De Musica: The Spheres of Musical Pedagogy

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Abstract

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In my thesis, "*De Musica*: The Spheres of Musical Pedagogy," I explore what role music pedagogy played in the history of music theory. More specifically, I examine the ways in which different pedagogies helped guide music's shift from a Pythagorean science to performance and practice. The history of early music theory is a richly-researched area, largely focusing on the place of learning (such as Murray, Weiss, and Cyrus, 2010), but the scholarship on pedagogy is lagging. I offer an analytical perspective of three pedagogical "spheres"—scientific, ritual, and instructional—to answer the following question: how did early pedagogical methods contribute to the progression of music from a science to an art?

The scientific realm of music pedagogy is represented mostly by Ancient Greek philosophers and mathematicians (Pythagorean school, Ptolemy, and Aristoxenus). These writings contain scientific and mathematical explanations for musical phenomena, teaching music as a matter of fact. Second is the ritual realm, represented by early Christian practices which set music as the language of worship. Treatises in this sphere (by Augustine, Cassiodorus, Isidore, and others)—address the practice of music, but not how it works or how to learn it. A third sphere—that of instruction—bridges the ideological gap between abstract theory and actual practice. Unlike the scientific and ritual pedagogical realms, the instructional realm is neither prescriptive nor descriptive, and it ignores aspects of science and religion. Instead, it seeks to aid the student, the composer, and the performer.

I believe that music's shift from a science to an art is a result of the interplay between these spheres. The intersection of science and ritual began discourse of the purity of music; the intersection of science and instruction provided insights on the compositional usage of dissonance; and the intersection of ritual and instruction has called for proliferation of repertoire and performers. Together, these spheres defined the role of music as it entered the realms of art and humanism. Where the three spheres meet reveals the motivation behind the shift, as initially observed by Aristoxenus: the motivation to deliver music from the abstract to the real.

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Examples

Introduction

Music theory is one of the most important pillars of music education today. Its pedagogical activity permeates all areas of musical study, from performance to analysis to composition and beyond. The academic field of music theory thrives on an abundance of new scholarship, and its prevalence in undergraduate music curriculum gives it a certain pride of place among topics in musical study. The field has never seen such a golden age as it does right now. It has, however, gone through many transformations in order to be what it is today.

Why did the field emerge? Where did it come from? How has it evolved? These are questions frequently asked by researchers of the history of music theory. When we think about the music of the past, we often have a hard time understanding how it can have any relevance for today's musical study. We tend to dismiss ancient music as "outdated" and focus instead on the repertoire of the common practice period. But in doing so, we neglect the fact that all of our knowledge of music—how it is created, organized, and manipulated—is the result of thousands of years of ideas, debates, discussions, writings, and referenda about what music is. To understand how music theory became what it is today, we need to identify what people thought about music—even before it was called "music."

I hope to fill some of the holes in the field of the history of music theory by offering more than just a chronicle of events, as much of the field's previous scholarship has done. Many works in the history of music theory have focused on the place of learning and the relationship between students and teachers.[1] Fewer works, however, focus on the cross-sections between the tangentially related sectors of music theory.

This project proposes a model for viewing and teaching the history of Western music theory with particular focus on its progression toward its current state. I suggest analyzing the main concerns of the intellectual authorities from three critical periods of development in Western musical thought: Greek antiquity, the Middle Ages, and the early Renaissance. To understand what people thought about music, scholars tend to use one of two methods.

The first method is to analyze the music repertoire of various time periods. This involves mainly looking at scores of pieces of music, and also encompasses listening to and playing through the music. For instance, an analyst doing a project on 16th-century counterpoint might be interested to see scores from the Renaissance and to identify elements such as form, melody, and polyphonic style in order to understand the performance and compositional practice of the period. However, the analyst using this method will be impeded by common challenges of reading Renaissance notation from a modern point of view. For example, scores written before the Renaissance are less intuitively comprehensible than modern scores are, because their system of notation was not fully developed yet and differs from modern music notation. Also, the tunings of many instruments have changed, which may give the reader a false impression of the piece, and the score may include certain antiquated nuance markings that the reader might not be able to audiate. And unfortunately, either because of the late onset of published scores or the poor preservation of them, there are not nearly as many scores available from key historical periods as

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[1] For example, see: Russell A. Murray, Jr., Susan Forscher Weiss, and Cynthia J. Cyrus, "Some Introductory Remarks on Musical Pedagogy," in *Music Education in the Middle Ages and the Renaissance* (Bloomington: University of Indiana Press, 2010).

scholars would like. While helpful, score study should not be the only method of research for a project on the history of music theory.

A second method is to read treatises on music. The tradition of treatise-writing has preserved and transmitted musical thought for over two millennia. These treatises contain written accounts of discourses on specific subjects, conveying the ideas, questions, and opinions held by key musicians of the respective time periods. By "key musicians," I mean the people directly involved with progressive musical thought, namely philosophers, composers, mathematicians, and educators. Some of these thinkers wrote music treatises to showcase their remarkable findings, while others wrote them as tribute to their creator; others wrote their treatises as guides to the practice of music. A thorough study of music treatises offers more informed evidence for historical musical thought than repertoire could. My thesis utilizes this method

My model for teaching the history of Western music theory divides key historical treatises on music into three overlapping realms—the scientific, ritual, and instructional realms—each discussed in its own chapter of this thesis. Chapter 1 discusses the scientific realm, which hosts theorists whose main concerns are music's cause and effect. These theorists (namely Pythagoras, Aristoxenus, and their students) inquire about the numerical phenomena that enable musical sound and debate issues of purity, variability, measurement, and how music is related to other academic disciplines. In Chapter 2, I shift my focus to the ritual realm, which focuses on the usage of music. Theorists in the ritual realm, such as Boethius, St. Augustine, and Hildegard von Bingen, seek to identify who counts as a musician, as well as what music should be used for. Finally, in Chapter 3, I discuss the instructional realm, a sector of musical thought dedicated to the development of notation (as taught by Guido d'Arezzo) and composition (by Tinctoris, Gaffurius, and Zarlino). Of course, these three areas of musical thought are not entirely separate, but rather deeply interconnected and equally cooperative. In the conclusion of my thesis, I elaborate upon the intermediate areas between the scientific, ritual, and instructional realms, focusing on what they all have in common.

Before we begin, I ask the reader to suspend their current understanding of what music is and, if at all possible, put everything they know about music theory aside. In order to think the way our ancestors did, we must start fresh, not taking their developments for granted. In a moment, we will discuss musical authorities from two thousand years ago, when the concept of music looked nothing like it has for the last millennium. I ask that we take these differences in stride, keenly observing how they gave way to modern music theory. With that, let us begin our journey in the Ancient Greek empire.

Chapter 1: The Scientific Realm

The scientific realm of Western music theory, like any other scientific discipline, is concerned with cause and effect. It seeks to answer the "how" of music, which is both a highly theoretical inquiry and a practical one. The breadth of ideas discussed under the umbrella of "scientific music theory" is characterized by the search for input and output, or background and exponent. While this particular realm of music theory is not necessarily more important than the ritual or instructional realm (which I will explore in chapters 2 and 3, respectively), it is the oldest and most fundamental to the development of early Western music. To illustrate this, consider what diverse meanings the word "music" carries with it.

The English word "music," just like music itself, has come a long way etymologically. "Music" derives from the Latin word *musica*, which itself emerged from the Greek term *mousikē technē*, meaning "art of the Muses." Herein is found the origin story. The Muses of the Ancient Greek tradition were the figureheads of the liberal arts, each considered to be something of a mythical pedagogue. Their roles in Greek society were to inspire curious minds and activate courageous inquiry in the seven Ancient Greek disciplines: grammar, logic, rhetoric, arithmetic, geometry, astronomy, and music. Why is this relevant? Simply put, it indicates that the word "music" encompasses the idea of being inspired to study, and underscores a critical notion: that music was on the front lines of the earliest recorded scientific revolution.

This chapter's aim is to show how the scientific realm of Western music theory spearheaded progressive musical thought. I seek to answer the following questions: which aspects of music theory are attributable to the scientific realm? Who were the original authorities of scientific musical thought, and what were their teachings? To what extent did these authorities agree or disagree with one another? To answer these questions, I will delve into the Greek academic tradition of music and identify music's role in the discourse of the sciences. I will then explicate the heart of the two main schools of Greek musical thought, the Pythagorean and Aristoxenian schools, and evaluate their stances on critical aspects of music theory. Finally, I will return to my guiding question and discuss which aspects of music theory are owed to the scientific realm, based on the teachings of the aforementioned scholars.

Division of the Greek Disciplines

Ancient Greek scholars were concerned with the nature of how certain phenomena worked. Historians debate the specificities of which topics the Greeks actually studied and how they categorized their disciplines, but the most trusted account of the Greek system's organization comes from Anicius Manlius Severinus Boethius (c. 477–524 CE), who translated a large selection of written works from Greek to Latin. Boethius showed that there were two discrete sectors of study in Ancient Greece, one scientific in nature, and the other intellectual.[2] He was mainly interested in the scientific subjects, which he named the quadrivium, Latin for "four-ways." The name denoted the four principle scientific disciplines: arithmetic, geometry, astronomy, and music.

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[2] Calvin Bower, "The Transmission of Ancient Music Theory into the Middle Ages," in *The Cambridge History of Western Music Theory* (Cambridge: Cambridge University Press, 2002), 141.

The logic of Boethius's division can be deduced from his definition of quantity. According to Boethius, there are two types of quantities: discrete and continuous.[3] Discrete quantities, which he calls “multitudes,” can be counted and manipulated (made greater or lesser). Multitudes come from the theoretical “monad,” or the "unity," which represents oneness and is indivisible.[4] Continuous quantities, on the other hand, cannot be counted or manipulated but are infinitely divisible; Boethius calls these "magnitudes." Multitudes are best understood as numbers, and magnitudes are best understood as shapes or lines.[5] The division of subjects in the quadrivium according to Boethius is thus derived from his definitions of quantities. If geometry is the study of magnitudes on their own and astronomy is the study of magnitudes in motion, then arithmetic is the study of multitudes on their own and music is the study of multitudes compared to each other. These four ways of thinking about quantities coalesce as the Ancient Greek quadrivium, for which music was a pillar.

Considering the contemporary definition and usage of “music,” it should seem peculiar that it is included in such a scientific collection of disciplines, so much so that any connection to present-day music might even seem tenuous. But the reality is that Western music, even in its present-day incarnation, emerged as the study of proportions, the examination of multitudes compared with other multitudes. Nicomachus (60–120 AD) explained that music is a studied imitation of the cosmos, just as music and astronomy are essentially applied versions of arithmetic

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[3] Ibid., 142.

[4] Ibid.

[5] Ibid.

and geometry, respectively.[6] In addition to comparing these disciplines conceptually, the Greeks largely believed sound waves to be continuations of waves produced by planetary movement, which influenced several aspects of musical science. For example, mathematicians named the notes in the *tonoi* (scales) after planets, each corresponding to a given planet's ascribed mass and velocity.

Scientific Divisions of Music

The question of what qualifies as "scientific" music theory is largely answered by Aristides Quintilianus (c. 3rd-4th centuries CE), whose treatise, *De Musica*,[7] offers the most comprehensive account of the division of the Greek musical system. Aristides divided the study of music into two separate domains: practical and theoretical.[8] Practical music mainly includes composition, which does not concern the scientific realm (at least until the Middle Ages). Theoretical music, on the other hand, deals in the currencies of science and mathematics.

Aristides further divided the domain of theoretical music into two more sub-sectors: physical and technical.[9] Physical music is concerned with how music functions in space and what properties of nature influence it. This particular subset of music theory considers the per-

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[6] Thomas Mathiesen, "Greek Music Theory," in *The Cambridge History of Western Music Theory* (Cambridge: Cambridge University Press, 2002), 117.

[7] Aristides Quintilianus, *On Music, in Three Books (Music Theory Translation Series)*, ed. Thomas Mathiesen (New Haven: Yale University Press, 1983).

[8] Andrew Barker, "Aristides Quintilianus," in *Greek Musical Writings (Cambridge Readings in the Literature of Music), Vol. 2: Harmonic and Acoustic Theory* (Cambridge: Cambridge University Press, 1989), 392.

[9] Ibid.

spectives of other quadrivium sciences on music, namely arithmetic and astronomy (or rather, physics). The limitation here is that physical explanations of music do not account for musical phenomena, but rather for acoustic phenomena. Musical phenomena can only be explained with musical terms, not with arithmetic or physical terms. For this reason, Aristides divided the technical division of theoretical music into three self-contained musical disciplines called harmonics, rhythmics, and metrics.[10]

Herein are found the critical aspects of scientific music theory. Theorists have not quite agreed upon exact definitions of harmonics, rhythmics, and metrics, but each one's domain can be deduced as follows:

- *Harmonics*, perhaps the most historically significant of these disciplines, is the study of pitch and harmony. It was the first scholarly area of Western music to be explored, and as such, nearly every aspect of Western music theory relates in some way to harmonic principles. Harmonics also incorporates the differentiation between high and low sounds, which early music theorists used to derive intervals, scales, modes, and tuning systems.
- *Rhythmics* encompasses the ability to parse rhythms. The applied usage of rhythmics in the Ancient Greek tradition was not much different from the discipline of philology, which was an early precursor to contemporary linguistics. Philology lent itself to the nascent study of syntax, and while the Greeks did not quite explore syntax as linguists do today, rhythmics is a comparable practice given the academic limitations of its time. It originally entailed the alignment of music with words, especially in chant, but with minimal musical repertoire available, the concept of rhythm was not as salient as harmony.

[10] Ibid.

- *Metrics* concerns the quantitative measurement of music over time. Although the concept of meter (as we use the term today) is not discussed at length until the 13th century CE,[11] the idea of musical measurement is a very old one.[12] While rhythmics focuses on variable sets of rhythms not dissimilar from human speech, metrics centers on the countable permutations in a given piece of music.

Rhythmics and metrics took backseat positions at the beginning of the Greek scientific revolution. This is because the concept of technical theoretical music, as opposed to physical, was not explored until long after the original exploration of musical science with harmonics. The scientific realm of Western music theory is concerned with cause and effect, but depending on the time, a given theorist might only be interested in one or the other. In Ancient Greece, this was very much the case.

At the advent of scientific music theory, two schools of thought formed, each with a distinctly different approach to the scientific study of music. The earlier of the two focused on *cause*: it took a physical, rather than theoretical, approach to music, attempting to describe musical phenomena in mathematical and physical terms. The second school sought to abandon music's mathematical descriptors and instead formulate a system of scientific terms that could describe distinctly musical phenomena, or music's *effect*. These were the schools of Pythagoras and Aristoxenus.

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[11] Johannes de Garlandia, *Concerning Measured Music (De Mensurabili Musica)*, tr. Stanley H. Birnbaum (Colorado Springs: Colorado College Music Press, 1978).

[12] For more on measurability of musical sound, see Mathiesen, *Greek Music Theory*, 115–16.

The Pythagorean School

The Pythagorean school studied music in the abstract, as taught by Pythagoras of Samos (570-495 BCE). Pythagoreans were fascinated with music's meaning as a *reflection* of something else. They viewed musical information as truth and as a reflection of higher reality, including music's apparent alignment with cosmic rotations. Their teachings surrounded music's harmonious reflection in number, a system from which many Pythagoreans drew divine inspiration. While the ancient Greeks enjoyed a great repertoire of music from various festivals and ceremonies, the Pythagoreans' theories did not concern existing music. They focused on music's *cause*, not its effect. If the Pythagoreans were the only authorities of musical thought, there would likely be no distinction between music and mathematics.

Since the word "music" encompasses the idea of being inspired by something that is empirically astounding, it should come as no surprise that the first story of musical development belongs to Pythagoras. Scholars and historians have no primary documents attributed to Pythagoras, suggesting that he did not record any of his teachings (or none of them survived). Fortunately, the corpus of Greek music theory was built on the foundation of Pythagoras's legacy,[13] so his teachings have frequently been outlined in others' treatises. His story of discovery of interval ratios has been reduced to a malleable myth that varies from telling to telling, but the meaning of the story helps retain its merit. Here are two tellings of the story.

