine, while the trine in ratio to the quartile is said to produce the *diatessaron*.[32]

As can be observed, the author does not describe all the possible zodiacal or musical ratios. The Barberini author is slightly more expansive than Ptolemy; even so, he calculates only two additional ratios, thus totalling four: those of 2:1, 3:2, 4:3, and 6:1, which correspond to the *diapason*, the *diapente,* the *diatessaron*, and the *bisdiapason cum diapente* (Figure 4.4).

The versions proposed about a century later by Conty and Oresme are significantly different, both in terms of the processes involved in the calculation of zodiacal configurations and the resulting analogous musical intervals. In his commentary, Conty focuses on the celestial division, as marked by the astrological signs. Each sign is defined by a 30° segment of the sky. The combination of signs leads to the formation of musical proportions. The proportion occurring between the whole zodiacal circle of 360° to the quartile (90°) produces the ratio of 4:1, which corresponds to the *bisdiapason*; half of the circle of the zodiac (i.e. 180°) and the sextile relate in a ratio of 3:1, which renders the *diapason cum diapente*; and the relation between the whole Zodiac and the trine aspect is that of a 3:2 ratio, that is, the *diapente*. In a second chain of zodiacal calculations, Conty argues that the proportion between the half celestial circle of 180° and the segment of 45°—defined here as the half of the quartile aspect—is 4:1, and thus produces the interval of the *bisdiapason*. The addition of the 45° segment to that of the quartile results in a proportion equivalent to the half circle of 180°:135° (or 4:3), which corresponds to the *diatessaron*. Finally,

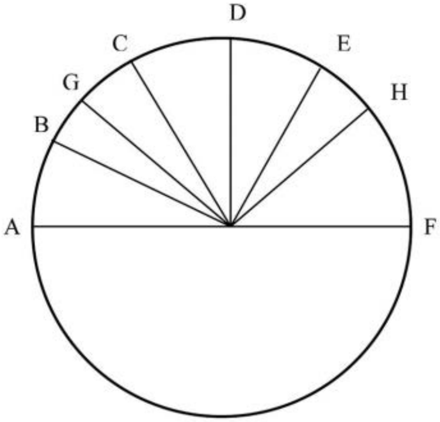


AA:AB = 360°: 60° = 6:1 = *bisdiapason cum diapente*
AB:AC = 180°: 60° = 3:1 = *diapason cum diapente*
AB:AD = 180°: 90° = 2:1 = *diapason*
AE:AC = 120°: 60° = 2:1 = *diapason*
AB:AE = 180°: 120° = 3:2 = *diapente*
AD:AC = 90°: 60° = 3:2 = *diapente*
AE:AD = 120°: 90° = 4:3 = *diatessaron*

Figure 4.4 Planetary aspects and musical ratios, the Barberini Anonymous (Vat. Barb. Lat. 283).

the proportion between the half celestial circle of 180° and one single zodiacal segment of 30° corresponds to the proportions of 6:1, or the *bisdiapason cum diapente*. His musical intervals encompass the entire gamut (i.e. the full range of pitches in a musical system) of *musica practica*, ranging from the unison to the *bisdiapason cum diapente* (Figure 4.5).

Moreover, all musical intervals mentioned in this second segment are deemed important because of their capacities to cure maladies or to change the air ('terminacions des maladies', 'mutacions de l'air'). These powers are probably derived from their association with specific planetary aspects and thus their astrologically determined, sublunar influences. The direct association with astrological functions notwithstanding, the number of intervals that emerge from the planetary aspects in Conty's version is significantly larger than that found in the Barberini treatise a century or so earlier. Moreover, the arcs of the zodiacal circle are systematically identified, not as mathematical divisions of the Zodiac



AB = 30°
AC = sextile
AD = quartile
AE = trine
AF = opposition
AG = half of quartile (45°)
AH = quartile + 45°

AA:AA = 360°:360° = 1:1 = *unison*
AF:AF = 360°:360° = 1:1 = *unison*
AF:AD = 180°: 90° = 2:1 = *diapason*
AF:AE = 180°:120° = 3:2 = *diapente*
AF:AC = 180°: 60° = 3:1 = *diapason cum diapente*
AF:AG = 180°: 60° = 4:1 = *bisdiapason*
AF:AH = 180°:135° = 4:3 = *diatessaron*
AF:AB = 180°: 30° = 6:1 = *bisdiapason cum diapente*

Figure 4.5 Planetary aspects and musical ratios, Évrard de Conty, *Les eschez amoureux moralisés*.

