Introduction

It is a rainy Fall morning in Upstate New York and I am scrolling through my friends' social media posts while drinking a cup of freshly brewed tea. There is one post that catches my attention; a high school friend who now lives in the Silicon Valley and works in a tech startup has posted a video of his five-year-old niece. The friend – a former Iranian Mathematical Olympiad bronze medalist with a PhD in STEM from a top US university – is asking his niece to name her favorite mathematician. The girl thinks for a few seconds and then in an impeccable Tehrani Persian accent shouts, "Fithaghuris!" This is, of course, the Persianized name of the famed ancient Greek mathematician, Pythagoras. My friend presses his niece (in Persian): "Why do you like *Fithaghuris*?" She thinks again for a few seconds and responds, "because of the Pythagorean theorem!" The video's caption reads "The next generation of mathematician scientists (*dānishmandān-i riyāżī*) in our family."

I cannot help but to chuckle. To my mathematician friend, Pythagoras is known for his famous geometrical theorem that is one of the fundamental elements of Euclidean geometry. So fundamental is the theorem that it has guaranteed him a hall-of-famer status for my friend's five-year-old niece. At the same time, her knowledge of the name and the theory signals to my friend a bright future for the soon-to-be mathematician scientist. To me, however, Pythagoras is known for many other beliefs. My mind goes through some of the more colorful ones that Pythagoras and his followers apparently held: adherence to dietary restrictions that prohibited eating fava beans; the prohibition of wool clothing; and a belief in metempsychosis – that is, the transmigration of the soul after death into another body, human, or animal – as well as the musical harmony of the cosmos,

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among other things.[1] One could even say the collection of beliefs that Pythagoras is said to have created[2] – including his mathematical theorems – in their entirety amounted to more of a holistic cosmology than separate religious and scientific bodies of knowledge.[3] Pythagoras' intellectual descendants in the medieval Islamic world – some of whom are the intellectual ancestors of my friend – held some of these beliefs as well. They might not have adhered to the restrictions against fava beans, but they certainly held onto many aspects of his cosmology. For my friend, however, this combination of science and "superstition" is simply unthinkable. The great mathematician – and by extension, math and science – must be purified from such beliefs. In fact, my friend is not alone in this process: some historians have gone so far as suggesting that the "Pythagorean" beliefs amounted to nothing more than a hotchpotch of superstitions created centuries later by Pythagoras' followers that could not and should not sully the name of this great man of history.[4] The fact that my friend's conceptualization of science contradicts historical uses of the term – as explored here – is irrelevant to his project. What matters is for science to be sacralized and purged from the impurities of "superstition." And so, it is done. Science is sacralized. Science is saved.[5] And the next generation of mathematician scientists in the form of a five-year-old little girl is ready to pick up the torch and continue the good work of the hallowed Pythagoras.

The historical process through which modernized Middle Easterners like my friend came to possess a contemporary understanding of science has been the subject of recent scholarship.[6] What I find curious, however, is the conceptualization of science that my friend's intellectual forefathers in the

[1] For a recent study of Pythagorean beliefs, see M. Laura Gemelli Marciano, "The Pythagorean Way of Life and Pythagorean Ethics," in *A History of Pythagoreanism*, ed. Carl A. Huffman (Cambridge: Cambridge University Press, 2014), 131–48.

[2] We know next to nothing about the historical Pythagoras and his beliefs. Much of our knowledge about him comes from sources written by later Pythagoreans in veneration of their intellectual forefather. See Geoffrey Lloyd, "Pythagoras," in *A History of Pythagoreanism*, ed. Carl A. Huffman (Cambridge: Cambridge University Press, 2014), 24–45.

[3] Gemelli Marciano, "The Pythagorean Way of Life."

[4] See for instance Leonid Zhmud, "Sixth-, Fifth- and Fourth Century Pythagoreans," in *A History of Pythagoreanism*, ed. Carl A. Huffman (Cambridge: Cambridge University Press, 2014), 88–111.

[5] On sacrality of science among some of its modern practitioners see David Bloor, *Knowledge and Social Imagery*, 2nd ed. (Chicago; London: University of Chicago Press, 1991), 46–50.

[6] See for instance Cyrus Schayegh, *Who Is Knowledgeable, Is Strong: Science, Class, and the Formation of Modern Iranian Society, 1900–1950* (Berkeley: University of California Press,

Islamic world held before the coming of modernity. How did the medieval Islamic intellectual tradition conceptualize and produce scientific knowledge? What can we learn about the medieval Islamic world from the way medieval Muslims examined and studied the universe? These are some of the fundamental questions to which this book aims to provide an answer.

In answering these questions, the science of music – one of the disciplines supposedly founded by Pythagoras himself – provides a unique vantage point. Widely considered to be an art today, music in the medieval Islamic world was categorized as one of the four branches of the mathematical sciences, alongside arithmetic, geometry, and astronomy; indeed, some philosophers and scholars went as far as linking music with medicine, astrology, and geography, among other disciplines, as part of an interconnected web of cosmological knowledge. But despite its status as a science in the premodern world, with the dawn of modernity, music lost its scientific credential and has since become one of the arts.[7] This book attempts to investigate what made music a science in the medieval Islamic world. In doing so it tangentially investigates what music – or rather, premodern science – lost in the modernization process that rendered it something other than science. The immediate question of this book addresses how the science of music, as a body of knowledge, was appropriated from its Greek origins, how this science was then produced and reproduced throughout Islamic civilization, and how Muslim societies situated it vis-à-vis Islamic tradition and cosmology. I examine the ontological debates surrounding the nature of music as a scientific discipline as well as the epistemological tools and techniques that contributed to the production of musical knowledge during the medieval period (third/ninth–ninth/fifteenth centuries).

SCIENCE, MUSIC, AND HISTORICAL PERIODIZATION

This book lies at the intersection of the history of music, the history of science, and the social and intellectual history of the medieval Islamic

2009); Daniel A. Stolz, *The Lighthouse and the Observatory: Islam, Science, and Empire in Late Ottoman Egypt*, Science in History (Cambridge: Cambridge University Press, 2018).

[7] This does not mean that there are no scientific or mathematical formulations used in music. Modern science's pervasiveness has left barely any part of our knowledge untouched. My point, rather, is that music does not contribute to the sciences the way it used to. Simply put, the relationship between science and music has become one-sided, as it is the case with science and virtually all forms of human knowledge.

world. Accordingly, it offers significant contributions to the scholarly debates in these fields. In what follows, I first discuss my theoretical interventions and contributions. I then turn to the scope of this study and its limitations in terms of subject matter, geography, and historical periodization.