It is said that one day, Pythagoras was walking through the market when he heard two blacksmiths simultaneously striking their anvils with hammers, each producing a clanging sound

[13] Thomas Mathiesen, "Introduction," in *The Cambridge History of Western Music Theory*, 22.

with every strike. He noticed that although the two men were performing the same action on anvils of the same size, the acoustic response from the each was different. Pythagoras did not take this difference for granted. When he examined the properties of the elements at play, Pythagoras discovered that the sound produced from each anvil was not affected by the strength of the man hitting it, nor the shape or material of the anvil, but by the weight of the hammer. He gathered that impact from lighter hammers results in higher pitches, and heavier hammers yield lower pitches.[14]

Nicomachus (c. 60-120 CE), a Neopythagorean mathematician, extrapolated this legend in his treatise *Enchiridion Harmonices*.[15] According to his account, Pythagoras heard the sounds of *four* blacksmiths hitting their hammers against their anvils and felt as though the hammers were singing to each other. Each man's hammer weighed a different amount: they were six, eight, nine, and twelve pounds, respectively. Upon examination of the hammers, Pythagoras deduced that the "singing" effect was a result of the proportional relationships between the hammers. The largest hammer was double the weight of the smallest, producing what sounded like the same note, but somehow smaller. When the six- and nine-pound hammers were struck at the same time, they produced a similar degree of agreement, even though they did not appear to be the same pitch.[16]

There is ample evidence to prove that this story (or at least this rendering) is fictitious, but the its implications have empirical value. Instead of thinking in units of weight, the concept

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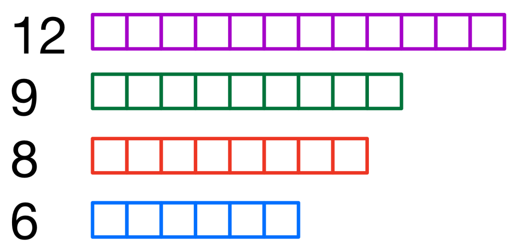
[14] Athanase Papadopoulos, "Mathematics and Music Theory: from Pythagoras to Rameau," *The Mathematical Intelligencer* 24/65 (2002), 67.

[15] Flora R. Levin, "Nicomachus of Gerasa," *Grove Music Online*.

[16] Papadopoulos, *Mathematics and Music Theory*, 67–8.

has merit when the measurements are in units of *length*. To compare the pitches of two discrete quantities, Pythagoras used the monochord, an instrument whose name means "one string." After hearing what an undisturbed string sounds like when it is plucked, Pythagoras would block the string at the appropriate ratio to hear the resulting pitch. Example 1 (shown below) compares the lengths side-by-side, as they would be compared on the monochord.

Example 1: Side-by-side lengths of strings in the Pythagorean interval allegory



Two critical discoveries about these proportions set the Pythagorean school into motion. First, Pythagoras deduced that 12:6, or 2:1 when reduced, the duple ratio, produces pitches that are nearly in perfect unison with one another. In other words, when a 12-inch string and a 6-inch string are plucked at the same time, both will produce what sounds like the same pitch, but the shorter one having the higher frequency. The consonance of this distance, which we now call the octave, can be explained in physical terms: when the human ear perceives a particular frequency, it translates the frequency into a constant pitch. When two frequencies are sounded at once, the ear calculates the interval between them. The duple ratio is such a pure one that the interval seems to almost recapitulate a pitch. The octave is often compared to the number 10, because when any single-digit is added to it, the “1” at the front of the number helps preserve the “10-ness” of it.[17]

Pythagoras’ second discovery concerned the ability to mathematically determine unique pitches, not just replications of the original pitch. The duple ratio is an insufficient measure of sonic distance on its own, so Pythagoras needed to find another measure of similar consonance that was mathematically related to the ratio of the octave. To do so, he turned to the scientific field of arithmetic. The Pythagoreans are known to have faithfully used three different kinds of means to find mathematical “centers.” These were the arithmetic, geometric, and harmonic means, shown in Example 2 below.

Example 2: Pythagorean means

Arithmetic Mean	Geometric Mean	Harmonic Mean
$a-b = b-c \qquad b = \frac{a+c}{2}$	$\frac{a}{b} = \frac{b}{c} \qquad b = \sqrt{ac}$	$\frac{a-b}{a} = \frac{b-c}{c} \qquad b = \frac{2ac}{a+c}$

Of the formulas above, Pythagoras used the arithmetic and harmonic means to determine consonances other than the 2:1 ratio. First, he used the arithmetic mean to determine the first consonance after the octave, and then he used the harmonic mean to determine the second. The formulas may be used as follows:

1. For the terms in the duple ratio (12:6), let the first term equal *a* and the second term equal *c*.
2. Using the mean formula, solve for *b*.

[17] Calvin Bower, “The Transmission of Ancient Music Theory into the Middle Ages,” in *The Cambridge History of Western Music Theory*, ed. Thomas Christensen (Cambridge: Cambridge University Press, 2002), 157.

3. Substitute *b* for *a*.

Following these steps lets us derive the consonant ratios ourselves. To determine the first consonant interval, take the arithmetic mean of the terms in the octave, as shown in Example 3:

Example 3: Taking the arithmetic mean of the duple ratio

12:6

1. $a = 12$, $c = 6$

   Arithmetic Mean:
   $b = (a+c) / 2$

2. $b = (12+6) / 2$

   $b = \underline{18 / 2}$

   $b = 9$

3. 9:6 —> 3:2

To determine the second consonant interval, take the *harmonic* mean of the terms in the octave, as seen in Example 4:

Example 4: Taking the harmonic mean of the duple ratio

1. $a = 12$, $c = 6$

   Harmonic Mean:
   $b = 2ac / (a+c)$

2. $b = (2)(12)(6) / (12 + 6)$

   $b = 144 / 18$

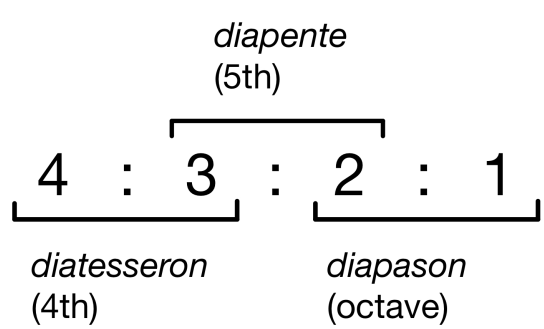
   $b = 8$

3. 8:6 —> 4:3

The resulting ratios—3:2 and 4:3—join the octave, 2:1, as the foundational intervals that determined the sounds of Western music. The duple ratio of 2:1 became known as the *diapason*, a Greek compound of the roots *dia* ("through") and *pason* ("all"). The name indicates that the diapason's interval measures the distance from one note to the higher version of itself. The triple ratio of 3:2 became known as the *diapente*, and the quadruple ratio of 4:3 became known as the *diatesseron*, meaning "through five" and "through four," respectively.

Pythagoras had a strong predilection for these ratios because of their inherent purity. But what qualifies a ratio as "pure?" Claudius Ptolemy (c. 90-168 CE) clarifies it in his treatise *Harmonics*,[18] suggesting that a ratio is pure (in the eyes of Pythagoras) if it is *superparticular*, meaning that its terms (numbers in comparison) have a difference of 1.[19] The aforementioned values are the superparticular ratios that may be formed from the first four consecutive integers, 1 through 4. Example 5 below illustrates their relationship.

Example 5: The four primary Pythagorean intervals, as formed by comparing the first four consecutive integers



[18] Ptolemy, *Harmonics*, tr. Jon Solomon (Leiden: Brill, 1999).

[19] G.D. Halsley & Edwin Hewitt, "More on Superparticular Ratios in Music," *The American Mathematical Monthly* 79/10 (1972), 1096.

At the Pythagorean school's advent, only the *diapason* and *diapente* were necessary for the establishment of a scale. Since the diapason recapitulates pitches and the *diapente* alters them, the Pythagoreans used these two measurements to determine the pitches in their scale: they used the *diapason* to determine octave limits, the *diapente* to identify the unique pitches between octave limits. As such, the Pythagorean system was built on the fifth: all designated pitches were assigned based on their distance from the "unity" in fifths. If a pitch exceeded the octave limit, the string would be cut in half, reducing the pitch by one octave. This was the first tuning system, and while its internal problems became evident very quickly, the assertion of designated pitches was indeed a monumental moment for scientific music theory.

From here, Pythagoras developed the rest of his scale using the pure intervals of the *diapason* and *diapente*. The *diapason* determined octave limits, and the *diapente* determined unique pitches. Because the *diapente* measures upward in pitch, Pythagoras relied on octave equivalence, which allowed for notes of varying octaves to be placed alongside each other within the confines of a single octave span. To the modern ear, the Pythagorean scale would sound out of tune, because its tuning system is entirely different than our present-day system. However, the Pythagorean scale was not meant to sound pleasing to the ear; rather, it was designed to measure "pure" ratios. This method worked for Pythagoras and his pupils, but it led him to an unavoidable mathematical problem.

Pythagoras built his scale on the fifth, positing that the interval's inherent purity would best determine the other pitches in the scale. It stands to reason that the fifth will ultimately lead back to itself, perfectly dividing the scale into twelve equal parts. Needless to say, this is not the case. When a pitch is raised by twelve fifths, the resulting pitch is *nearly* exactly seven perfect octaves higher than the original pitch, but it is noticeably out of tune—23.46 cents[20] flat, or the remarkably impure ratio of 531441:524288. This could have caused Pythagoras to reconstruct his entire scale, but he decided to keep the standard spacing of the fifths and leave the last fifth out of tune in favor of a largely perfect system. The gap between the two out-of-tune notes at the top end of the scale has come to be called the "wolf fifth," possibly because it sounds like a wolf howling.[21]

Perhaps the most striking feature about the *diapente* and *diatesseron* (the fifth and the fourth) is their supplementary relationship. The sum of the two results in the *diapason*, or in contemporary terms, the perfect fourth and perfect fifth combine to construct the octave. Plato (c. 427-347 BCE) explores the mathematical underpinnings of this relationship in his treatise *Timaeus*.[22] The difference between the *diapente* and *diatesseron*, he shows, is in no way an arbitrary gap. Rather, its numerical significance reveals the properties of the tone, a quantity that is fundamental to tonal systems. Plato uses different terms to describe the ratios: for the *diapente*, he uses the term "hemiolic," Greek for "half as much again," and for the *diatesseron*, "epitritic," meaning "a third as much again." Plato asserts, "The difference between hemiolic and epitritic intervals is filled up by an epogdoic remainder."[23] This last term, "epogdoic," means "an eighth as

[20] A cent is equal to 1/100 of a half step.

[21] Margo Schulter, *Pythagorean Tuning and Medieval Polyphony*, ed. Karl Burmeister (1998), 23.

[22] Plato, *Timeaus*, tr. Francis M. Cornford, ed. Oskar Piest (New York: Macmillan, 1985).

[23] Nicomachus attributes this to Plato in *Enchiridion*. For more, see: Barker, *Greek Musical Writings*, 259.

much again," or 9:8. In mathematical terms, Plato claims that the space between the diapente and diatesseron may be represented as the ratio 9:8, which yields the "whole tone."[24]

The whole tone, often called a whole step, is also a superparticular ratio (9:8), but it represents a degree of consonance that is smaller than the fifth, fourth, and octave. It measures the difference between the fourth and the fifth, but one cannot measure the length of fourths or fifths with full tones. Smaller divisions of the tone are helpful: the fourth is constructed with roughly two and a half tones, and the fifth with about three and a half tones. The distance of this "half" tone's interval may be calculated by taking the remainder after subtracting whole tones from the fourth and fifth, as shown in Example 6:

Example 6: Deriving the half tone

<u>Deriving the Half Tone</u>

(Fifth) – 3(Tone) = (Half Tone)

(Fourth) – 2(Tone) = (Half Tone)

In order to execute this calculation, simply convert the intervals into their numerical representations in cents.

[24] Barker, *Greek Musical Writings*, 260.

Example 7: Deriving the half tone numerically

Deriving the Half Tone Numerically

701.955 – 3(203.91) = 90.225

498.045 – 2(203.91) = 90.225

The resulting numbers are identical, which suggests that there is indeed a consistent internal measurement that may be used to calculate the distance of intervals smaller than the octave, fifth, and fourth: the distance of 90.225 cents, which may be represented by the ratio 256:243. However, there is a glaring problem with this: the calculated distance of this half tone is *not* numerically half of the distance of the whole tone (90.225+90.225≠203.91). Since it is still numerically significant, though, Pythagoras simply found the remainder of the "half" of the tone, shown in Example 8 below:

Example 8: Finding the remainder of the half tone

(Tone) – (calculated half tone) = (remainder of half tone)

203.91 – 90.225 = 113.685

113.685 cents, which may be represented as the ratio 2187:2048, is a second, larger variety of half tone. In Pythagorean tuning, each type of half tone is used for different purposes (discussed later in this chapter). For the sake of clarity, Pythagoras named both types of half tones. Today, we call them the "minor" and "major" semitones, but Pythagoras used the names *limma* (small half tone) and *apotome* (large half tone), respectively.

The goal of this chapter is to illustrate the ways in which the scientific realm has catalyzed Western music's progression from a form of mathematics to art. I could viably end the chapter here, since the Pythagorean school's contributions—the codification of the octave, fifth, and fourth—underly practically all of tonal theory. However, Pythagoras did not have a monopoly over scientific music theory, and these intervals do not constitute the study of musical phenomena; rather, they just study cause, or background. They explain the mathematics behind musical sound, but they say nothing in the way of how it is actually used. Also, the tuning problems that Pythagoras decided to overlook were not as negligible to his successors, who decided to reconcile the issues in the system that Pythagoras constructed.

The scientific realm is concerned with both cause and effect, but the Pythagorean school does not concern itself with effect at all. Studying music in terms of cause led Pythagoras to think of his system as universal, which music theory's history has proven wrong, time and again. Theorists today know that musical information should not be viewed as universal; it should be viewed in such a way that it is able to be debated, manipulated, adapted, and, eventually, notated. Issues taken up by the scientific realm shed light on these topics, allowing them to be explored and codified. Aristoxenus of Tarentum (375-335 BCE) spearheaded the movement that pushed music to be understood as something more than just the numbers that explain it.

The Aristoxenian School

The Aristoxenian school treats musical sound as a phenomenon in and of itself, separate from the physical sciences. It is concerned with music's effect: that is, what it sounds like, how people experience it, and how people think about it. Aristoxenus held the unique view that music should be an intellectual matter; it should be both studied and applied, not just discussed in the abstract.[25] Rather than disagreeing with the Pythagoreans per se, Aristoxenians distanced themselves from the pedantic style of Pythagorean sciences, instead focusing on the properties of musical sound. They did not think the Pythagoreans were wrong; rather, they did not concern themselves with issues of musical "purity" or mathematical processes for determining intervals. The Aristoxenian school relied on the sound of music to the ear, something that the Pythagoreans took for granted.

Unlike Pythagoras, much of Aristoxenus's writings, as well as those of his most notable successor, Cleonides (c. 3rd-4th centuries CE), are extant. Aristoxenus' and Cleonides' treatises, respectively titled *Elementa Harmonica* (*Harmonic Elements*)[26] and *Eisagōgē harmonikē* (*Introduction to Harmonics*),[27] contain the main corpus of information on this newer school of musical thought. The Aristoxenian school may be crystalized into four key positions that dictated its practice:

1. Music can and should be used.
2. Musical sounds should be measured with musical terms, not just with numbers.
3. Musical systems are variable.
4. Music is a skill.

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25 Mathiesen, *Greek Music Theory*, 120.