(trine, quartile, etc.) but, as mentioned above, as segments consisting of one or more conjunct astrological signs.

Oresme's account in his *Livre du ciel* is radically different. He puts forth a series of intervals encompassed only by one octave; thus, his intervals are fewer and smaller than those described by either the author of the Barberini treatise or Évrart of Conty. Furthermore, these intervals are expressed by ratios, which do not occur between arcs of the zodiacal circle, but between the chords of those respective arcs. The chord AC (Figure 4.6) corresponding to the sextile arc (60°), for example, is a side of an equilateral triangle, and therefore has the same length as the radius of the circle, which, for the sake of convenience, we can assign a value of one. The chord AD, which corresponds to the quartile aspect (90°), is the hypotenuse of an isosceles right triangle, whose legs have lengths equal to the radius of the circle; accordingly, the length of AD is the square root of two. The chord AE, which corresponds to the arc of the trine aspect (120°), is the longer leg of a right triangle whose

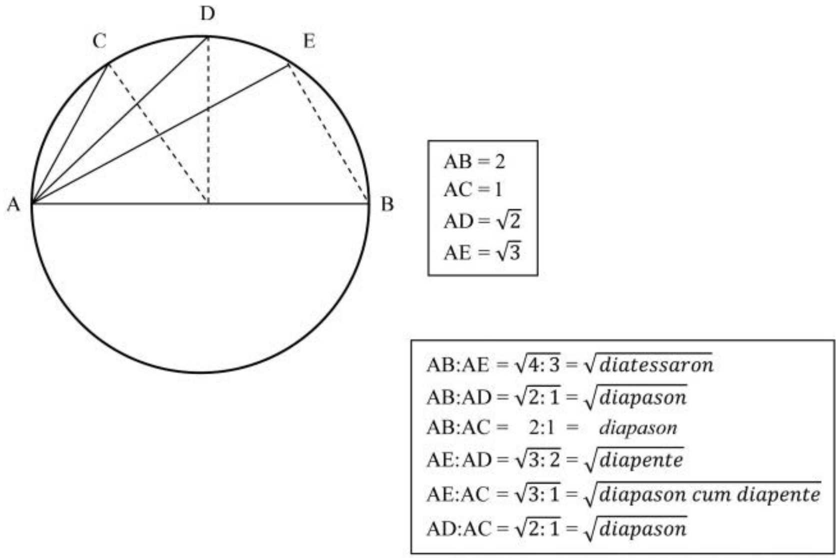


Figure 4.6 Planetary aspects and musical ratios, Nicolas Oresme, *Le livre du ciel*.

hypotenuse forms the diameter of the circle; the value of AE is, then, the square root of three. Consequently, almost all the proportions that these chords of arc form are radical forms of the common Pythagorean ratios that engender the *diatessaron*, *diapente*, *diapason*, and *diapason cum diapente*.

Oresme's account not only differs from Conty's version in terms of the nature of the mathematical relations that configure the celestial zodiac (i.e. different ratios and different resulting intervals) but also, and perhaps more importantly, in terms of its intellectual scope. First, unlike Évrart of Conty (or the Barberini anonymous), Oresme does not extract from the celestial aspects the ratios of 6:1, which correspond to the *bisdiapason cum diapente*, that is, the set of nineteen pitches that formed the music-theoretical gamut from the twelfth century onwards. Therefore, one could argue that he does not mean to connect his cosmic calculations to the contemporaneous musical *gamut* and hence to contemporaneous music theory. Secondly, by conceiving chords of arcs as sides of triangles inscribed in the celestial circle and avoiding any reference to the impact of planetary aspects on the sublunar world, Oresme not only moves the entire mathematical foundation of the Neoplatonic cosmic music from the realm of arithmetic into that of geometry, but also firmly anchors the notion of zodiacal music in the realm of mathematics, untainted by either astrological lore or musical practice.[33]

This brief assessment of these two late fourteenth-century versions of zodiacal musical correspondences and their contingence on both mathematics and astrological lore suggests that the two are related by virtue of the analogy between musical and celestial proportions, but that they display different specifics and have different goals. Évrart of Conty, as has been shown, calculated ratios among signs rather than aspects of the zodiac and viewed the resulting musical intervals as participants in the celestial causation. He thus emphasized the astrological dimension of the correspondence. As such, his approach would have been appealing to both the members of the faculty of medicine at the University and the world of astrologers and physicians, namely the world of Conty's professional peers. Moreover, by including his discussion in a commentary on a poem, which was modelled after the *Roman de la Rose*, he engaged with courtly vernacular literature and thus explicitly addressed a courtly audience.[34] Similarly, Oresme explains that he wrote *Le livre du ciel* 'for the purpose of animating, exciting, and moving the hearts of those young men [at the court] who have subtle and noble talents and the desire for knowledge to prepare themselves to argue against and to correct me because of their love and affection for the truth'.[35]

