From felt to measured time: The emergence of mensural music and the invention of the mechanical clock

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In a very fundamental and culturally independent sense, music is a temporal art form. In other words, in the process of performing a piece of music, time passes. However, this basic fact of music's temporal nature permits for a diverse range of realizations, which are dependent on how time and music—both per se and in their interaction with one another—were understood and experienced in a particular culture. Even though this has often been deconstructed in new music, one way to treat temporal structures that we as [Western musicians] will be familiar with is based on the definition of durations of tones in relation to fixed time units. These same fixed time units also shape the concept of time that is represented by the mechanical clock. The metronome reflects this relationship between musical and everyday concepts of time, just as clearly the term "counting time" does. Sometimes the similarities between counting time and clock time are so obvious that a composition like Haydn's Symphony No. 101 in D-Major received the subtitle "The Clock" in reference to the rhythmical structure in the second movement that reminds us of the ticking of a clock.

But the assumption that such an analogy between musical rhythm and evenly counted time is self-evident is probably incorrect. Admittedly, we are so intimately familiar with this approach to musical time that we may be tempted to conclude that such a concept is necessary; however, there are many indications that this concept is simply the product of a particular culture and other ways to view time in music exist in their respective cultures and historical contexts. This paper will attempt to shed light on a period of radical upheaval in the perception of time and the sociocultural organization of time as well as examining the possible role these wider trends had in a paradigm shift in the way time was perceived and organized

in music. Specifically, this study will examine the question whether it is possible to narrow down the structural factors—both cultural and historical—that were behind one of the most consequential changes in Western European music history, namely the emergence of explicitly notated rhythms made possible by fixed time units integrated into notation systems that appeared between ca. 1150 and 1350. In light of the pitfalls inherent in earlier often too facile attempts to place the music of the 13th century in a cultural and historic context, the present study will take a much more rigorous and self-critical approach to the methods used. Indeed, studies that seek to establish parallels between the Gothic cathedral and the motet—associated [p. 6] with many names ranging from August Wilhelm Ambros up to and including Christian Kaden, and also indirectly scholars such as Erwin Panofsky and Otto von Simson—have been rightly criticized in the work of Hartmut Möller, Christopher Page and others.[1]

The distinctive feature of mensural notation is that it fixes durations of tones using a defined unit of measurement and thereby making these available for polyphonic composition. This system gave birth to a notation that defined and regulated rhythm. Musical durations of tones are constructed from predefined quantitative units. And while the absolute duration of these units can of course vary from performance to performance, their relative size is precisely organized and thus calculable.

This does not mean that there was no rhythmic differentiation in music before this innovation. However, one crucial assumption for the thesis proposed here is that before mensural music there was no abstract, quantitative measurement system in musical praxis that regulated rhythm on a fundamental level. It goes without saying that the development described here should not be construed as progress but rather simply describes a cultural-historical change and should be understood as such. The central question in this study is which form of rhythm was

[1] August Wilhelm Ambros, *Geschichte der Musik,* vol. 2, Leipzig[2] 1880, pp. XV, 27, 358, and 427; Christian Kaden, "Modalrhythmus und 'Konkordanzperspektive': Soziale Strukturen in der Polyphonie der Notre-Dame-Epoche," in *Musiktheorie* 5 (1990), pp. 221–235; Christopher Page, *Discarding Images. Reflections on Music and Culture in Medieval France*, Oxford 1993, pp. 1–42; Hartmut Möller, "Von karolingischen Musikhörern und gothischen Konkordanzarchitekten," in: *Perspektiven des abendländischen Musikhörens*, ed. by Wolfgang Gratzer, Laaber 1997, pp. 59–110. For more on criticism of these approches, see also Andreas Speer, "Vom Verstehen mittelalterlicher Kunst," in: *Mittelalterliches Kunsterleben nach Quellen des 11. bis 13. Jahrhunderts,* ed. by Günther Binding and Andreas Speer, Stuttgart-Bad Cannstatt 1993, pp. 13–52; Annette Kreutziger-Herr, *Ein Traum vom Mittelalter. Die Wiederentdeckung mittelalterlicher Musik in der Neuzeit*, Cologne 2003; Susanne Fontaine, "Der 'nordische Wille zum Liniengewirr': Wilhelm Worringers Theorie der Gotik im Spiegel musikhistorischer Entwürfe," in: *Mittelalter-Sehnsucht?*, ed. by Annette Kreutziger-Herr and Dorothea Redepenning, Kiel 2000, pp. 87–102.