26 Andrew Barker, "Aristoxenus," in *Greek Musical Writings* (Cambridge: Cambridge University Press, 1989), 119–89.

27 Jon Solomon, "Cleonides," in *The New Grove Dictionary of Music and Musicians,* 2nd edition, eds. Stanley Sadie and John Tyrrell (London: Macmillan Publishers, 2001).

Each of these ideas distinguishes the Aristoxenians from the Pythagoreans, representing a movement of progressive musical thought that would catalyze Western music theory. In the following sections, I will discuss each of these four ideas in depth, illustrating how Aristoxenus mobilized music, shifting its focus away from the mathematical Pythagorean discipline and toward a culture of practice.

Music can and should be used

Aristoxenus and Pythagoras were similar in some ways. They were both motivated by the miraculous harmony of numbers, and they both sought out to codify a methodology for understanding that harmony. They admired the *harmoniai*, the cosmological bodies of which they understood music to be a reflection. Where they parted ways was the treatment of musical information. The Aristoxenian school believed the *harmoniai* to be of secondary value to the study of harmonics (and music in general), putting the sound and intellect of musical agreement at the center of speculation.

In Cleonides's definition of harmonics, he included the terms "speculative" and "practical":

> *Harmonics is the speculative and practical science having to do with the nature of the harmonious.*[28]

In the context of their time, these terms are rather ambiguous. How were the earliest musical scientists supposed to know the difference between which parts of their study were practical

[28] Leo Treitler, "Cleonides: Harmonic Introduction," in *Strunk's Source Readings in Music History* (Revised Edition), ed. Oliver Strunk (New York: Norton, 1998), 34–46.

or speculative? Later treatises from the medieval period make frequent reference to these terms, offering a retrospective explanation.

The "speculative" science of music may be associated with the later term *musica speculativa*, which refers to the type of scholarly study that deals with abstractions of musical truths.[29] The "practical" science of music, on the other hand, is associated with *musica activa*, or "active music." *Musica activa* deals with describing, defining, and categorizing musical phenomena—an entirely different scholarly area than *musica speculativa*. For the sake of this chapter, the distinction is clear: Pythagoreans focus on *musica speculativa*, while Aristoxenians focus on *musica activa*. Cleonides suggests that both are essential aspects of harmonics. Each one has its place in the Greek quadrivium; one is not more important than the other. The Aristoxenian school thus prides itself on its inclusion of *musica activa* in its discussion of harmonics and other aspects of musical science.

This Aristoxenian principle—that music can and should be used—may seem obvious to us, the modern musically-minded individuals, now that Western music has been developed for over two thousand years. But before it had aged, music as a study was still a very abstract idea. Until Aristoxenus, it was only described in numbers, so anyone who was not versed in the sciences could not access music. In order to make musical information more accessible, Aristoxenus had to distance music from the sciences. One way that he was able to communicate this dis-

[29] Andrew Hicks, '"Musica Speculativa' in the Cambridge Commentary on Martianus Capella's 'De Nuptiis,'" *The Journal of Medieval Latin 18* (2008), 292–305.

tinction was by discussing melody and composition, which he believed to be beyond the scope of harmonics.[30]

Musical sounds should be measured with musical terms, not just with numbers

Aristoxenus is chiefly concerned with the experience of music.[31] Even though his contemporaries tended to favor the provable parts of music, like the concord of certain superparticular ratios, he continued to pursue his fascination with the resulting *sound* of musical concord. The Pythagorean school's entire being undermined that fascination by attempting to merely explain it numerically.

Pythagoras was the first of many theorists to suggest an "order of consonances," or a list that ranks intervals based on their degree of concord: the octave is the most consonant interval (after the perfect unison), followed by the fifth, then the fourth.[32] If Aristoxenus were to ask Pythagoras why a particular piece of music sounded pleasant, Pythagoras would likely tell him it was because the ratios of the intervals were more pure than pieces with intervals of lesser purity. But this introduces a critical problem: can musical experience be explained by mathematical proof? Are numbers trustworthy descriptors of musical experience? Pythagoras would say that it is, but Aristoxenus would blatantly disagree. Aristoxenus was tasked with formulating a new system to differentiate sounds without relying on mathematics.

Perhaps one of the reasons why Aristoxenus's and Pythagoras's outlooks on musical study were so different was because of the particular instruments they used for differentiation. Py-

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30 Barker, *Greek Musical Writings*, 121.

31 Ibid., 124.

32 Mathiesen, *Greek Music Theory*, 116–17.

thagoras measured his ratios on the monochord, which had a highly limited range of use: it mostly allowed him to hear what certain ratios sounded like in contrast with another tone. Aristoxenus ironically used a much older instrument with a wider variety of uses, which was the voice. This was far more advantageous than using the monochord because the voice possesses certain properties that allow for more complex differentiation.

Aristoxenians discuss two distinct functions of the voice: it can be used continuously or intervallically. The voice can produce sounds at particular frequencies, but unlike the monochord, it possesses a greater ability to move between those frequencies, making it a far more versatile instrument. The voice produces sound that naturally flows between frequencies, and Aristoxenus calls this function *continuous*.[33] But in order for the voice to identify frequencies and sing them, the pitches must stay constant; they must not fluctuate. To do this, the voice has to move in specific intervals, skipping over the sound in between them, creating what Aristoxenus calls *intervallic* movement in the voice.[34] When the voice moves from a pitch to rest on another pitch, the space that has been passed over is the interval. Singing on specific pitches requires tension in the voice, and movement requires relaxation. As such, the sonic production of intervals is caused by the pattern of tension and relaxation. This pattern gives Aristoxenus an advantage over Pythagoras: instead of just knowing the numerical value of intervals, he knows how they *feel* in the body.

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[33] Barker, *Greek Musical Writings*, 132.

[34] Ibid.

This physical feeling of intervals cannot be described wholly in numbers. Instead, Aristoxenus focuses on the musical attributes of intervals to differentiate between them. According to his writings, intervals are verifiably different based on the following properties:

1. *Magnitude*: This is one of the most fundamental differences between the Pythagorean and Aristoxenian schools. While Pythagoreans measure intervals as ratios between multitudes, or numbers, Aristoxenians measure them by magnitude, or size. A measurement of magnitude focuses on the distance between designated pitches, rather than the amount represented by a proportion. Aristoxenians are better equipped to measure the size of intervals because the voice lets them feel which intervals are larger or smaller than others. However, it must be noted that Aristoxenus does *not* believe that the ability to discriminate based on magnitude leads to understanding musical sound; in fact, there are several more elements to that process.[35]
2. *Genus*: The concept of *genera* (singular: genus) is an early precursor to the major/minor dichotomy. For example, the Pythagoreans established two varieties of the half tone: the *limma* and *apotome*, which may be thought of "minor" and "major" half tones, respectively. The same, Aristoxenus differentiated intervals of similar magnitude by their *genera*.[36]
3. *Symphonic vs. Diaphonic*: The antiquated terms "symphony" and "diaphony" are synonymous with "consonant" and "dissonant," respectively. When the pitches that

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[35] Ibid., 156.

[36] Ibid., 159.

bound a given interval are sounded at the same time, the ear judges the space between the pitches as either pleasing or displeasing, or consonant or dissonant.[37]

4. *Rational vs. Irrational*: The ear is more likely to find the combination of two pitches to be pleasing, or consonant, if the ratio between the two is relatively simple. The concept of rationality and irrationality is essentially the numerically-based equivalent of symphony and diaphony, and it is perhaps the most prominent ideological link between the Pythagorean and Aristoxenian schools.[38]

These methods of differentiation may be used to expand and alter Pythagoras's system. Pythagoras developed his scale based on discrete proportions, but Aristoxenus proved that scales could be built based on note value instead. Aristoxenus used these methods to make his most important contribution, which was the *tonoi*, or species of the scale.

<u>Musical systems are variable</u>

Tonoi are systematic variations of the Pythagorean scale. While they continue to use Pythagorean intervals to some degree, they extend their usage to reorder and rebuild the scale.

The organization of the *tonoi* fused the mathematical background of Pythagoras's scale with Aristoxenus's ideology about variation and differentiation. The intervals are borrowed from Pythagoras, but their ordering and function are attributed to Aristoxenus. To derive unique *tonoi* (singular: *tonos*), Aristoxenians developed variations of the *tetrachord*, a four-part division of a given interval. The four parts, or notes, were given the names (from lowest to highest) *mese*,

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[37] Ibid., 159–60.

[38] Ibid.

lichanos, *parhypate*, and *hypate*, with the *mese* and *hypate* in fixed, unmovable positions, and the *lichanos* and *parhypate* in movable intermediary positions. The fixed pitches are the same for every tetrachord, but the positions of the middle notes vary, providing variation among tetrachords and therefore scales. The exact designation of the *lichanos* and *parhypate*'*s* positions are determined by the *genus*, or character, of the tetrachord.

It should be noted that the idea of variable *genera* is not attributable to Aristoxenus. The core of tetrachordal divisions occurred during the height of the Aristoxenian school, but a large number of pre-Aristoxenian theorists, as well as a handful of post-Aristoxenians, also made significant contributions to the practice.[39] The most notable theorist of the former group is Archytas (c. 428–347 BCE), a Pythagorean and a contemporary of Plato. Indeed, Aristoxenus's contributions to the practice of tetrachords are very historically significant, but Archytas (and Plato) actually enabled his teachings.

Historical records show Archytas to be the first music theorist to prescribe specific ratios to different *genera* of the tetrachord. He assigned the specific ratios to the intervals of three genera: diatonic, chromatic, and enharmonic (shown in Example 9 below). The diatonic genus, intended to be the most "natural-sounding" of the three, is supposed to resemble to beginning intervals of the Pythagorean scale. The enharmonic genus sounds less pure than the diatonic genus because it does not conform to the order in the Pythagorean scale, but it retains the purity of superparticular ratios (5:4, 36:35, and 28:27). But the ratios in the chromatic genus, unlike those in

[39] André Barbera, "Arithmetic and Geometric Divisions of the Tetrachord," *Journal of Music Theory* 21/2 (1977), 294–5.

the diatonic and enharmonic genera, are *not* (all) superparticular, rendering it the least natural-sounding genus.

Example 9: Archytas's genera

Archytas's Genera

	Diatonic	Enharmonic	Chromatic
Mese			
	9:8	5:4	32:27
Lichanos			
	8:7	36:35	243:224
Parhypate			
	28:27	28:27	28:27
Hypate			

Aristoxenus expanded on these genera by standardizing and mobilizing them. To do so, he used Plato's altered version of the diatonic genus, which changes the intervals in the genus to be slightly more traditional. Instead of having two different sizes of whole tones and an untraditional half tone, Plato adjusts the ratios to reflect Pythagoras's preferences. This ensured that the genus measured the exact intended distance, which was a fourth. Earlier in this chapter, I established that a fourth is the sum total of two whole tones and a single *limma* (small half tone), and Plato intends to retain those measurements: he replaces the whole tone intervals with 9:8, the Pythagorean whole tone, and the half tone interval with 256:243, the Pythagorean small half tone. Example 10 compares Archytas's and Plato's diatonic *genera*.

Example 10: Comparing Archytas's and Plato's genera

	Diatonic Genus (Archytas)	Diatonic Genus (Plato)
Mese		
	9:8	9:8
Lichanos		
	8:7	9:8
Parhypate		
	28:27	256:243
Hypate		

Aristoxenus borrowed Plato's method of converting nontraditional ratios into measurements of tones of half tones because it made for a simpler system of measurement. While he appreciated the mathematical value of the Pythagorean rations, he disliked their abstract quality. To Aristoxenus, using terms like "tone" and "half tone" was more conducive to musical productivity than referring to ratios, like 8:7. For example, one may easily remember what a tone sounds like, but it is harder to remember what the ratio of 8:7 sounds like. As such, the intervals in all of Aristoxenus's genera add up to equal a fourth.

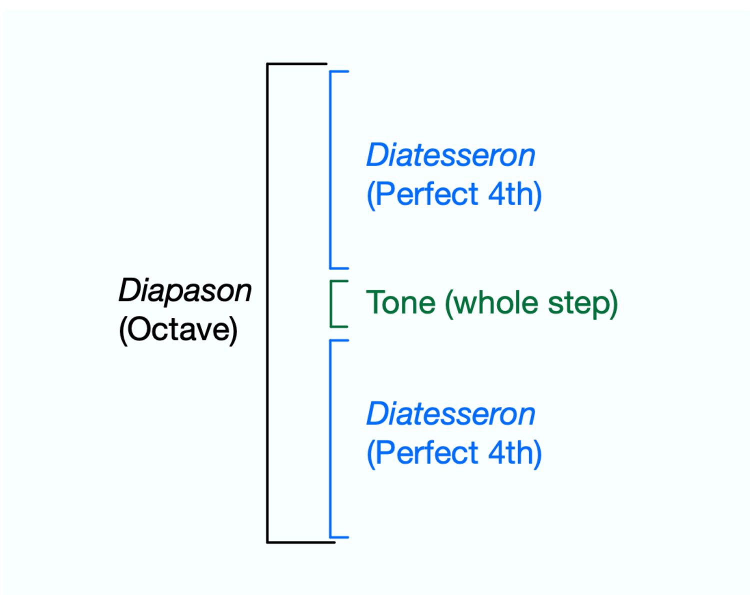
The genus is said to have dictated the character of a given tetrachord, similar to how today, the major and minor scales are known to convey distinct emotions. The diatonic genus, for instance, contains the most natural-sounding order of intervals, giving it an aura of truthfulness, even godliness. The chromatic and enharmonic genera, on the other hand, sound more artificially manipulated, almost as if they are versions of the diatonic genus that have been tampered with. Pythagoras would never have developed genera, especially like the chromatic and enharmonic ones, because the order of the ratios have no mathematical underpinnings; rather, they convey particular *sounds*, which give them their character. The concept of character in musical sound was indeed a very new one in Aristoxenus's time.

Example 11: Aristoxenus's genera

		enharmonic	soft chromatic	hemiolic chromatic	tonic chromatic	soft diatonic	syntonic diatonic
	Mese						
		2	1⅚	1¾	1½	1¼	1
	Lichanos						
2½ tones		¼	⅓	⅜	½	¾	1
	Parhypate						
		¼	⅓	⅜	½	½	½
	Hypate						

Of course, these genera did not exist in a vacuum: they were used to construct new scales, or *tonoi*. Each *tonos* is the composite of two tetrachords separated by the distance of a single tone, altogether spanning the distance of one octave.

Example 12: Construction of tonoi



From here, theorists mix and match the genera of the tetrachords indefinitely, yielding new *tonoi* and, eventually, modes. But at the risk of cutting the present discussion short, I will move on to the next and final Aristoxenian principle: that music is a skill.

Music is a skill

We think of intellectual thought as if it is a muscle: it can be trained and conditioned, used and tested, and one thought can compete with other thoughts. Aristoxenus's inclusion of musical science in the realm of intellectual thought elevated music to the status of a skill; a person may be skilled or unskilled at using music. Knowledge of certain numbers' harmonious relation to one another is markedly not a skill; rather, it is information, capable of being proved true or false. Understanding of the form and function of different species of the scale, for example, requires practice. When music is understood to be an intellectual matter, it no longer relies on empirical science, but on other academic disciplines, like rhetoric and logic.

The idea that music is a skill foreshadows the infusion of humanism into the Western musical tradition, which took place several hundred years later . The original school of music, the Pythagoreans, attributed music's functionality to the gods, removing the humanness of the music from the practice. Calling music a skill thus removes the *godliness* from the practice, instead putting the impetus on people. Because these people were scientifically minded individuals, this status of music launched them into something of a competitive frenzy. This sense of competition among theorists opened the floodgates to a new age of discussion of musical practice. I will explore that new age in the next chapter. But before I enter the next chapter, I return to my guiding question: how has the scientific realm contributed to the current state of music theory?

Conclusion

The scientific realm has made foundational contributions to current music theory. These contributions belong in two categories: rudiments of music theory, and appeal to the human mind.