However, while his *Le livre du ciel* was addressed to a courtly audience very similar to that of Conty, Oresme used complex mathematical ideas that he had developed decades earlier for a scholarly readership at the University. Moreover, known for his mistrust and at times open contempt towards astrology, Oresme rejected any astrological correlations, and kept himself entirely within his beloved domain of mathematics. In their attempt to serve similar, courtly audiences, therefore, the astrology-friendly physician and the astrology-sceptic mathematician ultimately provided their own variations on the same zodiacal theme.

Conclusion

The medieval scientists and natural philosophers were instrumental in shaping the reception of the Neoplatonic notion of a sounding cosmos. In particular, medieval renditions emerge as more than just wholesale adoptions of the late antique versions or mechanical reproductions of philosophically and scientifically inherited and outdated set of conceptual and scientific models. Medieval thinkers engaged in a constant effort to maintain the conceptual validity of this ancient notion by enlisting the support of contemporaneous scientific and philosophical positions: that is, they appealed to astronomical developments and offered new interpretations of theories about sound to negotiate between competing Neoplatonic and Aristotelian outlooks; and they 'vernacularized' their material to reach a broader audience. Opposing the notion that radical conceptual reconfigurations of this nature occurred only during the Renaissance, the present discussion has shown that medieval intellectuals provided variations on the cosmic theme that answered different contemporaneous challenges brought about by epistemological transformations, philosophical repudiations, and scientific astronomical models. In so doing, they paved the way for the Renaissance receptions of the theme. As such, one could make a strong case that the medieval variations of the cosmic theme ultimately emerge as a conceptual conduit that links late Antiquity to the Renaissance.

Notes

1 James Haar's '*Musica mundana*: Variations on a Pythagorean Theme' (PhD dissertation, Harvard University, 1960) remains the most comprehensive study on the fortunes of the Neoplatonic notion of cosmic music. His work on the subject inspired the title of this essay.
2 See, for example, the discussion in Haar, '*Musica mundana*', pp. 299–313.
3 Aristotle, *On the Heavens* 2.9.290b30–291a6, trans. John L. Stocks, in *The Complete Works of Aristotle: The Revised Oxford Translation*, ed. Jonathan Barnes (Princeton: Princeton University Press, 1984), p. 479.
4 In this volume, the ancient reception of this theme is addressed by Pelosi in Chapter 1.
5 See Haar, '*Musica mundana*', pp. 309–313. See also the recent discussion in Constant Mews, 'Questioning the Music of the Spheres in Thirteenth-Century Paris: Johannes De Grocheio and Jerome De Moravia Op', in *Knowledge, Discipline and Power in the Middle Ages: Essays in Honour of David Luscombe*, ed. by Joseph Canning, Edmund King and Martial Staub (Leiden: Brill, 2011), pp. 95–117.
6 Dorit Tanay, *Noting Music, Making Culture: The Intellectual Context of Rhythmic Notation, 1250–1400* (Holzgerlingen: Hänsler-Verlag, American Institute for Musicology, 1999).
7 Cf. Edward Grant, *The Nature of Natural Philosophy in the Late Middle Ages* (Washington, DC: Catholic University of America, 2010), p. 164.
8 For an examination of some attempts to resolve the conflict between the Boethian *musica mundana* and its rejection by the Aristotelian tradition, see Giles Rico, '"Auctoritas cereum habet nasum": Boethius, Aristotle, and the Music of the Spheres in the Thirteenth and Early Fourteenth Centuries', in *Citation and Authority in Medieval and Renaissance Musical Culture: Learning from the Learned*, ed. by Suzannah Clark and Elizabeth Eva Leach (Woodbridge: Boydell Press, 2005), pp. 20–28; see also Gabriela Ilnitchi, '*Musica Mundana*, Aristotelian Natural Philosophy and Ptolemaic Astronomy', *Early Music History* 21 (2002): pp. 37–74.
9 *Adalboldi Episcopi Ultraiectensis Epistola cum tractatu de musica instrumentali humanaque ac mundana*, ed. Joseph Smits van Waesberghe (Buren: Knuf, 1981); for a detailed discussion of the *musica mundana* portion of the treatise as well its attribution to an anonymous late thirteenth-century author rather than to Adalbold (975–1025), see Ilnitchi, '*Musica Mundana*, Aristotelian natural philosophy and Ptolemaic astronomy'.
10 Nicolas Oresme, *Le livre du ciel et du monde*, ed. Albert D. Menut and Alexander J. Denomy (Madison: University of Wisconsin Press, 1968). Oresme was the younger contemporary of Ockham and Johannes de Muris and probably the colleague of John Buridan at the University of Paris.
11 In this volume, this theme is also addressed in Chapter 1.
12 *Epistola cum tractatu*, p. 29.15: 'Sed et ipsae proiectiones radiorum, ut supradictum est, vim suam mutuantur ex musica. Si igitur musicae proiectiones radiorum, quae dicuntur aspectus, effectus planetarum philosophis