practiced in a particular culture and why this was so, or rather whether one of these cultural practices for dealing with time was reflected in music.

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Speculations about the connection between mensural music and the measurement of time in the 13th century can be traced back at least as far as Johann Nikolaus Forkel, who wrote the following in the second volume of his *Allgemeinen Geschichte der Musik* in 1802:

> If one were to divide the average citizen's day into just two parts, namely into night and day, we would not know how to keep all the multifarious dealings and events of an entire day straight—each of these occupy and require their measured time, which can be determined most effectively using hours or even minutes. In the two-part division of the day, everything that happened could at most be quantified according to night or day. But we do not do this in our daily life. We make use of much smaller divisions of time than night and day, but these always form the basis for the small divisions of time and govern the approximate number of different smaller units that are equivalent to the longer duration. [p. 7] This is the exact same way that mensural music was conceived. The bar is the basis for the general quantity, which is neither changed nor negated by the smaller divisions or the internal rhythm.[2]

Starting especially in the 1980s, scholars have put forward increasingly detailed hypotheses concerning the relationship between the perception of time and mensural music. Admittedly, some of these are not unproblematic. This is especially true of the work of Rudolf Wendorff, who published a sort of world history of time in 1980, where he attempts to trace the history of the relationship between time and culture from the ancient Babylonians to the present. Wendorff advances overly broad hypotheses based on a minimal number of sources. He does not cite any primary sources and the secondary sources are often published decades before. He even falls into reproducing nationalist stereotypes, such when he adopts Wilhelm Worringer's antithesis of "classical" and "northern gothic" ornamentation dating from 1922.[3]

To emphasize the "formal openness" of Gothic architecture Wendorff quotes Arnold Hauser, "the impression of endless movement that never comes to rest and the fleeting nature of every gesture that strives towards a goal" and Wendorff contends that this same characteristic feature finds expression in music:

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[2] Johann Nikolaus Forkel, *Allgemeine Geschichte der Musik,* vol. 2, Leipzig 1801, reprinted by Othmar Wessely (= Die großen Darstellungen der Musikgeschichte in Barock und Aufklärung 8), Graz 1967, p. 386.

[3] Rudolf Wendorff, Zeit und Kultur. Geschichte des Zeitbewußtseins in Europa, Opladen 1980, p. 129.

> The music heard in the Romanesque and Gothic churches and monasteries underwent a continuous development that paralleled that of the perception of time. Gregorian chants are to a certain extent lacking in temporal structure. The *cantus planus* hovers in the space like a prayer that time has forgot. The music is neither measured nor clearly delineated; it follows the spiritual content of the Word that is itself timeless. Tempo and rhythm are thus not notated. First beginning in the 13th century with the arrival of mensural music, do we see fixed time values and ratios of durations. One could say that the essential driving force behind this new way to structure time was the development of polyphony and that this was "just a superficial, purely technical" innovation, but this would neglect the relationship to the general development of linear and directed conception of time. And: what moved the composers to adopt polyphony? Isn't this cycle of diverging and converging in time, this expanded freedom of motions, the replacement of the sequential by a coordinated, "concerted" temporal simultaneity a phenomenon that lends even more weight to time and the changes in the content that take place in time? Is time not experienced even more intensely in this artful formal interplay full of greater harmonic surprises and changes?[4]

In the following section, Wendorff then discusses the invention of the verge and foliot clock.