Rudiments of Music Theory

2. *Conceptualization of pitch*: Fétis[40] describes tonality as a sensibility to the relationships between musical sounds. The ability to acutely perceive musical sounds is dependent on a structured, systematic conceptualization of pitch, which came to fruition with the advent of the scientific realm in Ancient Greece. This system is owed to Pythagoras for studying the mathematical relationships between superparticular ratios, and to the Pythagorean school for continuing his scholarship.
3. *Organizing principles*: In addition to the fundamental intervals of the octave, fifth, and fourth, the scientific realm also gave way to several organizing principles, including the employment of non-mathematical intervals, scales (*tonoi*), and sub-parts of scales (*genera*). The Aristoxenian principle, "musical systems are variable," has rung true throughout the history of Western music, yielding not only different scales, but different methods of establishing harmony, compositional models, and, of course, tuning systems.
4. *Tuning and modulation*: Musical systems are variable, and no system is a universal principle. How, then, could Pythagoras's tuning system, a fixed designation of pitches based on a

[40] For more on Fétis and his theory of tonality, see the conclusion section, especially pages 86–8.

mathematically pure ratio, have universal usage? It does not. Recall that Pythagorean tuning is based on the fifth, or 3:2, yielding a system of perfect fifths and imperfect means. Ptolemy suggests that instead of deriving all pitches from the fifth, all pitches should be derived from different superparticular ratios, a system that came to be called "just intonation." Because of their preference for superparticular ratios, theorists like Ptolemy prefer the major third to have a ratio of 5:4 (instead of the Pythagorean 81:64), which is closer to the modern-day well-tempered major third than the Pythagorean ratio. New developments in tuning systems, such as the establishment of just intonation, allow for modulation between key areas, a critical element of music theory. (It should be noted, though, that the general concern for tuning and modulation was largely lost in the Middle Ages. Since chant was the main form of musical practice, there was simply less of a need for a system that allows for modulation.)

Appeal to the Human Mind

1. *Metaphysical rhetoric*: A guiding principle of the scientific realm is that science alone cannot explain music. This is known to be true from Aristoxenus's discussion of the non-mathematical measurable aspects of music, and from Pythagoras's fascination with music's harmonious *reflection* in numbers (as opposed to its *reliance* on numbers). These ideas pave the path for the metaphysical science of tonality, which Fétis says exists in the human mind.[41] Without the Greeks' discussion of metaphysical musical ideas, the concept of tonality might not have been discovered.

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[41] See the conclusion section, especially pages 86–8.

2. *Value of human experience*: Music is not about the *harmoniai* that enable it, or even the mathematical underpinnings that explain it. Rather, it is about the people who interact with it and what they experience when they do. This idea was realized by Aristoxenus, who taught that music is an intellectual matter and a skill which is variable from person to person. As the Middle Ages approached, the role of humanism in music became increasingly prevalent.

The rudiments of music theory and music's appeal to the human mind are the exponents of the scientific realm of Western music theory. This realm did *not* cease to exist after the fall of the Ancient Greek empire in 146 BCE; in fact, most measurable aspects of present-day Western music can be traced back to the teachings of Pythagoras, Aristoxenus, Cleonides, Nicomachus, Plato, Ptolemy, and Aristides Quintilianus. It is possible that the Greek musical tradition could have died out if no one had revived it, but fortunately, Boethius translated much of the aforementioned authors' writings from Greek to Latin, permeating the "modern" tradition of music theory. Because of this, the scientific realm is alive and well, even today.

But Boethius's teachings and translations were not met without resistance. In addition to translating the scholarship, he also had to convince an entire population that music could be systematically theorized. His target audience, mostly comprised of religious practitioners and followers, was neither scientifically-minded nor receptive to the Greek musical tradition. To teach them how to use music, he had to use a different pedagogy, effectively casting Western music theory into a new realm. In Chapter 2, I will discuss this new sector, which I call the ritual realm.

Chapter 2: The Ritual Realm

In Chapter 1, I discussed scientific music theory and its two primary schools of thought: Pythagorean and Aristoxenian. I interpreted the implications of the Pythagorean school's teachings, which deal with music in the abstract, and I fleshed out the Aristoxenian school's extrapolation of Pythagoras's material and their new stance on musical usage. I also explored some of the contributions that that scientific realm has made to progressive musical thought, including rudiments of music theory and appeal to the human mind. The first chapter's main focus was on the scientific realm's search for cause and effect in musical sound, in both theoretical and practical terms. In this chapter, I shift my focus to an adjacent realm of Western music theory that asks an entirely different question about music. The ritual realm of Western music theory is the sector that grapples with the inclusion of humanism in the practice of music. If the scientific realm's goal is to find information about music's cause and effect, then the ritual realm's critical question is, "Who is a musician?"

This question is particularly pertinent because, until the aftermath of the Aristoxenian school,[42] musical thought concerned rather abstract ideas, and as such, music was almost universally considered to be of the sciences. It was a pillar of the Greek quadrivium, putting it on the same technical level as arithmetic, geometry, and astronomy. Music was unobjectionably a science, and so the idea that one could *use* music for purposes other than measuring sound—such as for singing or chanting—was of secondary concern until around the Middle Ages.

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[42] See Chapter 1 for more on the Aristoxenian principles that influenced the ritual realm, especially pages 22–33.

Unlike the scientific realm, which aims to explain how music works, the ritual realm says very little in the way of how musical phenomena actually function. The ritual realm focuses on *who* uses music, and more importantly, what the practitioner's reason is for using music. This issue may seem frivolous compared to scientific music theory; why should it matter who uses music? The scientific realm determined that musical sound exists in nature; should it not work the same for each person who uses it? Why should these gatekeepers of music be given their own realm of theory?

The answer is that the advent of humanism proliferated the Western musical tradition, which progressively affected the dynamic between people[43] and music, advancing and maturing the actual practice of music. During Greek antiquity, discussions on musical thought took place in the academy, and only the established scholars were considered to wield musical authority. After Aristoxenus, however, the discourse on musical thought began to leave the academic establishment and spread it into the public, reaching churches, traveling entertainers, vocational music educators, and even non-musicians, whose interactions with music were made possible by their religious practices. A fundamental shift in the status of music took place around the beginning of the Middle Ages, removing the sole power of musical authority from the elite and delivering it to people of lower status. In short, music's ritualization in Europe made it *accessible*.

In this chapter, I will examine four different approaches to the question of "Who is a musician?" as explored by ten medieval musical authorities: Anicius Manlius Severinus Boethius, Hucbald, Aurelian of Réôme, Augustine of Hippo, Marcus Tullius Cicero, Martianus Capella,

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[43] Again, the people in question are Europeans and anyone influenced by the tradition of Western music.

Regino of Prüm, Flavius Magnus Aurelius Cassiodorus, Isidore of Seville, and Hildegard of Bingen. The first of these groups is the "adjudicators," who posit that a musician is someone who can judge what he hears. I will then explore two approaches that are radically different from the first: one that values academic merit, and another that values a Christian musical upbringing. Finally, I will discuss the infusion of humanism into the Western musical tradition, an approach that highlights *who* the practitioner is, not just what they are. Finally, in the summary, I will explain how advances in the ritual and scientific realms enabled the flourishing of advanced musical composition in the Renaissance.

Adjudicators

According to Boethius, Aurelian, and Hucbald, a musician is an adjudicator, or a person who judges what he hears with a keen ear of musical reasoning. In the wake of the Greek musical tradition, the concept of music was often too vast to understand. It also took on a different form depending on who taught it: Pythagoras taught about the music that results from movement in the cosmos, while Aristoxenus taught about the construction of *tonoi* for practical usage. To many, these are not the same "music." How, then, should someone be able to discuss humanism in music without a basic, unified understanding of what music is? In his most famous teaching, *De Institutione Musica*, Boethius tries to systematically solve this problem by separating music into three levels: *musica mundana* (cosmic music), *musica humana* (human music), and *musica instrumentalis* (instrumental music).[44]

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[44] Anicius Boethius, *Fundamentals of Music: Anicius Manlius Severinus Boethius*, ed. Claude V. Palisca, ed. Calvin M. Bower (New Haven: Yale University Press, 1989).

Musica mundana, or cosmic music, is the music of the spheres with which Pythagoras was enamored. This level is largely associated with the harmony of bodies in motion, which is theoretically both a musical phenomenon and a physical one. In his discussion of *musica mundana*, Boethius cites the harmony of the heavenly spheres, the concord of the natural elements, and the harmony of the seasons as examples of effects of cosmic music.[45] Aurelian of Réôme (840–? CE), a Frankish writer and an avid follower of Boethius's teachings, elaborates on this notion of natural harmony in his treatise, *Musica Disciplina*:

> *Each season is such that it either brings forth its own fruit or helps the others to bring forth theirs, just as on the low strings of the cithara, there is a limit that prevents the lowness from descending into inaudibility.*[46]

Tasked with transmitting the Greek musical tradition into his own time, Boethius was required to write at length about *musica mundana*. However, it is not his primary focus by any means. Prior to the Middle Ages, little to no repertoire was available, mainly because there was no system of notation to record the music, and, prior to the advent of Christianity, there was a societal disconnect between performed and studied music. As such, theorists before Boethius's time tended not to focus on existing music. Rather, they focused on the science of musical thought, establishing the scientific realm. The Aristoxenian school put music on the level of the intellectual, making it something that the human mind, as well as ear, interacts with. But Boethius had an ear for both sacred and secular music, since both traditions had already been

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[45] Bower, *The transmission of ancient music theory into the Middle Ages*, 146.

[46] Aurelian of Réôme, *The Discipline of Music [Musica Disciplina],* tr. Joseph Ponte (Colorado Springs: Colorado College Music Press, 1968), 10.

proliferated by his time. As a result, Boethius was far more concerned with the human experience of music, which he calls *musica humana*.

Musica humana, or human music, is the middle tier of Boethius's threefold teaching. Any human process involving listening to, understanding, or judging musical sound fits into this category. Aurelian teaches that it "binds the soul to the body" by enabling the human body to process music. For example, a person who hears the sound of their own heart beating and feels the rhythmic pulsations interacts with *musica humana*. The same is true of someone who creates tension in their voice, enabling intervallic singing. Without question, the experience of hearing music belongs under the canopy of human music.

Finally, the lowest tier of Boethius's division is *musica instrumentalis*, or instrumental music. This involves any musical sound that is produced via artificial musical instruments. While they are not natural in the same sense as *musica mundana* and *humana*, their physical mechanisms do work by natural processes. Aurelian explains that there are three kinds of natural processes of instrumental sound: harmonic, organic, and rhythmic manipulation.[47] Harmonic manipulation involves the human voice; organic manipulation involves blowing air, creating sinusoidal vibrations similar to those of strings and voices; and rhythmic manipulation involves striking strings or percussive surfaces.

How does this answer my guiding question, "Who is a musician?" Boethius makes a major contribution to this question by distinguishing between what is and what is not human-involved music. Large-scale issues like planetary movement and small-scale issues like manipula-

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[47] Aurelian, *Musica Disciplina,* 12–13. While Aurelian does not use the term "manipulation" to refer to the functions of *musica instrumentalis*, I believe that the word is a fair interpretation of his teachings.

tion of air molecules are decidedly separate from the human experience of music. Listening, understanding, and judging music, Boethius says, can only occur in people, not nature. As such, Boethius only focuses on *musica humana* in his discussion the experience of music. This marks an important shift in the history of musical thought: the focus of the Greek musical tradition centered around *musica mundana*, and the opposition, led by Aristoxenus, was in the minority. But through Boethius's trusted account on music, he grants Aristoxenus a posthumous victory.

It would not be sufficient to say that a practitioner of "human music" fits Boethius's definition of a musician. He says that *musica humana* entails three musical abilities: listening, understanding, and judging. For the benefit of his theory, he repurposes the terms "harmonics," "rhythmics," and "metrics." Within the scope of human music, rhythmics refers to the ability to listen to music and mentally parse its rhythm, almost in a syntactic sense. Harmonics relates to understanding music, following the Aristoxenian principle that music is an intellectual matter. Finally, metrics entails the ability to analyze, judge, and constructively discuss music. Listening (rhythmics), understanding (harmonics), and judging (metrics) are all critical aspects of *musica humana*.

However, this is not Boethius's answer to my guiding question. While he values the abilities of listening and understanding, he holds that a musician is someone who can judge what he hears. Boethius calls anyone who can listen and understand rhythm an "instrumentalist," while someone who can understand melody and harmony is a "composer." Above both of these are the "adjudicators," who can judge musical sound. An instrumentalist may be able to judge rhythm, and a composer may be able to judge melody and harmony, but only an adjudicator can judge all of them. To Boethius, *this* is exactly what a musician is: an adjudicator of melody, harmony, and rhythm. Aurelian, differentiating between musicians and singers, crystalizes Boethius's idea in a single phrase: *"It is greater to know what someone does than to do what someone knows."*[48]

Hucbald (850–930 CE), another Frankish theorist who lived around the same time as Aurelian and was also deeply influenced by Boethius's teachings, further elaborates on the abilities that a musician should possess. In order to be a qualified instrumentalist and composer, the musician must be able to measure sound and differentiate between high and low pitches. As discussed in Chapter 1, measurement is a quantitative process, while differentiation is qualitative. Measuring intervals is a matter of knowing, while differentiating intervals is a matter of judging. Finally, Hucbald notes that a musician should also possess the keen understanding of a composer: they should know how musical tones are best combined to formulate melodies.

In summary, Boethius, Aurelian, and Hucbald believe that a musician is an adjudicator of melody, harmony, and rhythm. This has significant implications: it means that the entire Pythagorean school, who posit that music is about knowing, is not a school of musicians. It also means that anyone who sings, plays, or composes without thoroughly seeking to understand their own music and judge others' music is not a musician. Then who is? Anyone who can listen, understand, and judge.

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[48] Aurelian, *Musica Disciplina,* 19.

High-Minded Christian Scholars

According to Augustine of Hippo (354–430 CE), a musician is a high-minded Christian scholar.[49] Each of the three parts in that phrase—“high-minded Christian scholar” —is attributable to a single person: the “high-minded” aspect is owed to Pythagoras, “scholar” is owed to Plato, and “Christian” to St. Augustine himself. A scholar in his own right, he famously aligned himself with two longstanding schools of thought in different disciplines. For the discipline of philosophy, he agreed with the Platonic school, and for music, he identified as a Pythagorean.[50] St. Augustine’s archetype for the standard musician was thus informed by elements from Pythagoras’s musical teachings and Plato’s philosophical teachings. In a way, the infusion of Platonic principles into Pythagorean mathematical ideas is representative of the Aristoxenian tradition of musical philosophy, a school that renders music an intellectual discipline.

To elucidate St. Augustine’s stance on the question, “Who is a musician?” I will step back and examine the works of two scholars who may have influenced his writings. First, I will look at Cicero, who represents the Platonic and Pythagorean schools of thought in St. Augustine’s writing. Then, I will review the writings of Martianus Capella, St. Augustine’s contemporary. Finally, I will return to the notion of “high-minded Christian scholars” to crystalize St. Augustine’s historic stance on musicianship.

In his treatise, *De re publica*, Cicero (106–43 BCE) tells a parable about the *harmoniai*, the cosmological bodies of which music was believed to be a reflection. The account, which he

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[49] This phrase, which I repeatedly use, is written verbatim in Bower, *The transmission*, 141.

[50] Ibid.

calls *Somnium Scipionis* ("The Dream of Scipio"), describes the soul ascending to the cosmic level of the *harmoniai*, observing the concord of celestial rotations. In the story, the character Scipio Aemilianus (who is largely believed to be Cicero himself) dreams that he sees the universe from up above, observing the eight rotating spheres that comprise the universe (as understood by the Greeks and Romans): the Moon, Mercury, Venus, Mars, Jupiter, Saturn, Earth, and the heavens, which he believes to be God. He hears a loud, consonant sound emerging from the spheres, which he understands to be *musica universalis*.[51]

To Cicero, the key to the search for musical meaning is the soul. The soul can be led toward or away from certain truths, and the natural order of the universe dictates those truths. When the soul interacts with them, it may hear the sounds of *musica universalis*, leading to the soul's knowledge of its own immortality and, ultimately, knowledge of God.