SCIENCE AS AN ANALYTICAL LENS FOR HISTORICAL RESEARCH

"Is (Islamic) occult science science?" This is the titular question of an article by historian of the Islamic occult sciences, Matthew Melvin-Koushki.[8] Melvin-Koushki makes a long overdue intervention into the question of the place of the occult sciences in the historiography of science over the past two centuries by drawing attention to the colonial legacies that have afflicted the field. He argues that the banishment of the occult sciences into the realm of nonscience was a product of colonial intellectual projects that aimed at hitting two birds with one stone: On the one hand, deeply rooted in Enlightenment thought and Cartesian mechanistic dualism, these projects sought to separate the mind from the body – metaphysics from physics – and thus contributed to the establishment of religion/science dichotomy.[9] On the other hand, by positing the orient as "the Occult West," these projects removed the Islamic world from the realm of rationality. In doing so, they cast the occult sciences as "oriental science."[10] Melvin-Koushki provides an overview of the strategies that historians of the Islamic sciences have adopted to combat these colonial and orientalist legacies. One group has labeled the occult sciences as bad science and bad religion, to be excluded from respectable historiographies of Islamic science. The other group, while still considering the occult sciences to be bad science, has opted to consider them to be good religion to be venerated under the catchall category of mysticism. The problem is, Melvin-Koushki argues, that in deploying these strategies, these historians have inadvertently strengthened the discursive foundations of the same colonial legacies they have fought against – namely, the dichotomy of science and religion.[11] This mode of categorization is a deeply anachronistic one that would not have made much sense in the medieval Islamic

[8] Matthew Melvin-Koushki, "Is (Islamic) Occult Science Science?," *Theology and Science* 18, no. 2 (2020): 303–24.
[9] Melvin-Koushki, "Is (Islamic) Occult Science Science?," 304.
[10] Melvin-Koushki, "Is (Islamic) Occult Science Science?," 305.
[11] Melvin-Koushki, "Is (Islamic) Occult Science Science?," 306–8.

world. What existed instead, Melvin-Koushki argues, was a science/magic/religion triad, in which the middle category connected the other two to each other.[12] Any historical analysis of science in the medieval Islamic world must therefore take into account the place of the occult sciences in the relationship between science and religion and as such, the occult sciences must be considered a part of the history of science in the medieval Islamic world. It then follows that many branches of the occult sciences, such as alchemy and lettrism, should be considered – and thus studied as – branches of the sciences in the medieval Islamic world.[13]

Melvin-Koushki's arguments are quite valuable on their own. But what interests me here is that implicit in his arguments is a conception of science itself. To discuss which disciplines should and should not be considered science, one ought to understand what science itself is and how it is distinguished from other bodies of knowledge. One does not need to provide a clear and succinct definition – although doing so is obviously preferable. But at the very least, the category of science cannot be taken for granted; even without a formal definition, a conception must be implied. In Melvin-Koushki's case, it seems that he does have a particular understanding of what science entails. Multiple times in this article, he refers to science in the context of mathematics and the natural sciences.[14] It appears, then, that Melvin-Koushki considers anything and everything dealing with mathematics and the natural sciences to be the subject of science. It is through this categorization that he argues for the inclusion of the occult sciences into the fold of science. The problem is that this kind of conceptualization can easily devolve into a tautology. Science is natural sciences and mathematics, and mathematics and natural sciences should be considered science. But it does not tell us why these disciplines should be considered scientific or what distinguishes science from other forms of knowledge. Why should we differentiate lettrism (mathematized alphabetical combinations) and poetry (non-mathematized alphabetical combinations) as science and nonscience? In other words, how are we to demarcate the boundaries of science?

The question is a particularly thorny one for historians of science. With the rise of Foucauldian approaches to the study of modernity and modern concepts at the turn of the twenty-first century, some historians of science,

[12] Melvin-Koushki, "Is (Islamic) Occult Science Science?"
[13] Melvin-Koushki, "Is (Islamic) Occult Science Science?"
[14] See for instance, Melvin-Koushki, "Is (Islamic) Occult Science Science?," 304, 306, 310–13, 315, 317.

such as Peter Harrison, have suggested that science in the sense that we conceive of it today had no equivalent in the premodern world.[15] Adopting a genealogical approach, Harrison argues two points regarding the emergence of science as a modern category. First, in the premodern Latinate world, *religio* and *scientia* – the precursors to modern religion and science – were both understood more or less to be "moral ways of life," rather than bodies of knowledge preoccupied with facts. They were both centered around the moral well-being of humans and the provision of ethical guidelines to live by. As such, both *religio* and *scientia* competed with other moral ways of life, which meant their boundaries were more porous than those of their modern counterparts.[16] Second, disputations of Christian theologians after the Reformation laid the foundation not only for the creation of the category of religion, but also for the gradual extrication of natural philosophy from the realm of morality.[17] It was the continuation of these trends that, by the nineteenth century, had flourished into a fully fleshed out category of "science" defined in opposition to religion.[18]

One of the most interesting aspects of Harrison's groundbreaking argument is the rupture he identifies between *science* and *scientia*.[19] In fact, his use of the term *scientia* itself – similar to and yet distinct from its modern counterpart – is meant to highlight this rupture. An implicit consequence of Harrison's argument is that the term "science" should not be used to discuss the modes of inquiry dealing with similar subjects that existed in the premodern world. This calls into question the validity of applying the term "science" to any body of knowledge outside of modern Europe and its colonial and postcolonial inheritors. Two different approaches can be adopted in response to this dilemma.

First, one can argue that science's modernity by definition makes it inapplicable to the premodern world. In other words, the history of

[15] Peter Harrison, *The Territories of Science and Religion* (Chicago: The University of Chicago Press, 2015).
[16] Harrison, *The Territories of Science and Religion*, 21–54.
[17] Harrison, *The Territories of Science and Religion*, 84–116.
[18] Harrison, *The Territories of Science and Religion*, 145–82.
[19] In presenting this argument, Harrison positions himself in a long line of historians of science who believe in the theory of epistemic breaks between different scientific "paradigms." For some other examples of this theory see Gaston Bachelard, *The New Scientific Spirit* (Boston: Beacon Press, 1984); Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962); Michel Foucault, *The Order of Things: An Archaeology of the Human Sciences* (New York: Vintage Books, 1994).

science begins with ninetheenth-century Europe. Consequently, one cannot study the history of science as such in the medieval Islamic world, and the question of whether occult science is science or not is rendered moot. While one can study *scientia* and other precursors to modern science, the term "science" should not be used to discuss these premodern bodies of knowledge. Instead, we may use whatever emic terms premodern practitioners of these disciplines themselves would have used. In this regard, the Arabic term commonly translated to "science" – *ʿilm* – is more confusing than it is clarifying, since it broadly refers to all bodies of knowledge from grammar (*ʿilm al-naḥw*) to astronomy (*ʿilm al-hayʾa*). As a remedy, some scholars have opted to use more subject-specific and historically accurate terms, such as the "natural sciences" (*al-ʿulūm al-ṭabīʿī*), "rational sciences" (*al-ʿulūm al-ʿaqlī*), and "ancient sciences" (*ʿulūm al-awāʾil*), all of which refer to elements of classical Greek heritage that were appropriated by the medieval Islamic world.[20] But this approach is not without its faults.