Just a few years later, Alberto Gallo, who clearly was unaware Wendorff's work, published another similar treatment where he draws parallels between the shift in the perception of time in music from the "indeterminate *mensura* of liturgical chant" to the "fixed measured ratios of durations in polyphonic art music" and the pair of terms introduced by Jacques LeGoff: [p. 8] "*temps de l'église*" and "*temps du merchand*."[5] However, these remarks were only made in passing; Gallo did not attempt to formulate a proper thesis, nor did he make any effort to provide evidence for this claim.

On the other hand, Géza Szamosi dedicates an entire chapter of his 1986 book *The Twin Dimensions* to the relationship between the perception of time and mensural music. As a physicist, he is interested in exploring the implications of the discovery of time as a dimension independent of space, a discovery that he ascribes to Galileo Galilei.[6] He called this metric time and claims that it first appeared in the 13th century,[7] and he further maintained that the development of mensural music was an important or even possibly the decisive factor in the development of this concept of time.[8] Of course, humans have always adapted to seasonal and historical changes in their environment, but this ability must be carefully differentiated from the separate ability to measure time accurately. According to Szamosi, humans

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[4] Ibid, p. 130.

[5] Alberto Gallo, "Die Notationslehre im 14. und 15. Jahrhundert," in *Die mittelalterliche Lehre von der Mehrstimmigkeit*, ed. by Frieder Zaminer (= Geschichte der Musiktheorie 5), Darmstadt 1984, p. 259.

[6] Géza Szamosi, *The Twin Dimensions. Inventing Time and Space,* New York 1986, pp. 90–91.

[7] Ibid, pp. 92–93.

[8] Ibid, pp. 93 and 111.

acquired this ability so late because there was no need for such an ability for much of human history.[9] His contention is that Galileo's contemporaries' acceptance of the concept of metric time can be traced back to the fact that the very same metric concept of time was well establish in the European tradition of polyphonic music, which had already been around for four hundred years in Galileo's day.[10]

In Szamosi's text, the physicist paints this thesis with quite a broad brush. He fails to mention the prevailing theories to explain the shift in perception of time in the late Middle Ages that were current at the time he wrote his book, particularly notable is the omission of the works of Aaron Gurevich and Jacques LeGoff.[11] If he had considered this literature, it would have significantly weakened his claim that music was the decisive factor in the birth of a new consciousness of time. Nevertheless, the observation that a distinctive and also new concept of time that presupposed the abstract measurement of time took root in mensural music will be key for the larger argument in this paper.

Michael Walter addressed this subject in an important study from 1994, which has broader application beyond the present study. He examined this debate from a different perspective by focusing on the terms that music theorists employed to discuss rhythm and time. The period examined in his study stretches from the 9th to the 13th century. To fairly evaluate this study, one would have to examine the interpretations of every Medieval theorist that Walter presents individually. His analysis is at times highly subtle and [p. 9] perceptive, but one does encounter sections that are speculative and not always entirely plausible given the evidence available. At times one cannot help but think that other interpretations are possible and that such alternate interpretations would also imply a more complex and less linear developmental process of the terms used by theorists to discuss time in music. Walter maintains that in the period between the 9th century—especially as represented in the writing of Aurelianus Reomensis—and Franco of Cologne several shifts in the concept of musical time occurred, some of which are best understood as transitional phenomena.[12] Walter only briefly discusses the relationship between musical and more general concepts of time in two passages and then only in reference to pre-Franconian notions of time.[13]

In his 1997 book *The Measure of Reality*, Alfred W. Crosby includes a chapter on music in which he juxtaposes monophonic chant as non-quantitative music with

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[9] Ibid, pp. 94–95.

[10] Ibid, p. 100.

[11] Aaron Gurevich, "Time as a Problem of Cultural History," in *Cultures and Time,* ed. by Louis Gardet, Paris 1976, pp. 229–245; Jacques Le Go, *Pour un autre Moyen Âge,* Paris 1977.