This parable, which informs Cicero's stance on who musicians are, synthesizes Platonic philosophy and Pythagorean science. Plato's teachings focus on the soul's search for truth, while Pythagoras's teachings focus on how those truths are represented in numbers. Cicero tells that only souls who search for truth, as well as people who can mathematically imitate the sounds of the heavenly order in playing, singing, and composing, can hear those celestial tones. To Cicero, that is who a musician is: someone who searches for truth and imitates that truth with musical ratios.

Martianus Capella (360–428 CE) represents the infusion of Aristoxenian principles into the new Pythagorean-Platonic tradition that Cicero spearheaded. His writings play an important

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[51] Ibid., 140.

and highly under-appreciated role in Western music's history, which is the reinstatement of music as intellect.

Recall that one of Aristoxenus's fundamental beliefs was that music is a skill, an intellectual capacity for sonic awareness and measurement. Cicero's account, which deeply influenced Augustine's writings, portrays music in a highly empirical light, referring to music as "knowledge of certain truths." This evokes ancient Pythagorean tropes, presenting a problem for the status of music: if music only requires certain *knowledge*, then it is not a skill or an intellectual matter. In the early phases of the medieval Roman Empire, music's value was indeed in its facts. Since it was a staple of the quadrivium, young scholars sought to master its facts and figures, so as to be recognized as orators. But this superficial investment in music and its sub-disciplines, such as harmonics and rhythmics, did not meet the intellectual standards laid out by Aristoxenus. As such, the academic tradition of musical study faced significant drawback, losing some of its value as an intellectual matter as it began to shift into an empirical science for the orators to use as they please.[52]

Although Cicero's account introduced this conceptual clash, he actually ultimately helped advance, rather than impede, progress in musical thought. He did this by marking the knowledge in his parable as "divine," rendering it beyond the scope of worldly empirical truths. Even though Cicero described "divine knowledge" in his parable, it may be better understood as "divine *intellect*." To refine the usage of the term "divine," Capella told an alternative parable that synthesized the intellectual and religious traditions into a single comprehensive narrative.

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[52] Ibid., 137.

Capella's story was called *De nuptiis Philologiae et Mercurii*, meaning "On the Marriage of Philology and Mercury." As the title suggests, the allegory tells the story of a wedding between two concepts: Mercury, who represents divine intellect, and Philology, who represents human intellect. In the parable, Mercury is the groom, marking divine intellect as masculine, while Philology is the bride, marking human intellect as feminine. This gendered contrast shows how human and divine intellect are not necessarily *opposites* per se, but they have contrasting characteristics. However, despite their differences, they are seamlessly brought together through the divinely and mundanely intellectual matter of music, the only academic discipline that fuses knowledge of numbers with understanding of the soul. At the wedding, guests offer the bride and groom the gifts of the liberal arts, each representing a different path toward the divine. In short, Martianus Capella posited that music is the mediator between human intellect and divine intellect.

Now that I have reviewed two of St. Augustine's major influences, I return to his answer to the question, "Who is a musician?" His treatise, *De Musica*, synthesized the background of Cicero and Martianus Capella by supporting two major ideas about the usage of music:

1. Music should be used to distract the mind from the mundane and from worldly matters. From Cicero, St. Augustine learned about the role of *musica universalis* in the human mind, and from Martianus Capella, he learned that music forms the connection between human and divine intellect. As such, part of St. Augustine's definition of a musician includes the capability for "high-mindedness," or the skill to contemplate the more-than-human.

2. Music, and other secular topics, should be integrated into Christian education.[53] This was a highly progressive stance, since music was largely considered to be a science, and Christian education tended to stray from secular learning. But St. Augustine, through his treatise, communicated the new scholarship on music, explaining that it is indeed an intellectual and even spiritual topic that should be studied by every Christian.

In the centuries to follow, both *musica activa* and *musica speculativa* were taught in the standard classroom.[54] St. Augustine's approach to musicianship exemplifies the popular medieval notion that study, divine inspiration, and music are vitally interconnected. As such, according to St. Augustine, a musician is a high-minded Christian scholar.

Practitioners of Sacred Music

According to Regino of Prüm, Flavius Magnus Aurelius Cassiodorus, and Isidore of Seville, a musician is a practitioner of sacred music. This approach has two sides to it: Regino's approach, which is non-humanist, and Cassiodorus and Isidore's, which is pre-humanist.

Music theory of the 9th century was characterized by a stark dichotomy. Two main schools of thought existed in the late Middle Ages, one that followed the teachings of the Greeks as elucidated by Boethius, and another that focused on the practice of sacred music and chant, often called *cantus* theory. Because of this rift, much of the terms that theorists used at this time were confused with each other. For example, the Greeks called their scales *tonoi*, or tones, but

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[53] Bower, *The transmission*, 141.

[54] Andrew Hicks, '"Musica Speculativa' the Cambridge Commentary on Martianus Capella's 'De Nuptiis,'" *The Journal of Latin 18* (2008): 292–305.

Boethius suggested calling them *modi*, or modes.[55] The 9th century schools of music theory were at odds with each other, seemingly refusing to communicate, impeding the discussion of what qualifies someone as a musician.

The first recorded link between these two schools came about in Regino's treatise, *Epistola de harmonica institutione*. In it, Regino uses Boethian ideas to discuss ritual music in order to bridge the two. The most noteworthy teaching in the treatise concerns the definition of sacred music, in which Regino divides all music-making into two categories: artificial and natural music. He prescribes the following profiles to each type:

- *Natural music*, or sacred music, serves the purpose of praising God. It is only to be practiced by certified monks and priests who have been trained in the Christian musical tradition outlined by Augustine of Hippo. All natural music is created with the human voice (harmonic manipulation), and not with instruments (organic and rhythmic manipulation). Repertoire is to be exclusively in Latin and must be directly quoted from the Bible. The practice of natural music is *not* performance or art, but rather structured praise. Most of the music created in the Middle Ages fits under this label.[56]
- *Artificial music*, or secular music, is any practice of music that fails to satisfy all of the requirements of natural music. Regino considers any music created with instruments (organic and rhythmic manipulation) to be nonnatural—even though the act of playing an instrument involves natural processes. He also rules out any music whose text is not directly taken from

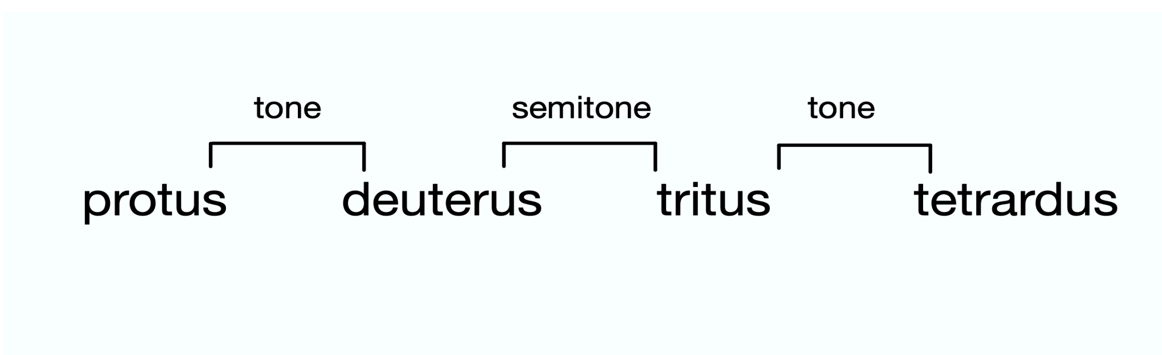
[55] Charles M. Atkinson, "Hucbald of St. Amand and Regino of Prüm," in *The critical nexus tone-system, mode, and notation in early medieval music* (Oxford: Oxford University Press, 2015), 169–70.

[56] Bower, *The transmission*, 152–3.

the Bible, as well as music with text in any vernacular language, namely French or Italian. For example, Regino would consider songs about drinking, women, and parties to be artificial. These songs were not quite understood to be art just yet, but they were certainly a form of entertainment.[57]

Needless to say, Regino believes that a musician is someone who practices natural music, not artificial music. He acknowledges that artificial music is built on the same *harmoniai* as its natural counterpart, but he does not believe that artificial and natural music are created equal. To illustrate this notion, he refers to Greek teachings. In *Epistola de harmonica institutione*, Regino teaches that the modes used for sacred (natural) music are inherently purer than those of secular (artificial music). Chants generally use only four principal notes (named *protus*, *deuterus*, *tritus*, and *tetradus*, as in the figure below), while secular music uses five tones and two semitones. The mode of sacred music is similar to the contemporary Dorian scale (Example 1), while secular music's mode is similar to major.

Example 1: Spacing of the principle tones in "natural music"



This modal construction may seem limiting: how could monks produce multiple chants with only four notes? Hucbald explains in his treatise *De harmonica institutione* that every mode

57 Ibid.

has a *plagal* variety. In this context, the term "plagal" indicates that a mode is expanded upward by a fifth and downward by a fourth. Regino describes these extensions as notes "flowing"[58] from the four principle tones, just as water does from a fountain, revealing the natural order of notes.

In short, Regino teaches that musicianship belongs to people who use music for its "intended" purpose of praising God. Others who use music in an artificial manner, such as with instruments or for the sake of non-worship activities, exploit the heavenly order. He could not separate "music" from chant, which both focused the discipline of music theory and restricted its usage. Regino, largely ignoring the humanness of music, approaches musicianship from a non-humanist perspective. This leaves no room for the musician to explore what the music means to them. Two theorists' stories expand on Regino's idea while adding pre-humanist elements to musicianship.

Cassiodorus and Isidore were the exponents of St. Augustine's approach. They exemplified St. Augustine's second principle, which was that music and secular learning should be integral parts of a Christian upbringing and education. Each in their own writing, the two scholars published teachings relating to music's role in the practice of Christianity, as opposed to Christianity's role in the practice of music.

Cassiodorus had planned to open a Christian university in Rome, though he never saw it come to fruition. Later in his life, instead of continuing to preach strictly Christian ideas, he published a two-volume encyclopedia of sacred and secular teachings, aptly titled *Introduction to*

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[58] Bower, *The transmission*, 153.

Divine and Human Readings. In it, he discussed the seven liberal arts (the Greek trivium and quadrivium) and their significance in the Christian tradition of learning. The ideas he presented in his encyclopedia were not original, but that was not important. What mattered was that Cassiodorus, a venerated religious figure, published secular teachings in the name of the Christian tradition, promoting St. Augustine's ideas about secular learning. Isidore, a figure of similar stature, published his *Etymologies*, in which he also discussed the treatment of the liberal arts in the Christian tradition. The two works differed in their treatment of the discipline of music: Cassiodorus placed music between arithmetic and geometry, while Isidore placed it between geometry and astronomy. In doing so, Isidore promoted the idea that musicianship is a high-level skill, indicating that one must be skilled enough in such disciplines as arithmetic and geometry in order to be a certified practitioner of sacred music.

Perhaps more significant than their academic writings were Cassiodorus and Isidore's experiences of music. The two were known to have been divinely inspired by the Christian practice of singing, particularly the singing of liturgical psalms. In their writings, they made frequent reference to the fact that singing is mentioned in the Bible, rendering it a holy practice and an integral element of worship. By including their own personal experiences of singing and spirituality in their writings, Cassiodorus and Isidore's writings were pre-humanist: they shifted the focus of musical practice away from God and toward the people that interacted with it.

In summary, Regino, Cassiodorus, and Isidore's answer to the question "Who is a musician?" is: a practitioner of scared music. To Regino, practicing sacred music served the purpose of distinguishing the holy from the mundane, but Cassiodorus and Isidore's teachings showed how musicianship can bring the secular world into the realm of the sacred.

Humanists

Thus far, the three models of musicianship described are restrictive—that is, they take reductionist approaches, limiting the concept of musicianship to a select few attributes. The "adjudicators" group specifies that instrumentalists and composers are decidedly not musicians, but rather mere practitioners; "high-minded Christian scholars" exclude anyone who is does not marvel at the cosmos, does not identify as a Christian, and does not immerse themselves in secular academic study; and "practitioners of sacred music" require an entire upbringing of religious observance and several years of church attendance, and excludes anyone whose definition of music includes secular music (i.e. not chant). Even the language these philosophers use, like Cicero's "*Only souls who search for truth*,"[59] allow minimal room for deviation from the norm. These attitudes had counterintuitive effects, causing blockages in the flow of music during the Middle Ages: instead of spreading the practice of music in an inclusive manner, as Christian scholars aimed to do, musical authorities ended up limiting its scope to experts, traditionalists, and religious leaders. In a way, the Western tradition of music became over-ritualized in the Middle Ages.

As I have illustrated, progressive thought was the backbone of Western music theory's development. Closed-mindedness toward musical progress restricted this very development.

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[59] Bower, *The transmission*, 140.

Even though the aforementioned theorists and philosophers in this chapter aimed to advance music theory, their ideas were curbed by their restrictive and reductionist attitudes toward musicianship. This attitude led itself into excess, and the conversation of musicianship was largely put on hold. But something happened in the 12th century that shifted the paradigm, and it may be explained by a teaching from Aurelian: "*In the music of the spheres, nothing can be excessive and destroy the other by its own excess."*[60]

Music is designed by its very nature to be devoid of excess; so too is music theory. This is why, historically, restrictive musical thought does not hold up against the current of progressive thought. It may have been impossible for the blockage in musical thought in the Middle Ages to end the progress that Aristoxenus started, but he paradigm shifted when an unforeseen nun created a rally cry for humanism in musical practice. This nun was Hildegard von Bingen.

In her time and today, Hildegard von Bingen (1098–1179 CE) has widely been considered to be one of the first women to hold authority in the sciences and other scholarly areas. The German-born polymath was particularly renowned for her work as a healer, writer, mystic, linguist, philosopher, and composer. Hildegard von Bingen, and most subsequent music theorists, adopted a humanistic approach to musicianship by allowing room for creativity and inclusion, a deviation from conventional practice and restrictions, and a far more accessible outlook on musical ownership.

On one hand, Hildegard's advancements in creativity and deviation were mediated by her femaleness, which made it harder for her to take musical risks than it would have been if she

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[60] Aurelian, *Musica Disciplina,* 10.

were a man. On the other hand, gender roles notwithstanding, her contributions paved the path to musical humanism for the Renaissance and beyond.

Hildegard composed seventy-seven new hymns in her lifetime. Medieval hymns were traditionally intended to be kept intact for as long as possible; the very idea of conceiving new hymns was reserved for the highest musical authorities, such as monks and academics, and definitely not nuns. Combatting this, Hildegard's compositions break the conventions of chant laid out by Regino, making room for her own creative profile. Notably, her compositions are more similar to the music after her time than that from her own day or before it. Hildegard was able to distinguish herself as an independent composer without ostentatiously flouting musical conventions of the day. Her hymns conformed to the structure of plainchant, which is characterized by a single melodic line with notes of equal rhythmic value. But she tactfully defied some codified conventions, such as the prescribed range, mode, and origin of text.

Hildegard's hymnody employs remarkably greater range than that of any notable composer before her. Simply compare previous hymnody to hers: medieval hymns generally kept to the suggested single-octave range, so as to retain the overall simplicity and "singability" of the music. Overlooking convention, Hildegard composed with a forward-thinking mind, employing well over the traditional octave in her hymns.[61] For example, her *Victimae paschali laudes* spans the distance of an eleventh, and her *O von angeli* demands the remarkable range of a nineteenth. This kind of experimental composition was beyond the grasp of previous medieval composers; their understanding of the scale had not yet evolved to the magnitude we now know.