In its extreme manifestation, this approach results in the total dissolution of "science" as a historical category and analytical lens for the study of the premodern world. One might think that the abandonment of the category is not a terrible outcome, especially given that what we gain is more historical accuracy. The problem is that by abandoning science as an analytical lens, we deprive ourselves of the potential for comparative and cross-cultural analysis. After all, the Latinate world did not conceptualize classical Greek heritage as "ancient sciences," – as the Islamic world did – but as *scientia*, which, when translated into English, brings us back to using the term "science" with all its modern baggage. Nor did the Sanskrit tradition consider certain disciplines such as astronomy to be a part of classical Greek heritage, meaning that in discussing these disciplines, we cannot universally consider them to be Greek in origin, either. Yet, cross-pollination between these traditions

[20] See for instance, Judith Pfeiffer, "Teaching the Learned: Jalal al-Din al-Dawani's Ijaza to Muʾayyadzada: ʿAbd al-Rahman Efendi and the Circulation of Knowledge between Fars and the Ottoman Empire at the Turn of the Sixteenth Century," in *The Heritage of Arabo-Islamic Learning: Studies Presented to Wadad Kadi*, ed. Wadad Qadi, Maurice A. Pomerantz, and Aram A. Shahin, Islamic History and Civilization: Studies and Texts 122 (Leiden: Brill, 2016), 284–332; Justin K. Stearns, *Revealed Sciences: The Natural Sciences in Islam in Seventeenth-Century Morocco* (Cambridge: Cambridge University Press, 2021); and Justin K. Stearns, "Writing the History of the Natural Sciences in the Pre-modern Muslim World: Historiography, Religion, and the Importance of the Early Modern Period," *History Compass* 9, no. 12 (2011): 923–51.

has been part and parcel of the history of these disciplines for the better part of the past three thousand years or so.[21]

Furthermore, even in its less extreme manifestations, it is not clear whether this approach amounts to anything more than a shift in nomenclature. Let us call this body of knowledge not science, but "rational" science. What differentiates "rational science" from other bodies of knowledge in the medieval Islamic world from a historical perspective? Anthropologically, one might argue that all that matters is that medieval Muslims understood these disciplines to be rational. But from a historical perspective, we must evaluate the very rationality of these disciplines in comparison to other supposedly nonrational or "traditional" (*naqlī*) ones. In other words, the follow-up to using a term such as "rational science" is to ask, "what is rational science?" – which brings us back to the same dilemma we had with "science" itself. We must still provide a conceptualization of (rational/ancient/natural) science and elaborate on its relationship with (traditional/new/supernatural) science.

Alternatively, one can argue that as historians, we should be able to use science as a historical category in the premodern world, despite the term's modernity. Science may be a modern concept, but we can identify premodern bodies of knowledge that are cognate with it. This is effectively the approach that many historians of science in the medieval Islamic world have adopted over the past few decades. In addition to Melvin-Koushki, one can mention Sonja Brentjes, George Saliba, Ahmad Dallal, A. I. Sabra, Nahyan Fancy, and more recently Ricardo Strobino, among many others, as proponents of this approach.[22] Perhaps the most important feature of this approach is that it allows for cross-cultural and global histories of science. But the approach is not without its perils, either.

As discussed here, Melvin-Koushki argues that this approach can easily read modern science onto the premodern world and thus runs the risk of delegitimizing disciplines that do not fit into modern conceptions of

[21] See for instance, Scott L. Montgomery, *Science in Translation: Movements of Knowledge through Cultures and Time* (Chicago: University of Chicago Press, 2000).

[22] See for instance, Sonja Brentjes, *Teaching and Learning the Sciences in Islamicate Societies (800–700)* (Turnhout; Belgium: Brepols, 2018); George Saliba, *Islamic Science and the Making of the European Renaissance* [Electronic Resource] (Cambridge, MA: MIT Press, 2007); Ahmad S. Dallal, *Islam, Science, and the Challenge of History* (New Haven: Yale University Press, 2010); Nahyan A. G. Fancy, *Science and Religion in Mamluk Egypt: Ibn al-Nafis, Pulmonary Transit and Bodily Resurrection* (London: Routledge, 2013); Riccardo Strobino, *Avicenna's Theory of Science: Logic, Metaphysics, Epistemology* (Berkeley: University of California Press, 2021).

science. In fact, Melvin-Koushki notes that many esteemed giants of the field on whose shoulders the rest of us stand have committed to this anachronistic conception of science and in doing so have distorted the history of the sciences in the medieval Islamic world.[23] Melvin-Koushki suggests that the solution lies in an emic evaluation of medieval sources to understand what medieval Muslims would have considered as science.[24] The approach seems strange, as it attempts to apply an inherently modern and European category – that of science – to an inherently nonmodern and non-European setting. While I agree with Melvin-Koushki's proposal, I think its execution must be done with the utmost care. For one thing, as I have already pointed out, Melvin-Koushki himself insists on identifying science as that which deals with mathematics and the natural sciences. But what did medieval Muslims understand these disciplines to mean? How did they understand the relationship between different bodies of knowledge? One of the two medieval sources that Melvin-Koushki consults to prove his points is Ibn al-Akfani's (d. ca. 749/1348) "*Guidance for the Seeker of the Sublimest of Goals*" (*Irshad al-qasid ila asna al-maqasid*).[25] But while Melvin-Koushki uses this work to argue that the occult sciences should be considered a part of the sciences, the work itself does not deal with science, per se. In fact, Ibn al-Akfani's examination begins with what we might consider the literary arts and goes on to cover many other disciplines that Melvin-Koushki himself would not consider scientific (since they do not belong to either mathematics or the natural sciences).[26] On what basis does Melvin-Koushki separate science from nonscience? I am not asking this as a rhetorical question. In fact, I agree with him and other scholars of the field who, like Melvin-Koushki, have classified or reclassified the sciences. Rather, I am drawing attention to the apparent absence of a clear and succinct conception or definition of science itself beyond the parameters of modern Europe.

The medieval sources available to us are not directly helpful in this regard, either. Neither Ibn al-Akfani nor Melvin-Koushki's other source, Shams al-Din Amuli (d. 753/1352), shed any light on what they

[23] I will not rehash Melvin-Koushki's criticisms here. For a more thorough examination of this issue, see Melvin-Koushki, "Is (Islamic) Occult Science Science?," 306–7.