[12] Michael Walter, *Grundlagen der Musik des Mittelalters. Schrift - Zeit - Raum,* Stuttgart 1994, quoted from the version accessible online, whose page count differs from the print version: <http://uni-graz.at/michael.walter/Texte/Grundlagen.pdf> (last access: July 25, 2013), pp. 138, 175 and 193–194.

[13] Ibid, pp. 135-136 and 192–193.

quantitative mensural music.[14] Compositional techniques such as those that would come to be labeled as "isorhythmic"[15] and works that explore mirrored structures[16] are in Crosby's view symptoms of this revolution in the way time was perceived: "Such music was possible only because a clock was ticking in the composer's mind, the same clock that was ticking in the performers' and listeners' minds."[17] Regarding the invention of the clock, Crosby simply comments: "Europe's mental metronome began to tick in the era of Leonin and Perotin nearly a century before Europe's first mechanical clock."[18]

And finally, in an essay from 1999, Laurenz Lütteken identifies the crucial turning point in the perception of time as not so much the transition from non-quantitative chant to quantitative mensural, but rather more specifically the shift from rhythmic modes to mensural music. In music written in modal notation, identically constructed rhythmic cells were repeated. "This type of music can so to speak be extended ad infinitum."[19] According to Lütteken, this was no longer the case in mensural music, where the duration of each individual note was in principle independent of its surroundings[20] and in which compositional techniques such as proportional diminution were now possible.[21] [p. 10] However, any sort of evidence for this claim—which is by no means self-evident—is missing, and it is thus very much doubtful whether the shift from rhythmic modes to mensural music is more of a decisive step than the transition from rhythmically free chant to structured quantified durations of the rhythmic modes, which Lütteken completely disregards. After all, rhythmic modes were a method to organize durations of tones according to quantitative rhythmic structures that was independent of language and its natural speech rhythm.

This brief sketch of the state of research in this area outlined here is characterized by a lack of any real dialogue between the various scholars: Walter and Lütteken cite Wendorff; Crosby cites Szamosi. Aside from these few exceptions, it is not possible to speak of a discussion within the field, let alone any sort of interdisciplinary discourse on the matter. Therefore, hardly any progress in field has taken place. The following study builds mainly on the work of Szamosi and Crosby

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[14] Alfred W. Crosby, *The Measure of Reality. Quantication and Western Society, 1250-1600,* Cambridge 1997, pp. 142 and 153, respectively.

[15] On the term, however, see Margaret Bent, "What is Isorhythm?" in *Quomodo cantabimus canticum? Studies in Honor of Edward H. Roesner*, ed. by David Butler Cannata et al, Middleton 2008, pp. 121-143.

[16] Crosby, *The Measure of Reality*, p. 163. 17 Ibid, pp. 162-163.

[17] Ebd., S.162–163.

[18] Ibid, p. 161.

[19] Laurenz Lütteken, "Zeitenwende. Zeit und Zeitwahrnehmung in der Musik des Spätmittelalters," in: *Neue Zeitschrift für Musik* 160, no. 5 (1999), p. 17. 20 Ibid, p. 18.

[20] Ebd., S.18.

[21] Ibid, p. 19.

rather than that of Walter for two main reasons. Firstly, Walter aspires to a level of differentiation in his interpretations of the historical events that is in my estimation unattainable. Consequently, the present study will begin by pursuing a much more elementary goal, in which the focus will be simply on answering the question to what extent it is even possible to establish a parallel between the development of musical rhythm and the spread of a new sense of time or novel way of dealing with time. Secondly, Walter draws almost exclusively on theoretical writings on music; however, the question of how time was dealt with in the actual practice of music and the question of the reflective and conscious rationalization of musical time can indeed be teased apart. As such, theoretical sources must not be overemphasized in this context. It may, as Szamosi suggests, in fact be the case that a change which presupposes or implies a modified sense of time first took hold in musical practice even though a theoretical conceptual framework was yet to be developed.