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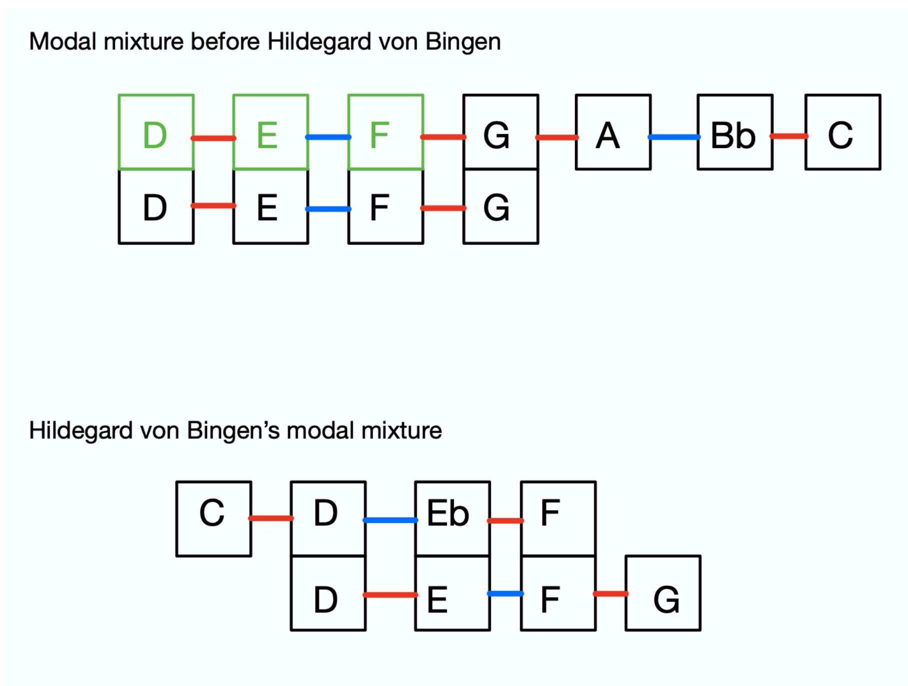
[61] Honey Meconi, *Hildegard of Bingen* (Champaign: University of Illinois Press, 2018), 95.

Hildegard also explored the relatively new ideas of modal mixture and transposition in her works.[62] She was not the first composer to use more than one mode in a given piece: some of her contemporaries would combine certain church modes with their corresponding plagal neighbors. Hildegard's modal mixture looked more like our modern-day practice of the same name, utilizing modes with entirely different spacing and pitches in order to convey more than one character in a given hymn (see Example 2).

Example 2: Illustration of the usage of mixture before Hildegard von Bingen, compared with Hildegard's own style of mixture. Red lines indicate whole steps, blue lines indicate half steps, and green boxes indicate the plagal extension of a mode.



In the figure above, there is a discrepancy between the upper and lower diagrams. In the upper diagram, the red and blue lines (symbolizing whole and half tones, respectively) line up

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62 Ibid., 97.

with each other vertically, even when the upper mode is extended plagally. The lower diagram, which is representative of Hildegard's method of modal mixture, has misaligned whole and half tones. In a way, modal mixture of this kind may seem more erroneous than innovative, but the prolific reception of Hildegard's hymns indicate that her compositions were accepted with excitement, even given their doubled-faced character. This is indicative of Hildegard's adventurous compositional style, which defied the conventions of modal mixture, range, and even text.[63]

Hildegard von Bingen's humanistic outlook on musicianship was pivotal in ensuring that the Western musical tradition not be restricted to the musical elite. Because of her leadership in composing hymns, as well as countless other academic areas, medieval women saw themselves represented in the musical tradition, allowing and encouraging them to partake in the craft.

Conclusion

As I have illustrated in this chapter, musical thought and practice were changing during the Middle Ages. Boethius's transmission of the Greek musical traditions ignited a rapidly spreading culture that would consistently evolve and adapt for centuries, engaging people all across Europe in a complex discourse on musicianship. Boethius initially posited that the musical ideas from the Greek scholars pertained to adjudicators of musical sound, but his successors interpreted the Greek traditions differently. St. Augustine and his contemporaries argued for music's importance in adolescent Christian education, suggesting that educated Christians were the only proper musicians; and Hildegard von Bingen fought for the notion that anyone can be a mu-

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[63] Meconi, *Hildegard of Bingen,* 89.

sician, regardless of affiliation. All across Europe, people discussed and debated musical ideas, beginning the first historic era of widespread music theory.

In the 10th century, a monk named Guido d'Arezzo channeled the nascent vigor of music theory into a system that would allow the practice itself to advance. With the advent of simple, replicable, graphic musical notation, composers were given the tools to write increasingly complex pieces of contrapuntal vocal and instrumental music in the Renaissance. In the aftermath of the ritual and scientific realm's flourishing, a third discrete body of music theory came to fruition, which I call the instructional realm.

Chapter 3: The Instructional Realm

The first two chapters of this project addressed two distinct pedagogical realms of music theory. Chapter 1 focused on the scientific realm, which seeks to identify cause and effect in musical sound. Chapter 2, on the ritual realm, analyzed different medieval approaches to the humanist question, "Who is a musician?" This third chapter once again takes a step back and describes another independent sphere of pedagogical musical thought, which I call the instructional realm. As evident by its name, this realm is concerned with the process and methods of teaching music.

A critical distinction must be addressed: teaching and pedagogy are not equivalent terms. Teaching refers to the *action* of informing or instructing, while pedagogy is the *methodology* thereof. Theorists had been employing different *pedagogies* in their work for centuries, ~~even just~~ as exemplified in their treatises: for example, Plato's *Timaeus* reads as a dialogue between a teacher and his students, while Augustine's *De Musica* more closely resembles a lecture series; Cicero's *De re publica* tells stories that he intends as parables; and Aurelian's *Musica Disciplina* lays out sets of rules, restrictions, and suggestions. No single pedagogy encompasses the entirety of Western musical thought. However, these pedagogies ~~do~~ all serve a singular common purpose, which is to teach, or instruct.

In some sense, music theory can be construed as originally instructional. Whether or not the theorists in the scientific and ritual realms recognized that their works all commonly shared the purpose of teaching, their writings employed relatively novel pedagogies, which were instructional in nature. This is not to say that the scientific and ritual realms serve the *sole* purpose of teaching; rather, each realm's pedagogical outcomes involve teaching in some way or another.

We can identify a few ideological shifts in musical thought which occurred between the Medieval era and the middle of the Renaissance, which made instruction an issue at the forefront of music theory, joining the ranks of issues such as mensuration and tuning. These shifts resulted in the formation of a third discrete realm of music theory, which is the topic of the present discussion. The theorists in this sphere of thought transmitted the European tradition of music to the coming generations. Largely serving to maintain the continuity of Western musical practices, the instructional realm was the source of many innovative educational tools in music, such as graphic five-line notation, solmization, and certain models for composition.

Between the periods of the Middle Ages and the Renaissance in Europe, two fundamental changes took place in the Western tradition of music theory, both of which helped ensure the continuity of the tradition itself. First, music theorists recognized their need for a systematized and codified method of notation, which culminated in the establishment of the five-line musical staff that we use today, as well as a system of solmization. Second, a significant change occurred in the practice of composition, which led to new codified methods of composing polyphonic and contrapuntal music. These two ideological shifts—notation and polyphonic composition—built the framework for the instructional realm.

This sphere illuminates Western music's dual nature in the late Medieval era. On one hand, composers and theorists advanced their musical culture in such a way that their compositions and practices became increasingly complex, counterintuitively introducing more challenges for students than were previously present. Vocal lines became far harder to learn and sing than they had been before, and the composite of voices in late Medieval vocal repertoire required highly advanced knowledge of music in order to be understood. Of course, this complexity was not needless: advanced polyphony "decorated" text, serving an almost ornamental role for the music. On the other hand, however, the same authorities that complicated vocal music, imposed sanctions on the existing system of music education, giving students the necessary cognitive and tangible skills necessary to acquire musical aptitude. In this way, Western music theorists in the late Medieval period effectively moderated their own theoretical advancements in order to make them more accessible to students.

The following section elaborates upon the historical and sociocultural background of the instructional realm's advent. Afterward, I will review the teachings that brought about the ideological shifts in notation and composition, respectively.

Background

What brought these changes about? Logically, there must have been an economic need for notation. The Catholic Church, which controlled a great deal of land and people in Europe, relied heavily on its musicians—but as the music they had to perform became increasingly hard to learn, there simply could not have been enough qualified musicians at any given time. Before the theorists in the ritual realm determined that musicians could be many different kinds of people, only certified practitioners, typically monks, had the prerogative to perform during this period. This limitation made it difficult to maintain the Western musical tradition, necessitating an instructional system that could make more monks, or increase the number of certifiable practitioners of Christian hymnody. To do so, music education had to be targeted at early childhood.[64]

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[64] Russell A. Murray, Jr., Susan Forscher Weiss, and Cynthia J. Cyrus, "Some Introductory Remarks on Musical Pedagogy," in *Music Education in the Middle Ages and the Renaissance*, 1.

As such, music education in the early Middle Ages largely focused on teaching children to read musical score, as well as developing a simple system of notation for them. This system would enable these children to sing chants they had never seen before on first sight, which, in turn, ensured that the Western musical tradition was transmitted properly and efficiently.

However, developing a comprehensive model for teaching children how to sing proved to be challenging. Recall that it took *thousands* of years for humans to cognitively conceptualize pitch,[65] and centuries to realize that they could use the pitch for artistic purposes. While we do have evidence that musical cultures existed well before Greek antiquity, humans only began to perceive pitches as independent functional entities around the time of Pythagoras (570–495 BCE). At this time, the primary discussions about music were *scientific* in nature, so the theories that emerged from this era mostly searched for cause and effect (numeric ratios determining harmonic intervals, construction of *tonoi*, continuous and intervallic voice, etc.). Instruction was not in their purview. But once this scientific school of thought proliferated other parts of Europe, an increasing number of people were inclined to use these *tonoi* in different sociocultural contexts, both sacred and secular. As the Western tradition of music spread into new geographic areas, musicianship became both a skill and a trade, creating an economy for people who could use music.

Notation: A Brief History of the Musical Staff

Any account on the history of musical notation would be incomplete without a discussion of Guido d'Arezzo (10th–11th Century). In the context of his time, Guido was a remarkably suc-

[65] For more on the conceptualization of pitch, see Chapter 1, especially page 34.

cessful music theorist. His historic treatise *Micrologus* was the second-most distributed musical treatise of the Middle Ages, second only to Boethius's *De institutione musica*.[66] His teachings and ideas about music theory and education even received praise from Pope John XIX, who invited Guido d'Arezzo to Rome in 1028 CE. Notably, a common misconception about d'Arezzo is that he invented the musical staff and our modern method of notation. Only half of this claim may be true: he did set the foundation for our present-day graphic musical notation, but he did not invent it. Rather, he *adapted* an existing system to make it easier for young people to learn from it. In other words, Guido made specific changes to the staff principally for instructional purposes.

In the Medieval era, monks were the sole Christian-certified practitioners of music,[67] mostly performing hymns in church services. Teaching and learning these hymns mainly relied on *aural* transmission of the music—that is, by singing, listening, and rehearsing. However, this method of transmission presented several didactic challenges. For one, singers could easily forget some hymns after trying to memorize too many. Also, with the development of double and triple organum (discussed later in this chapter), teaching multiple vocal lines aurally became increasingly difficult to learn and even harder to commit to memory. To help with this, musicians used a method outlined in an anonymously-authored treatise entitled *Musica Enchiriadis*.

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[66] Claude V. Palisca, "Introduction," in *Hucbald, Guido, and John on Music: Three Medieval Treatises* (New Haven: Yale University Press, 1978), 49.

[67] For more on the role of certified practitioners of Christian music, see Chapter 2, pages 49–53.

Musica Enchiriadis suggested guidelines for a neumatic system of notation,[68] meaning a semi-graphic illustration of the relative pitch and duration of sung syllables. This pre-Guidonian staff, often simply called the "*chordae*," featured five horizontal lines as the backdrop for the neumes and text. But before any musical information was to be marked on the *chordae*, the text scribes always made their markings first. This is the most fundamental difference between pre- and post-Guidonian notation: after Guido, the musical pitch designations took precedence over all other markings, including text, rhythm, and meter. Guido was keenly aware of the fact that pitch, not text, was the most challenging aspect of learning to sing. After all, many children in Guido's time learned to read music well before they learned how to read words.[69] Pitches on the *chordae* were designated in accordance with a movable clef, which marked the note C. All hymns were set in church modes, which all contained seven notes with varying whole- and half-step patterns. This caused another learning problem: since the church modes all contained two half-steps in different scalar positions, the young singer could easily forget where they occurred. On top of this, the neumes' rhythmic values were not systematically consistent,[70] rendering a great degree of guesswork from students. Because of these challenges, learning hymns and chants from written notation could have actually been *harder* even than receiving them via aural transmission. Before Guido, the system was not yet tailored to the needs of students.

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[68] Constantin Floros, "Early Slavonic Notations," in *Introduction to Early Medieval Notation*, trans. Neil K. Moran (Warren: Harmonie Park Press, 2000), 87.

[69] Murray, Jr. et al, "Some Introductory Remarks on Musical Pedagogy," 6.

[70] Floros, "Early Slavonic Notations," 88.

Guido, a monk himself, recognized the inherent struggles in the notation system, positing that the existing system actually impeded, rather than aided, music education. To combat these struggles, he piloted new features of notation in his Antiphoner,[71] a collection of chants meant to help young Christian students learn to sing chants and hymns. Two written excerpts survive from the antiphoner, titled *Aliae regulae* and *Regulae rhythmicae*, which are respectively the prologue and introduction to the volume. A noteworthy feature in the Antiphoner's notation was Guido's usage of color as an instructional aid, with yellow signifying C and red signifying F.[72] These pitches were the base notes of his hexachords, the six-note "mini-scales" that Guido used in place of church modes.[73] He preferred hexachords to the modes because they only had one half step each, making it easier for young singers to learn chants they had not seen before (I will return to the discussion of these hexachords in the section on Gaffurius toward the end of this chapter).

According to Guido, musical aptitude was determined by one's ability to train their own senses to perceive correctly and to interpret the transmission with a discerning ear of musical judgement.[74] His beliefs concerning music aligned with Boethius's model of musicianship,[75] suggesting that in order to develop such an ear, he suggested students gain familiarity with existing, well-known pieces of music. For example, he cites *Ut queant laxis* and *Alme rector*, two common Latin chants, and references specific syllables in the chants to give examples of scale

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[71] Claude V. Palisca, "Introduction," in *Hucbald, Guido, and John on Music: Three Medieval Treatises* (New Haven: Yale University Press, 1978), 50.

[72] Ibid.

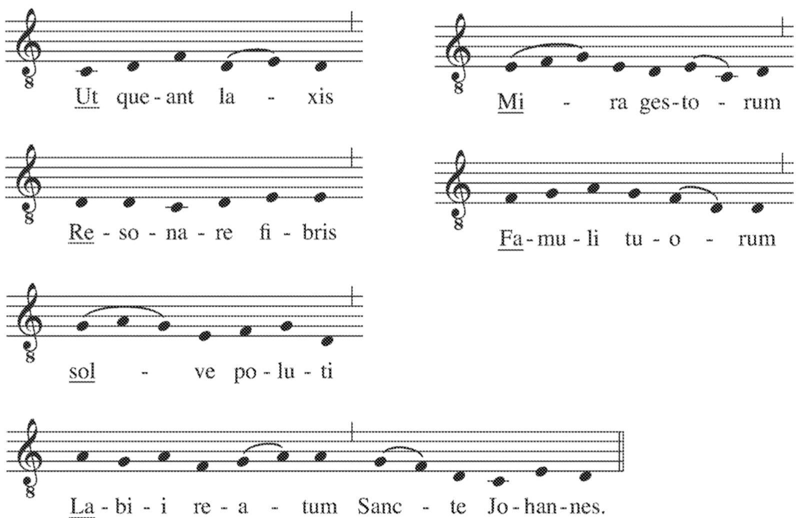
[73] Ibid., 49.