[24] Melvin-Koushki "Is (Islamic) Occult Science Science?," 309.

[25] Muhammad ibn Ibrahim ibn al-Akfani, *Irshad al-Qasid ila Asna al-Maqasid* (Cairo: Maktabat al-Anjlu al-Misriyya, 1978). See also Jan Just Witkam, "Ibn al-Akfani (d. 749/1348) and His Bibliography of the Sciences," *Manuscripts of the Middle East* 2 (1987): 37–44.

[26] Ibn al-Akfani, *Irshad al-Qasid*, 36–48.

conceptualize science to entail. In fact, their intellectual forefather, Ibn Sina, does not provide a clear definition for science, either – nor should we expect him to. After all, he lived almost a millennium before science came to assume its modern form. Thus, Ricardo Strobino's otherwise detailed and meticulous examination of Ibn Sina's theory of science is forced to take the category of science itself for granted. At the beginning of his inquiry, Strobino points out that Ibn Sina's notion of *ʿilm* is similar to its Greek and Latinate cousins, *episteme* and *scientia*, all of which translate to science.[27] However, as I have already pointed out, recent scholarship by Harrison has argued against the identification of *scientia* – and presumably *episteme* and *ʿilm* by extension – with science. But since we have yet to formulate a conception of science in the medieval Islamic world, Strobino has no choice but to take the category of science for granted.

The task at hand for historians of medieval Islamic science is simple and yet complicated. While acknowledging the insufficiency of the modern concept of "science" to discuss premodern modes of knowledge that did not clearly demarcate the boundaries of physical and metaphysical knowledge – as modern science has done – we must ask what is familiar in some premodern bodies of knowledge that enables us to identify them as precursors to modern science more so than others. More importantly, what did these bodies of knowledge possess that was lost in the process of transitioning to modern science as the main category of knowledge tasked with studying the physical universe? Answering these questions is among the most important theoretical interventions of this book.

In forming my arguments in this regard, I have drawn inspiration from recent scholarship by scholars who have attempted similar feats for different analytical lenses such as religion and secularism. One interesting example of this scholarship is Sherman Jackson's notion of "the Islamic Secular" where he repurposes a modern category – that of the secular – to explain a phenomenon prevalent in the medieval Islamic world with similarities to its modern counterpart. Similar to Jackson's ideas, this book attempts to repurpose the modern category of science for the purpose of elaborating medieval Muslims' understandings of different forms of knowledge about the universe and their relationship to each other.

It is in the context of these discussions that I have found the science of music to be particularly illuminating. As discussed in this Introduction, music's categorization as a science in the medieval Islamic world on par

[27] Strobino, *Avicenna's Theory of Science*, 3.

with astronomy and in conversation with medicine and geography, among other disciplines, makes it an interesting case study. Unlike astronomy, which is still considered a science, music was only categorized as such in the medieval Islamic world. Moreover, unlike astrology and alchemy, music did not lose its legitimacy; it simply became an art and thus non-science. In other words, its contents were never rendered "incorrect" – as happened with astrology – but simply became nonscientific. This rather unique positioning allows us to see how a civilization – in this case medieval Islamic civilization – constructed "correct" scientific knowledge about a subject and how it envisioned its relationship with other bodies of knowledge. Examining the science of music thus helps us understand what "correct" scientific knowledge means for a society. Furthermore, we can examine what kind of roles this science played in the society that constructed it, and how historical processes shaped and reshaped the relationship between a scientific discipline, its practitioners, and the society.

Consequently, this book argues that the science of music was a part of a larger intellectual and sociocultural context in the medieval Islamic world, and that its history cannot be properly understood without taking this context into consideration. Many monographs have been written on the science of music in the medieval Islamic world over the past forty years. But with the exception of studies on Pythagorean music theory, these studies often approach the science of music as a scholarly expression of art-music and as such take it out of its intellectual context. As a result, the science of music is often studied apart from the rest of the mathematical sciences, which results in misconceptions about its purposes and place in the intellectual milieu of the medieval Islamic world. This book argues that only by situating music in the cosmology of the medieval Islamic world can we properly avoid such misconceptions.

Similarly, this book argues that a proper understanding of the science of music in the medieval Islamic world requires sociocultural contextualization. Dwight Reynolds and Amnon Shiloah have presented studies that situate art-music within its social and cultural context.[28] At the same time scholars such as George Saliba and Dmitri Gutas have situated the pursuit of the sciences in the sociocultural and political context of the medieval

[28] See Dwight Fletcher Reynolds, *The Musical Heritage of al-Andalus*, SOAS Studies in Music Series (Abingdon, Oxon: Routledge, Taylor & Francis Group, 2021); Amnon Shiloah, *Music in the World of Islam: A Socio-Cultural Study* (Detroit: Wayne State University Press, 1995).

Islamic world.[29] Bringing these two trends together, this book offers a new perspective regarding the pursuit of the science of music in the medieval Islamic world by situating it in its sociocultural and historical context.

Finally, this book emphasizes the connectivity of the postclassical and classical periods of Islamic intellectual tradition by demonstrating the continuity of classical thought into the postclassical period. In doing so, it contributes to a growing body of literature that aims to question long-standing paradigms regarding the development and decline of the philosophical and scientific intellectual traditions of the medieval Islamic world.[30] This book argues that the intellectual heritage of the classical period was not lost for the major scholars of the postclassical period. In fact, these scholars added to this intellectual heritage by critiquing the major scholars of the classical period and offering corrections to what they perceived as their predecessors' mistakes. Consequently, this book calls for a reassessment of periodizations such as classical and postclassical.

Now that I have laid the groundwork for my arguments and their significance within the current scholarship, I will discuss the limitations of my research in terms of the subject matter and its geographical and temporal boundaries.

THE SCIENCE OF MUSIC IN CONTRAST TO AUDIBLE MUSIC

Before the dawn of modernity, throughout the Islamic world, *mūsīqā* or *mūsīqī* were the terms that were used to designate the science of music, categorized as a subdiscipline of mathematics. Yaʿqub ibn Ishaq al-Kindi (d. ca. 256/870) was one of the most well-known and earliest philosophers of the Islamic world who introduced this division into scholarly writings on the subject. According to al-Kindi, Mathematics has four subdisciplines, music being one of them, with the other three being arithmetic, geometry, and astronomy.[31] Al-Kindi's inclusion of music among the mathematical sciences might be one of the earliest examples of such a classification in the Islamic world, but it is far from being the only one. Al-Farabi (d. ca. 339/950) follows a similar schematization in his *Ihsaʾ*

[29] See Dimitri Gutas, *Greek Thought, Arabic Culture: The Graeco-Arabic Translation Movement in Baghdad and Early ʿAbbasid Society (2nd–4th/8th–10th Centuries)* (New York: Routledge, 1998); Saliba, *Islamic Science*.