ostendunt, longe plenius harmonia caelestium, cum cognita fuerit, eorum arcana consilia revelabunt'. For a discussion of the theories of celestial causation in the Middle Ages and beyond, see Edward Grant, *Planets, Stars, and Orbs*: *The Medieval Cosmos, 1200–1687* (Cambridge: Cambridge University Press, 1996), pp. 569–617 and John D. North, 'Medieval Concepts of Celestial Influence: A Survey', in *Astrology, Science and Society: Historical Essays*, ed. by Patrick Curry (Woodbridge: Boydell & Brewer, 1987), pp. 5–17.

13 See *Epistola cum tractatu*, p. 24.11–12 [cf note 9] and p. 29.12–13: 'Secundum hos aspectus radius solis, refractus in luna, et inferiora reverberans, alios et alios habet effectus; in cerebro et medullis, quod patet physicis; in mari et conchyliis, immo etiam in aeris varietatibus, quod patet marinariis; in herbis et arboribus et infirmitatibus, in rebus quampluribus, quod patet etiam idiotis et simplicibus. … Verumtamen licet radiorum sit multa potentia, revera longe fortior est musica. Nam planetae non minus operantur, ubi radiant, quam ubi non radiant. Luna oriens existentibus in longitudine nonaginta graduum, et apud Indos et apud Brittanos, aequaliter extolit oceanum, licet ilis radiet, istis non radiet. Sonus omnia solidissima penetrare potest; radius vero non potest'.

14 For the place of al-Kindī in the medieval reception of the doctrine of world harmony, see also Chapter 2 in this volume.

15 See Ilnitchi, '*Musica mundana*, Aristotelian natural philosophy and Ptolemaic astronomy', pp. 70–73.

16 Oresme, *Le livre du ciel* 2.18, p. 476–478.

17 Oresme, *Le livre du ciel* 2.18, p. 478: 'Or avons donques que les corps du ciel par leurs mouvemens ne font pas son sensible. Et peut estre que aucuns anciens qui mettoient ou ciel armonie ne entendoient pas que le ciel feist tel son, mais entendoient que ou ciel est un maniere de musique laquelle est es propocions des quantités et des qualités et de mouvemens et des vertus et des influences des corps du ciel. … samblablement les sons sensibles sont d'autre guise et d'autre maniere que ne sont les sons celestielz lesquielz sont insensibles'.

18 Oresme, *Le livre du cie*l 2.18, p. 480: 'selon ce peut estre que les corps du ciel … font continuelment nouvelle musique insensible: Et canticum novum, si que onque ne fu tel'.

19 For the Carolingian, specifically Eriugenian vision of a dynamic music of the spheres, see Gabriela Ilnitchi Currie, '*Concetum caeli quis dormire faciet?* Eriugenian Cosmic Song and Carolingian Planetary Astronomy', in *Quomodo cantabimus canticum: Studies in Honor of Edward H. Roesner*, ed. by David B. Cannata, Ilnitchi Currie, Rena Charnin Mueller, and John L. Nádas (Middleton, WI: A-R Editions, Inc., 2008), pp. 15–35. See also Susan Rankin, '*Naturalis concordia vocum cum planetis*: Conceptualizing the Harmony of the Spheres in the Early Middle Ages', in *Citation and Authority*, pp. 3–19.

20 Édouard Jeauneau, 'Le commentaire érigénien sur Martianus Capella', (*De Nuptiis*, lib. I) d'après le manuscript d'Oxford (Bodl. Libr. Auct. T.2. 19, fol. 1–31) in *Quatre thèmes érigéniens (Conférence Albert le Grand, 1974)*, (Montreal: Institut d'Études Médiévales Albert-le-Grand, 1978), pp. 127 (*De armonia caelestium*): 'quod verum moveantur voces siderum iuxta spatia absidarum' and 125: 'non eisdem intervallis semper soni appropinquare sed secundum absidarum altitudinem'.