[74] Guido d'Arezzo, "Micrologus," in *Hucbald, Guido, and John on Music*, 58.

[75] For more on Boethius's model of musicianship, see Chapter 2, pages 39–44.

degrees.[76] In *Ut queant laxis,* Guido refers to the note "ut" as the note that is sung on that syllable in that particular chant. This process is illustrated in Example 1 below.

Example 1: Guido d'Arezzo's pitch designation for his system of solmization[77]



This practice, called solmization, helped students obtain "tone-consciousness,"[78] a critical step in being able to sing new chants. Evidence of Guido's writings on solmization only actually appears in *Epistola de ignoto cantu*, a preserved letter that he wrote to Brother Michael of Pomposa.[79] As such, historian do not know much information about how he taught or practiced it, but the letter does distinguish Guido as the inventor of solmization.

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76 Charles M. Atkinson, "Pseudo-Bernelius, Bern of Reichenau, Pseudo-Odo, and Guido D'Arezzo," in *The Critical Nexus: Tone-System, Mode, and Notation in Early Medieval Music* (Oxford: Oxford University Press, 2015), 230-33.

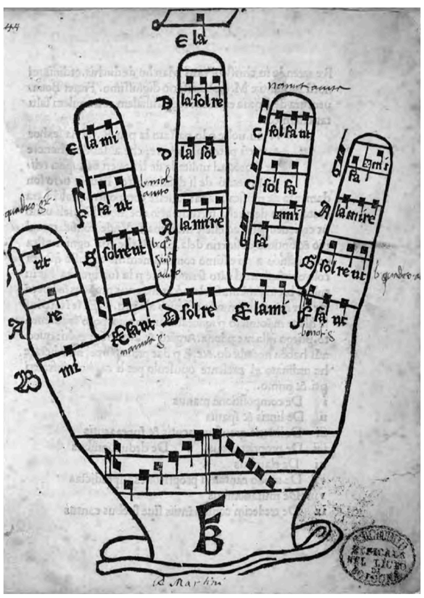
77 Ibid., 231.

78 Dolores Pesce, "Guido D'Arezzo, Ut Queant Laxis, and Musical Understanding," in *Music Education in the Middle Ages and the Renaissance,* 28.

79 Ibid.

Using these chants as reference points, Guido developed another chant-learning system that was emblematic of his didactic nature: the Guidonian hand, diagrammed in Example 2. The Guidonian Hand was a method that used the joints on the hand as markers of notes in relation to each other as the parts of human anatomy do. By establishing this practice, Guido ensured that his students always had their music-learning tools on hand—so to speak. His model of education was not centered around insular scientific practices or elitist policies; rather, he sought to be inclusive, like Hildegard von Bingen.[80] In this way, Guido may be thought of as a humanist.

Example 2: The Guidonian Hand[81]



Between Guido and the Renaissance: from Plainchant to Counterpoint

Guido's contributions to music education allowed for upgrades in the Western system of musical notation, expanding the impact of its usage. Activity in singing rehearsals became better-

[80] For more on Hildegard von Bingen's model of musicianship, see Chapter 2, pages 53–8.

[81] Murray, Jr. et al, *Music Education in the Middle Ages and the Renaissance*, 5.

coordinated, and the musical information on the staff became increasingly involved and informative. Although church music was originally meant to be sung in unison or octaves, the Guidonian staff allowed for a greater degree of musical complexity on the written page. The music that was once called "plainchant" evolved, taking on the new form of "organum."

Organum is best described as chant involving multiple voices in note-against-note harmony. The form features a main voice, called the tenor, which carries the primary melody or chant in a piece. In accompaniment, an additional voice or voices join the tenor to create a larger, more complex sound with which to perform chants. At its advent, there were four varieties of organum:

- *Parallel organum* is the chant style in which a second voice joins the tenor, singing the exact same chant, but transposed up a perfect fifth or down a perfect fourth. The spacing by perfect intervals ensures consistent concord throughout the entirety of the chant, evoking feelings of holiness and divine perfection. (In the conventions of contemporary music, parallel fourths and fifths are considered to be erroneous, since they cause tonal pieces to sound modal.)
- *Oblique organum*, as the name suggests, describes vocal music in two voices, where one voice moves up and down the staff while the other remains static.
- *Mixed organum* includes hymns with both parallel and oblique organum.
- *Free organum* strays from the confines of the previous three styles, allowing for "florid" decoration of noteworthy syllables in the text. Free organum makes use of melisma, which allows for multiple notes per syllable of text.

Organum emerged as a product of the School of Notre Dame (approximately 1160–1250), a group of composers and educators widely credited with shifting the Christian musical tradition from monophonic to polyphonic. The main exponents of the School of Notre Dame were Léonin and Pérotin, two historic composers of sacred vocal music. Léonin (1135–1200 CE) is thought by some historians to have authored the *Magnus Liber Organi*, the "great book of organum," which contains record of the earliest known pieces of organum duplum (two-voice polyphony). Many of the same historians believe that Pérotin (late 12th century CE) revised Léonin's compositions by adding third and fourth voices to the compositions, and added several of his own chants to the repertoire. However, Léonin's and Pérotin's organa differ in one significant way: Léonin's music adhered strictly to the format of organum duplum, while Pérotin's expanded to organum triplum (three voices) and organum quadruplum (four voices).

Pérotin's inclusion of additional voices both enhanced and complicated the organum. While the larger number of parts did allow for more elaborate texture, harmony, and sonority, it likewise warranted more effort on the part of the composer. Multi-part organa were thus categorized into three subtypes:

- *Standard organum quadruplum:* entails three voices singing in polyphonic motion above a single voice singing a drone, a consistent grounding pitch. The top three voices only need to come together rhythmically, harmonically, and melodically (or, in modern terms, cadence) at the end of the piece.

- *Conductus:* involves many vocal parts that mostly adhere to each others' textural patterns. For example, in a piece of organum conductus, if the highest voice were to rise, some of the lower voices may rise as well, while one or two may remain static.
- *Clausula*: like standard organum quadruplum, it also allows voices to move in complex polyphonic motion, but the voices cadence many times throughout the piece. This gives the listener an idea of how sections in a piece are divided over time.

Compositions of these types created a body of works that warranted their own category. This fusion culminated in the establishment of the medieval motet, the most popular form of polyphonic music in both secular and sacred settings. Similar to organum quadruplum, the motet was typically comprised of four voices singing in polyphonic motion, featuring an existing text sung in the tenor part. Some motets even contained two different existing texts—often in entirely different languages—in a style called the double motet. Other varieties included the Franconian motet, which emphasized the performative role of the highest voice by giving it far more melismatic melodies than the lower voices; and the Petronian motet, which expanded the use of melisma in polyphonic vocal music.

The late medieval motet was largely characterized by its employment of isorhythm, or the repetition of a unit of musical information throughout a single piece. The two aspects of isorhythm—*talea* and *color*—foreshadow the development of the musical motif some centuries later. *Talea* refers specifically to rhythmic units, and *color* refers to melodic patterns or pitch collections. Composers had the option to draw inspiration from existing chants, which would inform the isorhythmic units in their pieces. For example, if a composer liked the melody or rhythm of the chant *Ut queant laxis*, they might have written parts for voices that mimic the motion of the melody and the form of the rhythm.

As I pointed out at the beginning of this chapter, these advancements in counterpoint had counterintuitive effects. While Guido's notation and the development of polyphonic vocal music allowed for more intuitive educational methods, the sheer complexity of the new music counteracted the instructional efforts, making music *harder* for students and nonprofessionals. The problem was that instructional theorists such as Guido and the anonymous author of *Musica Enchiriadis* focused almost entirely on the practice of performance, which, while critically important, did not address all or even most of the issues that music students faced.

In the era of the Renaissance, theorists and composers, such as Johannes Tinctoris, Franchinus Gafurius, Gioseffo Zarlino, and Heinrich Glarean directed their musical thought into the art of musical composition. Their theoretical writings and compositions set guidelines and instructional suggestions for the creation of polyphony, culminating in a rich cannon of contrapuntal music.

Composition

The Renaissance in Italy was characterized by a resurgence of Ancient Greek ideas in art, science, literature, and musical thought. This new interest in an old culture began with advancements in visual media, such as painting, sculpture, and architecture, and later spread into the intellectual fields of philosophy and music. For example, t~~he~~ music theorist Heinrich Glarean (1488–1563) wrote about the Aristoxenian principle of multiple transposition, an inherently scientific concept which had been left almost untouched in the music of the Middle Ages.[82] But the Renaissance-era music theorists, who were also mainly composers and educators, faced an entirely different musical culture than their Greek ancestors, who were philosophers and mathematicians. Besides the advancements in music theory, two key cultural developments set these two musical cultures apart. First, the Greeks likely had no system of notation,[83] which was a critically important feature of Renaissance music. And second, the invention of the printing press in the mid-15th century helped rapidly disseminate musical score, spreading it to exponentially more people than ever before. In the Renaissance, music and musical thought did not belong solely to the elite, but to students and amateurs as well.

Tinctoris on the Aristoxenian Principles

Tinctoris (1435–1511), one of the first music theorists to publish and disseminate a treatise on counterpoint, demonstrated that the widespread interest in Ancient Greek teachings sided with Aristoxenus, not Pythagoras. In his 1477 treatise, *The Art of Counterpoint*, he embodied all four Aristoxenian principles, which I discussed at length in Chapter 1.[84] To review two of them:

- *Music can and should be used:* Tinctoris rejected the common understanding of *musica universalis*, the highest level of Boethius's three-tier philosophy of music. In the prologue to his treatise, he explained that most theorists' perspective on *musica universalis* was in-

[82] Heinrich Glarean, *Dodecachordon*, trans. Clement A. Miller (Münster: American Institute of Musicology, 1965), 56–8.

[83] It is possible that the Greeks did have a system of notation that did not survive, but there is little to no evidence to ascertain this claim.

[84] See pages 22–33.

correct. While most others understood it to be the *potential* for musical sound stored in the *harmoniae*, Tinctoris agreed with Aristotle, who viewed *musica universalis* as the actual sound of consonance that emerges from the cosmos. While he was indeed interested in the mathematical background of the music he composed, Tinctoris was far more concerned with the sounds that his compositions and teachings produced. As evidence of this, Tinctoris actually stated in the first book of his treatise that the *diatesseron* (perfect fourth) was *not* a perfect consonance, even though it is a superparticular ratio (4/3).[85] This claim was in direct contradiction with the Pythagorean principle of the musical perfection of superparticular ratios, exemplifying the Aristoxenian notion that the ear should be the musician's primary tool for judgement.

- *Music is a skill:* When music theory treatises began discussing existing repertoire, they mostly addressed monophonic music, often in the form of Gregorian chant. Then, around the time of the School of Notre Dame, the object of study shifted to two-voice organum, mostly in parallel motion, then in more complex patterns (like oblique and florid organum). The transition into four-part, highly decorative counterpoint was met with hesitation simply because it was something of a slippery slope: four-part vocal harmony allowed for so many opportunities for musical discord, which conservative music theorists feared might taint or worsen the new repertoire. To combat this, rather than carefully walking on eggshells to avoid speaking about discord, Tinctoris actually advocated for *embracing* discord as a means of contrasting it with concord.

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[85] G.D. Halsley & Edwin Hewitt, "More on Superparticular Ratios in Music," *The American Mathematical Monthly* 79/10 (1972), 1096.

Although much of his writing concerned how musical sound works, some sections of Tinctoris's treatise on counterpoint were unmistakably instructional. The second book[86] of the treatise, for example, gave actual guidelines and suggestion for how to effectively use discord in contrapuntal composition. Below are eight of these rules:

1. Use discord sparingly.
2. Use discord for the primary purpose of ornamenting the music, not as a central feature of it.
3. Avoid using "false discords" (such as the tritone, diminished octave, and augmented octave).
4. Approach discord in stepwise motion.
5. Discord should resolve to concord by intervals no bigger than thirds.
6. Discordant passing tones should occur only on unaccented beats.
7. Cadences should be led into with discordant suspensions.
8. Cadences are made stronger with discord.

In the third book of the treatise, Tinctoris offers another eight concrete rules for the general practice of composing counterpoint:

1. All pieces of contrapuntal music must begin and end in perfect concord.
2. Imperfect chords may be used in parallel motion, but perfect chords may not.

[86] *The Art of Counterpoint* is divided into four parts. In the prologue, Tinctoris states his beliefs about *musica universalis* and praises recent trends in composition. The first book covers concord, and the second book covers discord. Lastly, the third book of the treatise contains Tinctoris's eight principal rules of counterpoint.

3. When the tenor remains on a single pitch, it is better for the accompanying voices to use oblique motion than to remain static as well.
4. When possible, move in scale-wise motion (i.e., in the pattern of a scale).
5. Cadences should serve to restate the mode of the piece.
6. It is best not to repeat melodic or rhythmic figures more than just a few times each.
7. Consecutive cadences should not be made on the same pitch.
8. Variety is the soul of counterpoint.

Tinctoris's teachings elucidating the steps of the compositional process, inviting more amateur composers to engage in the complex art of counterpoint. His pedagogical approach to teaching counterpoint was able to reach a diverse audience, since it focused on both specific compositional principles ("approach discord in stepwise motion") and large-scale artistic concepts ("variety is the soul of counterpoint"). Like the other theorists discussed in this chapter, Tinctoris made advances in music theory for primarily instructional purposes.

<u>Zarlino and Conservatism</u>

However, not all of Tinctoris's ideas received approval from the musical elite. One of his most noteworthy critics was Gioseffo Zarlino (1517–1590), a theorist who lived roughly one century after Tinctoris. Zarlino was one of the most prominent musical traditionalists of the Renaissance,[87] promoting ancient ideas as the rule of musical law. Because of his conservative outlook, he disagreed with some of Tinctoris's teachings.

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[87] Palisca, "Introduction," in *The Art of Counterpoint (Gioseffo Zarlino): Part Three of* Le Instittutioni Hamoniche*, 1558,* trans. Guy A. Marco & Claude V. Palisca (New Haven: Yale University Press, 1968), xiii.

Tinctoris's highly progressive belief that the perfect fourth was not a true consonance, for example, irked Zarlino.[88] According to Zarlino, the contemporary music theorists held no such authority to reject a perfect consonance. If they were to depend upon the system that their Greek ancestors established, they must adhere to the ancient authorities' judgement calls—including determining what was pure and was not.

This is not to say that Zarlino pitied his own musical culture; on the contrary, he was a prolific scholar of music theory and a widely respected composer of counterpoint during the middle to late Renaissance. His contributions to music theory helped make great strides in composition, especially in regard to the development of the fugue.[89] But he was strikingly critical of his contemporaries in the Florentine Camerata, a group of elite Renaissance musicians, poets, and artists. Zarlino openly rejected the work of many its members, effectively drawing battle lines between artistic progressives and conservatives.

Of course, Zarlino was an extremist in this sense, and his opposition to the new school of musical thought was hardly a popular stance. However, I believe the message of his conservatism is not to be overlooked: he wanted to ensure that the new music theories were properly grounded in issues of the past.

Gaffurius and Modes

Zarlino was not the only Renaissance-era music theorist to look backward into history for instructional purposes. Franchinus Gaffurius, who is widely considered to be Tinctoris's immediate successor, sought to fix a problem with Guido d'Arezzo's hexachords that had never quite

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[88] Gioseffo Zarlino, *The Art of Counterpoint*, 12.

[89] Ibid., 126.

been rectified. While so many of Gaffurius's colleagues invigorated their work with Ancient Greek teachings, Gaffurius noted that there were various musical issues from as recent as the Middle Ages that required scholarly attention. One of Gaffurius's biggest instructional concerns was the ability for students to understand modes—that is, how they are constructed and how they are to be used in composition. As I mentioned earlier, Guido's pedagogical methods used hexachords since their structure was more basic than that of the church modes.