[30] See for instance Frank Griffel, *The Formation of Post-Classical Philosophy in Islam* (New York: Oxford University Press, 2021).

[31] Al-Kindi, *Muʾallafat al-Kindi al-Musiqiyya* (Beirut: Manshurat al-Jamal, 2009), 84.

al-ʿUlum (The Classification of the Sciences), dividing the mathematical sciences into seven subdisciplines with music being one of them.[32] Ibn Sina's (d. 428/1037) division of mathematics in his philosophical encyclopedia, *Kitab al-Shifaʾ* is fourfold, with music being one of the branches.[33]

The schematization, of course, was not an invention of al-Kindi or any other Islamic philosopher for that matter, as it was rooted in the classical Greek heritage. As early as Archytas of Tarentum (d. 347 bce), a group of scholars and philosophers known as the Pythagoreans acknowledged the relevance of the four branches to each other, with Archytas calling them sister sciences.[34] Although not a Pythagorean himself, Plato – who was nevertheless influenced by that school – conceived of a similar schema that had five branches for mathematics, dividing geometry into two distinct forms of plain and solid, in addition to arithmetic, music, and astronomy.[35] By the time of Ptolemy (second century ce), the four-fold division seems to have been accepted as the standard schematization.[36] In the Latin West, Boethius (d. 524 ce) made the schematization canonical in his writings, which came to be known as the quadrivium.[37]

As a consequence of this schematization, music was pursued as part of the study of mathematics in the medieval Islamic world, with many treatises composed on the subject and a scholarly literature that spans close to a millennium. The questions that were discussed in these treatises ranged from the acoustics of sound production to musical scales and the melodic and rhythmic modes in vogue at the time of a given treatise's composition. While many philosophers and scholars such as al-Kindi, al-Farabi, and Ibn Sina expounded upon these topics, arguably none were as influential as Safi al-Din ʿAbd al-Muʾmin ibn Yusuf ibn Fakhir al-Urmawi al-Baghdadi (d. 693/1294, in short known as Safi al-Din al-Urmawi,). His

[32] Al-Farabi, *Ihsaʾ al-ʿUlum* (Cairo: Maktabat al-Anjlu al-Misriyya, 1968), 93–110.

[33] Ibn Sina, *al-Shifaʾ*, vol. 3, 4 vols. (Qum, Iran: Maktabat Ayat Allah al-ʿUzma al-Marʿashi al-Najafi, 1984). There are quite a number of other encyclopedic works written in the medieval Islamic world that follow a similar schematization. I have only mentioned the two examples of al-Farabi and Ibn Sina here for the sake of brevity.

[34] Archytas, "Fragments," in *Greek Musical Writings*, ed. Andrew Barker, vol. 2 (Cambridge: Cambridge University Press, 1990), 39–40.

[35] Andrew Barker, ed., *Greek Musical Writings*, vol. 2 (Cambridge: Cambridge University Press, 1990), 53.

[36] Ptolemy, "Harmonics," in *Greek Musical Writings*, ed. Andrew Barker, vol. 2 (Cambridge: Cambridge University Press, 1990), 373.

[37] For a discussion on Boethius' division of the mathematical sciences see Andrew J. Hicks, *Composing the World: Harmony in the Medieval Platonic Cosmos* (New York: Oxford University Press, 2017), 70–77.

two treatises on music are among the most influential on the subject written in the medieval Islamic world as can be seen from the sheer number of the manuscripts still extant and their vast geographical dispersion. Between the seventh/thirteenth century, when al-Urmawi composed his two treatises on the science of music, and the mid-thirteenth/nineteenth century, many scholars from diverse parts of the Islamic world engaged his thought, particularly those who wanted to educate themselves in the mathematical sciences. Our main evidence for this claim comes from the catalogues of manuscripts held in libraries around the world, but mainly in Iran, Turkey, England, France, and Germany.[38] As a result of the popularity of his treatises in the premodern Islamic world, in this study I utilize the scholarship of al-Urmawi as a focal point that connects the great scholars of the classical period (second/eighth–seventh/thirteenth centuries) such as al-Kindi, al-Farabi, and Ibn Sina to scholars of the postclassical period.

Now that I have expounded on my sources, a few words must be said about the term "music" itself. For an average modern English speaker, music is primarily an audible phenomenon. Although not everything that is perceived by the ear merits the rubric of "music," whatever is called music must be audible. The term itself – and its cognates in several other languages, including Arabic and Persian (*Mūsīqā* and *Mūsīqī*) – is derived from the Greek *mousikē*, a reference to the works and products of the nine muses in the ancient Greek mythology. Overtime, the term came to represent the products of only one of these muses, that which we identify with the audible phenomenon nowadays: music.[39] As the Oxford Dictionary suggests, even in its scientific capacity, the term is connected with sound, at least as far as average English speakers are concerned.[40] Music is so intertwined with sound that it is virtually inconceivable for a

[38] Muhammad Taqi Danish pazhuh, Qudrat Allah Pishnamaz zadih, and Hashim Bana pur, *Fihrist-i Asar-i Khatti dar Musiqi* (Tehran: Markaz-i Nashr-i Danishgahi, 2012), 95–115.

[39] For discussions about what music constitutes from an ethnomusicological point of view, see Bruno Nettl, "Music | Grove Music," January 20, 2001, https://doi.org/10.1093/gmo/9781561592630.article.40476.

[40] *Oxford English Dictionary* [Electronic Resource], n.d. Some ethnomusicologists have refused the idea that music is principally sound. I have used the definition of Oxford's dictionary as an indicator of how an average English speaker would understand the term. It goes without saying that even some ethnomusicologists consider sound to be an integral component of music. For more discussion on the matter see Nettl, "Music | Grove Music." For an example of the avoidance of reducing music to sound see Alan P. Merriam, *The Anthropology of Music* (Evanston: Northwestern University Press, 1964), 32–33.

modern audience to imagine the former without the latter.[41] Yet this conflation was not always the case and throughout history humans have conceptualized several varieties of silent music.