Accordingly, in the present study, the search for a relationship between cultural-specific experiences of time and musical (rhythmic) practice will be examined in light of the fundamental conflict between a rhythmic system where durations of notes measured in predefined proportional units—that is to say that durations that can be counted—are a constitutive element and a sort of rhythmic system where this is not the case (however, it is unimportant whether the notation system employed to encode the rhythm uses a particular combination of symbols as with the rhythmic modes or whether the symbol itself represents the rhythm as in Franconian notation). In this context, Franconian notation and the so-called *ars nova* should be seen as continuations and refinements, but by no means as similarly drastic innovations.[22] Considering rhythmic modes and later innovation together is useful because before one can propose a further differentiated model [p. 11] of how the experience of time evolved[23] in its connection with musical rhythm, the basic pillars of such a model must first be established. The ultimate success of this endeavor is far from certain. Therefore, the following examination will attempt to more exactly characterize the relations between the experience of time and music, which remain very impressionistic in Szamosi and Crosby. Indeed, the greatest weakness in these works is their vagueness and the lack of sufficient evidence.

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[22] Cf. Richard L. Crocker, "Rhythm in Early Polyphony," in *Studies in Medieval Music. Festschrift for Ernest H. Sanders*, ed. by Peter M. Leerts and Brian Seirup, New York 1990, p. 168, and. Edward H. Roesner, "The Emergence of *Musica mensurabilis,*" in *Studies in Musical Sources and Style. Essays in Honor of Jan LaRue*, ed. by Eugene K. Wolf and Edward H. Roesner, Madison 1990, pp. 42 and 50.

[23] Terms such as "experience of time," "perception of time," and "sense of time" will be used in the following largely synonymously, because it would be overly presumptuous to suggest that we are able to reconstruct the time concepts of the Middle Ages so precisely that such distinctions—certainly meaningful in principle—would be appropriate. Expressions such as "concept of time" or even "consciousness of time" are avoided, as these imply a rationalization of time that need not be presupposed.

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The emergence of mensural music as a cultural and music-historical event can only be properly described against the background of the rhythms of earlier music. However, little can be said with certainty about rhythm in earlier styles. The question of the rhythm in monophonic chant is very controversial. The most recent overview of the research can be found in David Hiley's *Western Plainchant* from 1993.[24] All conceivable rhythmic interpretations of the plainchant have been proposed, from the assumption that each note was of equal duration to the suggestion that the chant should be read strictly mensurally. Hiley speaks of "'equalist' and 'mensuralist' interpretations."[25] Although a more up-to-date review of the research in this area is overdue, as far as I can see, at least for Gregorian chant, the prevailing assumption at present is that plainchant was based on more subtle rhythmic differences. Eugène Cardine's "Gregorian semiology," which already received special attention in Hiley's survey, seems to have presented the most persuasive case for this interpretation to date. Cardine's seminal book *Semiologia gregoriana* was first published in 1968.[26] Since then, numerous chant scholars have adopted and extended Cardine's approach. Cardine assumes that speech rhythm is essential to chant:

> Because Gregorian chant is exclusively vocal music, the rhythm comes about solely through the interplay of word and melody, or more precisely, of syllable and tone. [...] Here, the syllabic time value as a unit also remains the starting and reference point for the rhythmic movement. This syllabic time value, however, is by no means a strictly measured and absolutely constant unit. It is flexible and variable and is also [p. 12] subject to modifications that derive from the different "weights" of syllables, which leads to unavoidable changes of the syllabic time value.[27]

In this sense, Cardine and his successors interpret neumes in terms of rhythmic nuances that are directly related to linguistic structure and semantics.

In a completely different way, Michael Walter came to a similar conclusion that the rhythmic differences in chant were derived from the linguistic structure and semantics of the text, namely:

– from the word stress of the sung texts (and not from the syllable quantity);[28]

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[24] David Hiley, *Western Plainchant. A Handbook,* New York 1993, pp. 373–385.
[25] Ibid, p. 385
[26] German edition: Eugène Cardine, *Gregorian Semiology,* transl. by Johanna Grüger, Solesmes 2003.
[27] Ibid, p. 12.
[28] Walter, *Grundlagen der Musik des Mittelalters*, pp. 105, 112, 120, and 131.