In *Practica Musicae*, the second of his three treatises on music, Gaffurius reviews Guido's system of hexachords before showing how they may be used to understand the church modes.[90] He explained that Guido's hexachords came in various *species*, or formats, just as the Aristoxenian *tonoi*. To demonstrate this, he divided Guido's seven hexachords into three categories: "square," which started on G; "natural" on C; and "round" on F.[91] Each of these hexachords contained one half step, while the church modes all contained two. Understandably, Guido preferred hexachords over modes because they were easier for young students to understand. But Gaffurius offered a comprehensible review of church modes in *Practica Musicae*, increasing the viability of the modes' instructional merit.

Let us recall that the octave species were originally constructed by combining perfect fourths and separating them by a single tone.[92] Gaffurius offered an alternative view, explaining that they would be better understood as species of fourths and fifths in combination. According

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[90] Franchinus Gaffurius, *Practica Musicae*, trans. Clement A. Miller (Münster: American Institute of Musicology, 1968), 42–53.

[91] Ibid., 34–5.

[92] See Chapter 1, Example 12.

to Gaffurius, the perfect fourth had three species, and the perfect fifth had four, as shown in the example below:

Example 3: Gaffurius's species of the fourth and fifth[93]

Fourth Species	**Fifth Species**
(4.1) T S T	(5.1) T S T T
(4.2) S T T	(5.2) S T T T
(4.3) T T S	(5.3) T T T S
	(5.4) T T S T

Gaffurius continued with his explanation of the seven church modes, noting that they were simply compounds of the species above. Each mode is constructed by combining a fourth species with a fifth species.[94] I have summarized Gaffurius explanation in the table below:

[93] "T" and "S" are shorthand for "tone" and "semitone," respectively. In the parentheticals, the first number corresponds with its interval value (fourth or fifth) and the number after the decimal point is the subtype. For example, "5.2" refers to Gaffurius's second species of the fifth.

[94] Gaffurius, *Practica Musicae*, 45.

Example 4: Gaffurius's species of the octave

Octave species	Compound	Name
1	4.1 + 5.1	Aolian
2	4.2 + 5.2	Locrian
3	4.3 + 5.3	Ionian
4	5.1 + 4.1	Dorian
5	5.2 + 4.2	Phrygian
6	5.3 + 4.3	Lydian
7	5.4 + 4.1	Mixolydian

Gaffurius's simplification of the church modes system had a twofold effect. On one hand, it helped students understand the modes' construction, making them better at sight-singing and increasing their tone consciousness. On the other hand, it improved aspiring composers' understanding of modes, allowing them to write more advanced music in a greater variety of modes than before. This cultural shift was emblematic of the instructional realm's behavior: pedagogical advances happen at the same time as compositional advances. When educational music tools develop, so too do the quality and quantity of existing repertoire.

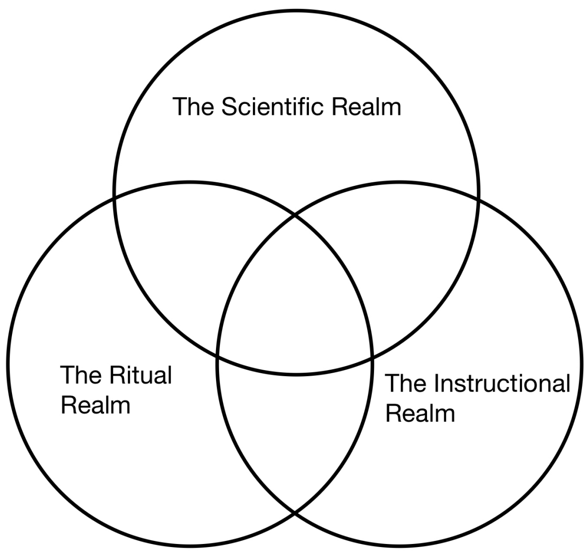
Conclusion

In this chapter, I make a claim that Western music theory's instructional realm developed in Europe between the late Middle Ages and the middle of Renaissance as a result of significant advancements in notation and composition. We may conclude, through the analysis and comparison of the period's primary treatises on harmony, counterpoint, and pedagogy, that these advancements played critical roles in the development and transmission of Western music theory. Guido d'Arezzo's innovations in musical notation and education shifted the dynamic between teacher and student, adding emphasis on instructional aspects of music theory. These instructional advances directly affected the style and complexity of Renaissance music, creating a culture of counterpoint. Wielding their new tools and instructional methods, these composers and theorists were emboldened to push the boundaries of music theory and counterpoint even further.

As I discussed earlier in this chapter, the theorists who wrote the instructional treatises were inspired by Ancient Greek teachings, and their beliefs and values were primarily aligned with the Aristoxenian school of thought. This last point is what I will discuss in the conclusion of my thesis. It is not a coincidence that the instructional realm has obvious crossover with the scientific and ritual realms, which are related to one another as well. How are these different areas of music theory arranged in relation to one another? What do they share, and what sets them apart? In the final pages of this project, I will answer these questions.

Conclusion

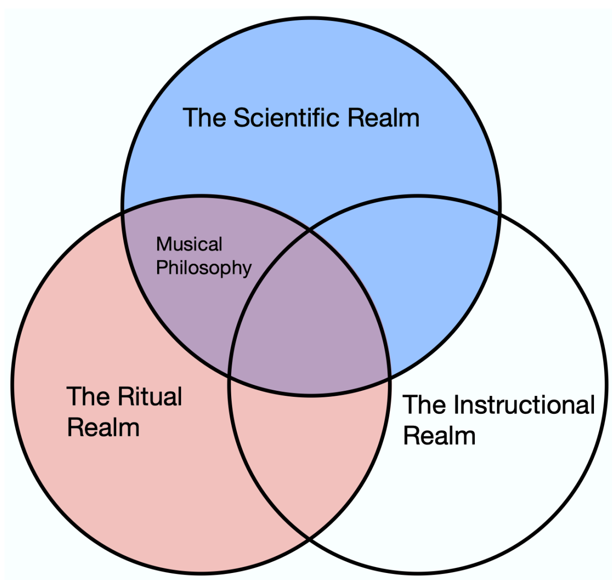
Let me review what I have discussed so far. Each chapter of this project addressed a foundational sector of Western music theory: scientific, ritual, and instructional. Each realm asks its own central question: the scientific realm asks, “What is the cause and effect of musical sound?” The ritual realm asks, “Who is a musician?” And the instructional realm asks, “How should music be taught?” My thesis derives answers to these questions from key historical treatises on music. But a critical question lingers: exactly how are they related to one another? The three realms fit together in a three-way Venn diagram, as illustrated below:



The realms of Western music theory all ask different questions, but the products of their inquiries are not all separate. They all have overlap with one another. In the following sections, I will explore which components of the previous three chapters might fit into those intermediary spaces.

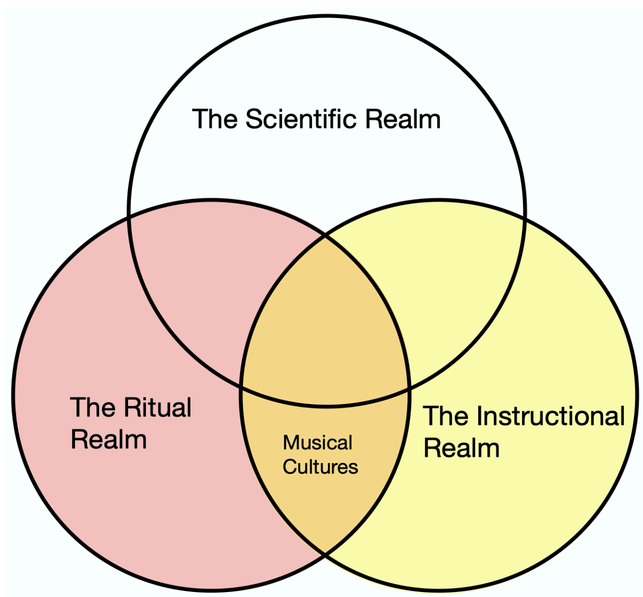
Musical Philosophy

The intersection of the scientific and ritual realms has yielded several distinctly philosophical teachings concerned with music. As I discussed at the end of Chapter 1, one of the scientific realm's main contributions to the development of Western music theory was its attention to the human mind's experience of music. Supplemented by the institutionalized religious practice from the ritual realm, this focus on human experience led many theorists to ask profound questions about music and the soul. Boethius's three-tiered theory of music, for example, belongs in this cross-section because it synthesizes teachings from the scientific realm (e.g. differentiating between harmonics, rhythmics, and metrics) and the ritual realm (considering the human experience of music).



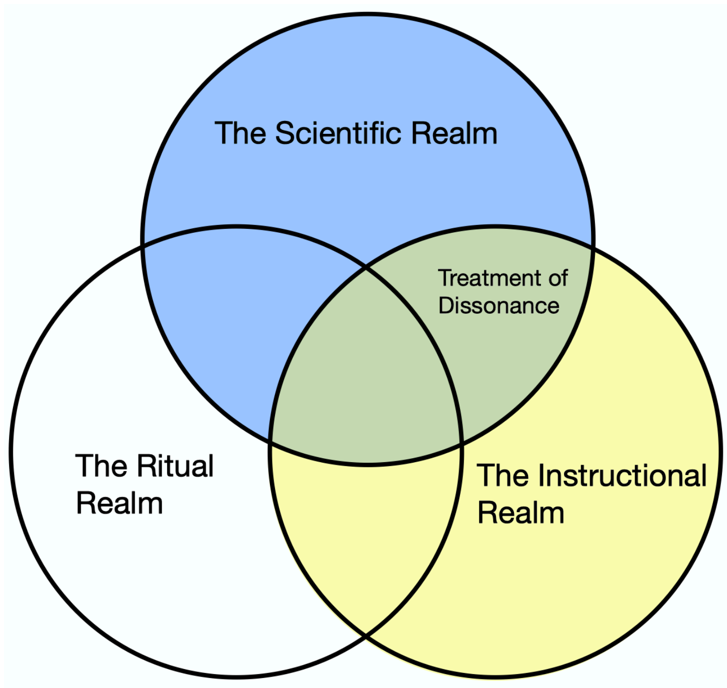
Musical Cultures

Throughout my thesis, I use the term "musical culture" to refer to the particular character of different eras and spaces. For example, the contrast between the music of the Greek Empire and the Catholic church was not so much a difference of musical ability, but a difference of culture. A musical culture is essentially the combination of how one's society teaches music and defines musicianship—or in other words, the cross-section between the ritual and instructional realms. Theorists like Guido d'Arezzo and composers like Léonin and Pérotin fit into this intermediary area in my model because, each in his own way, they all helped develop musical cultures as results of their progressive stances on musical issues.



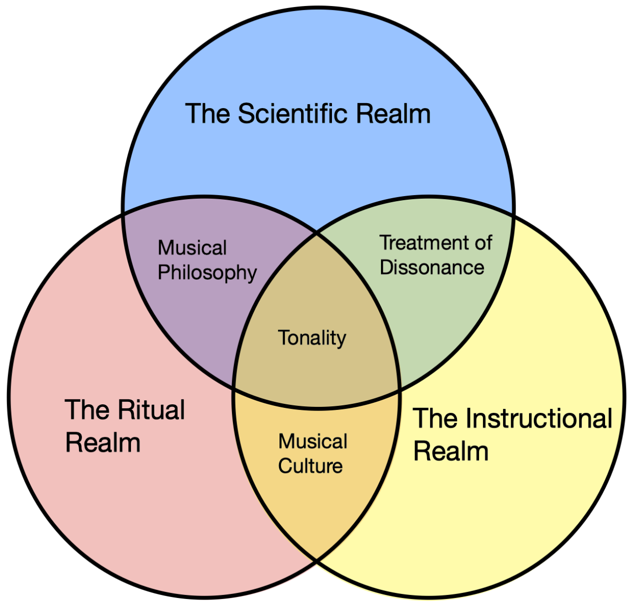
Treatment of Dissonance

For the first several centuries of its development, Western music theory was primarily concerned with the *purity* of musical sound. Pythagoras's discovery of harmonic ratios, for example, was driven by a search for purity of numbers. However, a great number of music theorists in the shared space between the scientific and instructional realms intentionally discuss the usage of dissonance as a compositional tactic. Tinctoris' and Zarlino's theoretical disagreements, for example, began discussions about how dissonance should be contrasted with consonance in counterpoint, suggesting that we may take advantage of numerical imperfections for musical purposes.



The Center: Tonality

By its very nature, the epicenter of scientific, ritual, and instructional musical thought must be an area of study that synthesizes several disciplines—or at least three. For this reason, I would like to suggest that tonality at the center of this model.



Notably, the theory of tonality was not established until as late as the mid-18th century, setting it vastly apart from all other theories of music discussed in this project. Given the chronological difference, it may seem peculiar, even inappropriate, to include the modern topic of tonality in a project on the development of early Western musical thought. However, I feel that the cross-section of all three spheres of musical thought deserves to be considered exceptional in this case. Each of the three realms took centuries to find their footing as separate sectors of musical thought; so too did tonality.

The French and Belgian music theorist and composer François-Joseph Fétis established the practical, theoretical, and logical framework for tonality in 1844 in his treatise, *Traité complet de la théorie et de la pratique de l'harmonie*. Fétis introduced the idea of tonality as a metaphysical principle, almost a more-than-human process, suggesting it existed uniquely in the human mind. He defined tonality as a sensibility to the relationships between musical sounds with a keen ability to logically identify their patterns. His hypothesis that this metaphysical human process governed all of Western music was his best attempt to systematically combine musical science and musical philosophy, seeking to do away with what he saw as the divide between math- and philosophy-governed music theory.

When he proposed the idea that tonality governed the perception of Western music, what was Fétis's goal? What was he trying to do? An initial answer may be gleaned from his historical context.

Fétis's ideas about tonality were foreshadowed by the writings of Jean Philippe Rameau, a mid-18th century composer and theorist of similar stature. Rameau was one of the first major voices of musical thought to use their platform to suggest that the pioneers of music theory (namely the Ancient Greeks) did not understand harmony and melody, since they were too consumed in the mathematics of music, distracting themselves from the sounds they were creating. Ironically, just like in the case of Fétis, Rameau was a well-established mathematician and scientist who was generally unlikely to question conventional science. In his 1750 treatise, *Démonstration du principe de l'harmonie, Servant de base à tout l'art Musical, théorique et pratique*, Rameau aimed to give scientific justification for philosophical ideas in music, virtually revising the Ancient Greek tradition. Rather than dismiss Ancient Greek ideas, which foregrounded math in music theory at its inception, Rameau refined what he saw as their flawed details in order to make a coherent argument about the structure and usage of Western musical sound. For example, Rameau scorned the Pythagoreans for choosing the perfect fifth (*diapente*) as the generator for their *tonoi* because of the tuning issues that it introduced. Rameau suggested that the Greeks should have instead chosen prominent intervals from the harmonic series to determine their scales, because the harmonic series lends itself more to sounds pleasing to the human ear.

Fétis and Rameau's arguments crystalize the point of my thesis quite clearly: in the study of music, no system is a universal principle. There is no single system that can account for all of musical thought. If we let everything we know about music be dictated by one narrow perspective or discipline, we misunderstand the object of our study. Music theory is not purely scientific, ritual, or instructional. It is not simply math, a religious practice, or a trained skill. It is all of these, and more. Fétis and Rameau emphasize that *experience* should always be at the center of music theory, because our perception of music synthesizes all other areas of study.

That is why I offer this model. The spheres of musical thought are separate, but linked. Anyone who studies the history of Western music theory should be aware that the key voices of musical authority had starkly different goals, but the products of their inquiries contribute to the same corpora of work. I hope my model for teaching this history sheds light on the distinctly interdisciplinary nature of the study of music and elucidates how our current state of music theory found its roots.

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