Perhaps the most noteworthy type of silent music was the unheard music of the cosmos, a concept developed by Pythagoreans. From early on, it seems that the Pythagoreans believed in the superiority of this silent music of the cosmos over the audible music of humans. Aristotle posited that the Pythagoreans' faith in their schemata far outweighed their experientially gained knowledge of the universe. Hence, if they believed in the ubiquity of the number ten but could only find nine heavenly bodies in the cosmos, instead of revising their assumptions, they would conjure up an imagined heavenly body to round out their numbers to ten.[42] Plato's adoption of some of the doctrines of Pythagoreans, expressed in his *Timaeus*, was the gateway through which Pythagoreanism was introduced into mainstream philosophy and later on, into Neoplatonist writings about music.[43] But these writings about the silent music of the cosmos, and in fact any other writing about music, bore another type of silent music within themselves as well: that of the text itself.

Whether the written word should be subordinated to the spoken word has been the subject of heated arguments among modern scholars of linguistics and philosophy. Some scholars have argued that the written word is secondary to the spoken, itself being secondary to mental concepts to which the spoken words refer. In linguistic terms, the written word is the signifier of the spoken word, itself a signifier to a signified that is the human conceptualization of a given object, be it tangible or abstract.[44]

[41] Some contemporary musicians have tried to break this connection by composing avant-garde "musical" pieces such as John Cage's 4'33". But by the virtue of being avant-garde, these pieces have remained controversial regarding whether they constitute music or not. In any case, the discussions about what constitute music in contemporary ethnomusicological discourse is beyond the scope of this book.

[42] Aristotle, *The Metaphysics*, trans. John H. McMahon, Great Books in Philosophy (Buffalo: Prometheus Books, 1991), 22–23 (985b–986a).

[43] More will be discussed about the Pythagoreans and their theories in Part II of this book. For a description of Pythagoreanism and the Pythagoreans' doctrines see Barker, *Greek Musical Writings*, 2:28–29.

[44] Early twentieth-century Swiss linguist Ferdinand de Saussure was among the first and staunchest advocates of this theory. Following him, linguistics throughout the twentieth century insisted on the secondary and functional nature of the written compared to the spoken. For a representation of this school of thought's positions on the relationship between the written and the spoken, see Jacques Derrida, *Of Grammatology* (Baltimore: Johns Hopkins University Press, 1976), 27–44. For Saussure's original discussions on the subject, see Ferdinand de Saussure, *Cours de Linguistique Generale* (Paris: Payot, 1973).

According to this model then, a text is the visual representation of a spoken discourse and is thus not silent, or at best artificially silenced, having a purer primary state in which it was (or can be) audible. As Jacques Derrida has argued, however, this model has its roots in a European, ethnocentric logocentrism that in turn is rooted in the Platonic idea of the superiority of mind over matter.[45] Hence according to Derrida, once we shed this Platonic archaism, we can analyze the written as a form of inscription that exists in time and space on its own terms.[46] And so, a text about music can itself constitute a form of silent music.[47] This book will delve into this form of silent music as propagated by the scholarly writings on the subject of music produced in the medieval Islamic world.

While audible music was a skill whose mastery required physical training more than anything else, the science of music was a branch of mathematics, itself a branch of the speculative philosophical sciences, as previously mentioned. Obviously, the two were not completely disconnected from one another, particularly for non-Pythagorean conceptions of the science of music. But they should not be conflated into a single category. The acknowledgment of the existence of a relationship between the science of music and the practice of music should not be taken as evidence that professional musicians needed to learn the former to be better at the latter. In fact, as I discuss in the Chapter 2 of this book, there were many musicians with no training in the science of music in the medieval Islamic world. Conversely, many scholars of music, such as Ibn Sina, were notorious for lacking any talent in the audible art of music.[48] As I will argue, scholarly writings on music during the medieval period in the Islamic world had a more descriptive than prescriptive nature. At the same time, by invoking these dichotomies (silent vs. audible music and descriptive vs. prescriptive knowledge about music) I do not intend to

[45] Derrida, *Of Grammatology*, 6–73.

[46] One could even go a step further, as Derrida himself has done, and argue that music itself is a form of writing, as it is a form of inscription in space and time. See Derrida, *Of Grammatology*, 9.

[47] Granted, as Konrad Hirschler has argued, at least in the context of the medieval Islamic world, texts were meant to be read out loud and most often in public gatherings. There is evidence to suggest that even scholarly texts were read in study circles and hence, probably out loud and in a spoken format. (See Konrad Hirschler, *The Written Word in the Medieval Arabic Lands: A Social and Cultural History of Reading Practices* [Edinburgh: Edinburgh University Press, 2012], 32–81.) But this should not compel us to assign a primacy to the audibility of these writings over their innate and original silence.

[48] See for instance, Ario Rostami, "Risalih-i ʿIlm-i Musiqi Asar-i Mir Sadr al-Din Muhammad-i Qazvini," *Faslnamih-i Musiqi-i Mahur* 5, no. 18 (1998): 91.

reproduce the practical vs. speculative dichotomy which has been used in the study of the history of the science of music.[49] Nor do they map exactly onto the contours of the practical vs. speculative dichotomy. The musical discussions found in the treatises studied in this book were not entirely devoid of information about audible music. Rather, my point is to shift the focus from the study and reconstruction of audible music through these treatises – which has been the goal of the scholarship of prominent scholars of the field– to the inherent textual nature of, and information found in, these texts. The subject of this book, as it has been pointed out, is texts about music and not audible music itself. As a result, all the sources used here are subject to textual (i.e., methods and tools found in philology, paleography, manuscript studies, etc.) rather than musical analysis.

Still, there is the matter of the dual functionality of the term music itself, which can be confusing. On the one hand, as modern speakers of English we are accustomed to associate the term music (and its cognate counterparts in Arabic and Persian) with the audible phenomenon. On the other hand, the term music for all intents and purposes was used in the medieval Islamic world to discuss the science of music.[50] Since the subject of this book primarily is the latter, to distinguish between these two types of music, I will use the term "science of music" or, simply, "music" to refer to the scientific kind. Whenever any reference to the other kind is made, I will qualify it as "audible" music, "practiced" music, or art-music.

THE GEOGRAPHICAL AND TEMPORAL BOUNDARIES OF THIS STUDY

Equally as important to demarcate the boundaries of this book is the geographical and temporal scopes of this study. The vast geographical regions and a long temporal period under study can pose serious concerns in terms of the coherence and consistency of this book. On the one end of the temporal spectrum, the beginnings of the tradition under study stretch

[49] For a collection of essays on different approaches to the study of speculative and practical music in Western music theory, see Thomas Christensen, ed. *The Cambridge History of Western Music Theory* (Cambridge: Cambridge University Press, 2002). For a similar collection examining the subject in the Islamic world, see Owen Wright, Rachel Harris, and Martin Stokes, eds., *Theory and Practice in the Music of the Islamic World: Essays in Honour of Owen Wright*, SOAS Musicology Series (Abingdon, Oxon; New York: Routledge, 2018).