21 For Eriugena's planetary astronomy, see Bruce S. Eastwood, 'Astronomical Images and Planetary Theory in Carolingian Studies of Martianus Capella', *Journal for the History of Astronomy* 31 (2000): pp. 1–28; and Bruce S. Eastwood, 'Johannes Scottus Eriugena, Sun-Centred Planets, and

Carolingian Astronomy', *Journal for the History of Astronomy* 32/4 (2001): pp. 281–324. The Plinian excerpts have been studied by Karl Rück, *Auszüge aus der Naturgeschichte des C. Plinius Secundus in einem astronomisch-kamputistischen Sammelwerke des achten Jahrhunderts* (Munich: F. Straub, 1888). The diagrams associated with the transmission of these excerpts have been studied by Eastwood, 'Plinian Astronomical Diagrams in the Early Middle Ages', in *Mathematics and Its Applications to Science and Natural Philosophy in the Middle Ages: Essays in Honor of Marshall Clagett*, ed. by Edward Grant and John E. Murdoch (Cambridge and New York: Cambridge University Press 1987), pp. 141–172.

22 Jeauneau, 'Le commentaire érigénien sur Martianus Capella', p. 127 (*De armonia caelestium)*: 'in octo caelestibus sonis omnes musicas consonantias fieri posse credendum est, non tantum per tria genera, diatonicum, dico, chromaticum, enarmonicum, verum etiam in aliis ultra omnium mortalium ratiocinationem'.

23 Aristotle, *Metaphysics* 1073b1–1074a13.

24 Grant, *Planets, Stars, and Orbs*, pp. 271–293: pp. 279–281.

25 Oresme, *Le livre du ciel* 2.18, p. 481. For brief and preliminary observations with respect to Oresme's cosmic music and mathematics, see Gabriela Currie, 'Poetics of Proportions: Late Scholastic Views on Cosmos, Sound, and Color', in *Proportions: Science, musique, peinture et architecture*, ed. by Sabine Rommevaux, Philippe Vendrix and Vasco Zara (Turnhout: Brepols, 2012), pp. 119–133.

26 The most comprehensive study of Kepler's views on cosmic harmony to date is Bruce Stephenson, *The Music of the Heavens: Kepler's Harmonic Astronomy* (Princeton: Princeton University Press, 1994). See also the important study by Daniel P. Walker, 'Kepler's Celestial Music', *Journal of the Warburg and Courtauld Institutes* 30 (1967): pp. 228–250.

27 See, for example, Joan Cadden, 'Charles V, Nicole Oresme, and Christine de Pizan: Unities and Uses of Knowledge in Fourteenth-Century France', in *Texts and Contexts in Ancient and Medieval Science: Studies on the Occasion of John E. Murdoch's Seventieth Birthday*, ed. by Edith Sylla and Michael McVaugh (Leiden: Brill, 1997), pp. 208–244.

28 Alistair Minnis, 'Standardizing Lay Culture', in *The Beginnings of Standardization: Language and Culture in Fourteenth-Century England*, ed. by Ursula Schaefer (Frankfurt am Main: Peter Lang, 2006), pp. 43–60: p. 44.

29 Évrart de Conty, *Le livre des eschez amoureux moralisés*, ed. by Françoise Guichard-Tesson and Bruno Roy (Montreal: CERES, 1993).

30 Ptolemy, *Tetrabiblos* 1.13, ed. and trans. Frank E. Robbins (Cambridge, MA: Harvard University Press, 1940), pp. 73–74.

31 See note 9.

32 See *Epistola cum tractatu*, p. 23. 2–7: 'Igitur gradus trini aspectus ad gradum quarti aspectus diatessaron faciunt; gradus quarti aspectus ad gradum sextilis aspectus diapente; gradus trini aspectus ad gradum sextilis diapason. Item oppositio ad quartum aspectum diapason facit, ad trinum diapente, et trinus ad quartum diatessaron facere dictus est'. For a detailed discussion of this letter, see Ilnitchi, '*Musica mundana,*' p. 66.

33 This thesis is further, albeit briefly, explored in Currie, 'Poetics of Proportions', pp. 121–126.

34 Conty, *Les eschez amoureux moralisés*, Introduction, p. 64.

35 Oresme, *Le livre du ciel*, p. 731. On Oresme's intended audience, see Edward Grant, 'Nicole Oresme, Aristotle's *On the Heavens*, and the Court of Charles V', in *Texts and Contexts in Ancient and Medieval Science*, pp. 187–207.