[50] For a discussion about the scientific connotations of the term *mūsīqā*/*mūsīqī* in Arabic writings on the subject, and the distinction between the science of music and audible music and their respective terms, see Shiloah, *Music in the World of Islam*, 59.

back as far as the third/ninth century. While not all of the musical achievements of this early period will be examined, at least in regard to the genealogy of terms used later on by al-Urmawi, it is imperative to examine this early stage. On the other end of the spectrum, well into the ninth/fifteenth century, scholars were still using al-Urmawi's treatises to educate themselves on music and hence were engaging his writings in one way or another. This means that the temporal limitations of the book (without considering the examination of the genealogy of musical terms in their ancient Greek origins) could be around six centuries. One may argue that this is too long of a period to choose for this study. Yet, for a variety of reasons, this longue durée approach still seems to be the best way to move forward.

First, in this book, I will follow the advice of prominent historians such as Reinhart Kosselleck and Fernand Braudel, that it is only in a longue durée study that one can discern patterns of historical change.[51] My intention is to deemphasize the study of historical events (in this case, the composition of a musical treatise) in favor of the study of historical structures (here, traditions of music scholarly writing and their contribution to learning the science of music over more than half a millennium). Second, the terminological glue that connects all these diverse writings on the science of music to one another was conceived sometime during the third/ninth century and remained in use for quite a few centuries. The meanings of these terms might have been subject to change over time, but the terms themselves were not. Furthermore, even the changes – in either what the terms connoted, or which terms were preferred – happened over time and were the result of a temporally long process. Longue durée is therefore part and parcel of this book, since the study of these changes is a part of what I hope to achieve here. Third, al-Urmawi's two treatises are the focal subjects of this book. The genealogies of the musical terms matter insofar as they discuss the terms that were available to al-Urmawi. Similarly, as long as other scholars in the Islamic world were consulting his works to gain knowledge on the subject of music, they remain relevant

[51] For more on longue durée and its benefits and hazards in historiographical research see Fernand Braudel, *On History* (Chicago: University of Chicago Press, 1980), 25–54; Reinhart Koselleck, *Futures Past: On the Semantics of Historical Time* (Cambridge, MA: MIT Press, 1985), 105–14; Jo (Joanna) Guldi, *The History Manifesto* (Cambridge: Cambridge University Press, 2014). *Isis: A Journal of the History of Science Society* dedicated parts of an issue to the question of longue durée in the history of science. See H. Floris Cohen, ed. "Viewpoint: The History Manifesto and the History of Science," *Isis* 107/2 (2016): 309–57.

to this book. In fact, it is only through a longue durée examination of differing approaches toward al-Urmawi's treatises that one can detect changes in musical concepts used in the Islamic world.

The same applies to the term "Islamic world." During the medieval period Islam was present in many lands, from Andalusia to India and later even in Indonesia, and from Transoxiana to Mali. But this book only examines musical treatises from some of these regions. As with the temporal boundaries of this study, what connect the chosen regions are al-Urmawi's two treatises. As I have already mentioned in this Introduction, based on the manuscript evidence that we have at hand, we can comfortably state that his writings were part of the scientific tradition on music in certain regions more than others. These regions were modern-day Turkey, the Levant, Iraq, modern-day Iran, Azerbaijan, Transoxiana, modern-day Afghanistan, and Mughal India. This puts us in a precarious situation, where the use of the term "Islamic world" risks overgeneralizing the evidence from a small part of the Islamic world to its entirety. This is not the intention of this book. The evidence provided here, rather than being representative of the entirety of the Islamic world, highlights aspects distinctive to it.

The temporal/geographical focus of the book is mainly divided into two parts. The first part that discusses the formative period of scientific writings in the Islamic world covers between the third/ninth to the seventh/thirteenth centuries and mostly focuses on the city of Baghdad. This frame was chosen due to the importance of the patrons and scholars who lived in Baghdad during that time frame. Al-Kindi, the author of the earliest treatises on the subject, lived in third/ninth century Baghdad, while al-Urmawi lived and died in Baghdad in the seventh/thirteenth century. In addition, many of the patrons who supported the continued production of musical treatises were connected to Baghdad in one way or another, either by being raised there or by spending most of their careers in that city. It should be noted, however, that this framework in no way implies that the pursuit of the science of music was unique to Baghdad for the period in question. Rather, my framework is an artificial one that has been chosen for the sake of convenience. As such, the results of my analysis in this part can be applied to many other locales in the medieval Islamic world that had a similar structure of patronage and scholarly environment. Conversely, evidence from other locales has been used to paint the picture of learning the science of music in medieval Baghdad. In this regard, Muhsin al-Musawi's discussion on what he has called the "medieval Islamic republic of letters" (i.e., a network that connected intellectual life

of different locales in the Islamic world to one another after the fall of the Abbasid caliphate of Baghdad) has some parallels to the period before the fall of the Caliphate, which is the primary period under investigation in this part of the book.[52] These parallels can help us in understanding the interconnectedness of intellectual culture of different cities of the Islamic world, which transcended some of the more destructive historical events that befell the region.

The second part of this book focuses partly on the tradition of commentaries on al-Urmawi's two treatises. As indicated here, these commentaries came from many other locales in the Islamic world, well beyond the city of Baghdad. If al-Musawi's argument can be tangentially helpful to the first part of this book through drawing parallels to the intellectual life of the Islamic world prior to the Mongol invasion, it is undoubtedly helpful for the study of the second part of this book. The scholarly community that engaged with al-Urmawi's two treatises is a compelling example of the network of intellectuals that al-Musawi discusses in his book. In many instances, as I will demonstrate, scholars who studied al-Urmawi's texts and wrote commentaries on them, referenced each other's works, either agreeing or disagreeing with the content of their peers' comments. Still, regardless of these scholars' positions on al-Urmawi's writings, their shared subject of inquiry (i.e., al-Urmawi's treatises) acted as a glue that kept all of them in a diachronic discourse that transcended geographical and temporal boundaries. The ideal approach would have been to study all of these commentaries that stretched from the early eighth/fourteenth century to the mid-thirteenth/nineteenth century. Unfortunately, the sheer number of these texts and the magnitude of such an undertaking means that the scope of this part of the study had to be limited. As such, I have decided to stop at the commentaries that were produced around the end of the ninth/fifteenth century, which more or less marks the early modern period. This way, the book can hold true to its title as a study of the science of music during the medieval period. As such, the term "medieval" in this book refers to the period between the third/ninth and late ninth/fifteenth centuries.[53]

[52] On the issue of the continuation of cultural dissemination after the fall of Baghdad see Muhsin Jasim al-Musawi, *The Medieval Islamic Republic of Letters: Arabic Knowledge Construction* (Notre Dame: University of Notre Dame Press, 2015), 8–12.

[53] Recently the term "medieval" itself has come under scrutiny by some historians as well (see for instance Thomas Bauer, *Warum Es Kein Islamisches Mittelalter Gab: das Erbe der Antike und der Orient* [Munchen: C. H. Beck, 2018]). Suggestions for replacement often include using dynastic periods (i.e., Mamluk Egypt or Ilkhanid period, etc.) instead of

CHAPTER OUTLINE

This book is divided into two parts. In the first part, I examine the cosmological and social contexts of conceptualizing and learning knowledge regarding the science of music in the medieval Islamic world. The second part of the book takes a closer look at the mechanisms of knowledge production on the science of music by examining the works of several prominent scholars of music from the classical and postclassical Islamic world.

Chapter 1 will examine the ontological and epistemological questions surrounding music in the knowledge system of the medieval Islamic world by exploring the philosophical system of Ibn Sina and his later followers, all of whose works laid the foundations for scholars of music in the centuries to come. In particular, I will address how mathematics was conceptualized vis-à-vis the cosmology of the *falsafa* tradition as the discipline that examined the existents whose existence was dependent on physical matter but could be conceptualized without the said matter. Through this conceptualization of music and mathematics, scholars of music were able to broaden their subject matter to cover topics from the melodic modes in vogue in their time to the poetics of music, since all of these could be conceptualized without the presence of any sensible music. At the same time, since everything in the universe, from God and the heavenly bodies to humans and earthly matters, were connected to one another, music was linked with many other scientific disciplines such as astronomy and medicine.

Chapter 2 will begin by emphasizing the role of elite patrons in the production of educational treatises on the science of music. The chapter will then provide an analysis of the relationship between learning the science of music, and musical practice, including performance, poetic skills, and listening to music. After providing some medieval philosophical arguments regarding the necessity of learning the science of music in order to better appreciate music performance, the chapter pivots toward presenting the sociocultural benefits of learning the science itself, especially among the elite of the city of Baghdad between the third/ninth and the

medieval which has a Eurocentric connotation. Unfortunately, such suggestions cannot properly address the longue durée nature of this book. As such, I have decided to follow Jonathan Berkey's advice in begrudgingly adhering to the term medieval. For Berkey's argument regarding the necessity of using the term see Jonathan Porter Berkey, *The Formation of Islam: Religion and Society in the Near East, 600–1800* (New York: Cambridge University Press, 2003), 179.

seventh/thirteenth centuries. Through aphorisms and entertaining anecdotes by famous Baghdadi literati such as Ibn Khurdadhbih, al-Sarakhsi, and al-Tawhidi, I demonstrate how knowledge about music – as opposed to art-music itself – was used by the elite as a social currency to gain access to certain social circles that would have otherwise remained inaccessible to them.

Utilizing the arguments of the previous chapter, Chapter 3 will look into the sociocultural and intellectual conditions of Baghdad before and after the Mongol conquest of the city in 656/1258 as the locus of the production of al-Urmawi's treatises on music. Scholarship on the history of the city and of the Abbasid caliphate has usually considered the fall of the city as a watershed moment in its history. While scholars traditionally have viewed this event as a moment of demise and collapse for the city (and indeed the Islamic civilization as a whole), recent scholarship has pointed out some of the more positive outcomes for the Islamic world following the collapse of the Abbasid caliphate. While not dismissing the damage that the city suffered during the conquest, this chapter will focus on the impact of the arrival of the newcomers on Baghdad's intellectual environment. In particular, I will focus on the role of the Juwayni family, the rulers of the city in lieu of the Mongols as well as al-Urmawi's patrons, in reviving the scientific spirit of the Baghdadi society.

Chapter 4 considers another major actor in the learning of musical knowledge, besides the patrons: professional scholars. While it is true that musical treatises were for the most part commissioned for the elites, once a text was out in the market, anyone with an interest in the subject and a small amount of money in their pocket could acquire a copy. Professional scholars pursued music as a part of their training in mathematics. I center my discussion around the studies of one such scholar of music at the madrasa of Mustansiriyya, who was a student of al-Urmawi himself. I analyze a rare manuscript that contains marginal notes written by this scholar who studied the subject matter under the master. This rare manuscript grants us a unique perspective into how scholars actually went about learning their subject matter.

Chapter 5 starts with the definitions of the note and the acoustics of sound production. Here, I first examine the acoustical underpinnings of the classical Greek writings on the subject and the impact they had on how the musical note was conceptualized. I then demonstrate that scholars of the medieval Islamic world approached their received wisdom with a skeptical eye and occasionally disagreed with their intellectual masters. These disagreements resulted in illuminating conversations about the

nature of a musical note, how it should be differentiated from mere sound, and what role do acoustics of sound production play in these discussions.

Chapter 6 discusses the definitions of ratios and intervals as different ways of conceptualizing the relationship between musical notes. Here, my main interest lies in the two different ways in which the ancient Greek scholars of music, the Pythagoreans and the Aristoxenians, conceptualized the relationship between any given two notes and how scholars in the Islamic world synthesized these two divergent views. While the former understood notes as equal to numbers and thus conceptualized the relationship in the form of a numerical ratio, the latter understood them as points on a continuum and thus perceived the relationship as a geometrical distance between the two points on a scale. A third group of Greek scholars, the later Neoplatonic scholars, tried to reconcile the two Pythagorean and Aristoxenian approaches into a synthesis. It was this synthesis that Islamic scholars of music inherited during the medieval period. This chapter will provide a history of numerous approaches to and adaptions of the Greek classical heritage by scholars of music in the medieval Islamic world.

Chapter 7 will examine the question of consonance and dissonance of musical ratios and intervals in the medieval Islamic world and the growing importance of the human soul in the discussions pertaining to this question. Just as in the previous chapter, the two groups in the classical Greek heritage disagreed on the underlying causes behind consonance and dissonance. The Pythagoreans, having conceptualized the relationship between two notes as a numerical ratio, insisted that the key to consonance and dissonance lay in the mathematical neatness of these ratios. The Aristoxenians, however, insisted that consonance and dissonance were a matter of human experience, with the human ear being the only judge for discerning the intervals' pleasantness. A third group of synthesizers emerged that aimed at reconciling the two approaches: Neoplatonic philosophers. Inheriting the works of these philosophers, chief among them Ptolemy, scholars of music in the Islamic world set about the task of explaining the mechanisms of apprehension of consonance by human ears according to mathematical rules. In this process, the role of the soul as the link between humanity and the cosmos – with its mathematical underpinnings – gradually grew in emphasis. This chapter will examine the gradual emergence of a discourse among scholars of music in the medieval Islamic world on the role of the soul in apprehending beauty and the impact of this apprehension on the soul itself.