- from lengthening and shortenings in line with the standard pronunciation, but also from changes to this usual syllable duration,[29] e.g., with the aim of intensifying the movement of the vocal lines;[30]
- from melismas that fill longer syllables;[31]
- from highlighting the key content of the text, which could be underlined by longer tones.[32]

Walter sums up this particular conception of rhythm by stating that neither the sense of the rhythm nor its terminology should be understood as an indication of fixed time relations, but rather as an instruction for action.[33] Against this background—but at the same time seen through the lens of a theorist, for whom *musica mensurabilis* was an part of musical normality—it should then be easier to understand Johannes de Grocheio's later (ca. 1300) statement that chant is "non praecise mensurata [...]."[34]

Comparable assumptions about the rhythmic realization of monophonic music of the Middle Ages have also been made in relation to other repertoires, such as Tropes, the "new songs" of the 12th century,[35] or the music [p. 13] of the Trouvères.[36] But similar theories have also been developed in relation to early polyphonic music, in particular by Richard Crocker.[37] From the moment when two voices are made to sing in a coordinated manner, linguistic and musical factors necessarily collide. However, the essentially contextual nature of the rhythm, which

[29] Ibid, p. 123.
[30] Ibid, p. 126.
[31] Ibid, p. 125.
[32] Ibid, p. 131.
[33] Ibid, pp. 127 and 135.
[34] Johannes de Grocheio, *De musica,* ed. and transl. by Ernst Rohlo, Leipzig 1972, p. 124.
[35] Wulf Arlt, "Nova Cantica. Grundsätzliches und Spezielles zur Interpretation musikalischer Texte des Mittelalters," in: *Basler Jahrbuch für Historische Musikpraxis* 10 (1986), pp. 13–62, 25 and 37; cf. also p. 60. At the same time, Arlt points out that such an interpretation of rhythm closely related to language cannot be assumed for the Old Roman and Milanese chant, because there musical contexts are in the foreground (p. 20). But here, too, it is a matter of a context-dependent rhythm, only that (to put it simply) it is musical instead of linguistic features that produce the rhythm.
[36] See the research overview in Elizabeth Aubrey, *The Music of the Troubadours*, Bloomington 2000, pp. 240-244; see also Hans-Herbert Räkel and Elizabeth Aubrey, "Troubadours, Trouvères," in: *MGG2,* Sachteil vol. 9, Kassel 1998, column 964.
[37] Crocker, "Rhythm in Early Polyphony."

was not based on a rigid pulse, remained.[38] Crocker himself speaks of a "syllabic beat" in relation to his concept of a language-dependent flexible rhythm.[39]

The *organum purum* was also clearly based on a context-dependent free rhythm, as implied by the tradition of some text passages by thirteenth-century music theorists, especially Johannes de Garlandia, Anonymous IV, and Franco of Cologne, often referred to under the name "concordance rule." The best-known version from the *musica mensurabilis* by Johannes de Garlandia reads, "Longae et breves in organo tali modo dinoscuntur, scilicet per <concordantiam>, per figuram, per paenultimam. Unde regula: omne id, quod accidit in aliquo secundum virtutem <concordantiarum>, dicitur longum."[40]

The interpretation of this passage was highly controversial,[41] but as far as I can see, the discussion calmed down after Jeremy Yudkin's presentation of all the relevant information, which allowed him to conclude that, despite all the complexity of the situation, one could not ignore the fact that the authors obviously had a non-modal rhythm in mind.[42] In fact, the discussion was sometimes so focused on such subtleties that one lost sight of that [p. 14] which was unambiguous. Probably for this reason, it was not until 1990 that attention was drawn by Charles Atkinson to a formulation in Franco of Cologne, who explains:

> Item notandum, quod quotienscumque in organo puro plures figurae simul in unisono evenerint, sola prima debet percuti, reliquae vero omnes in oratura teneantur.

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[38] Ibid, pp. 147, 149, 162, 163, and 173. See also Frieder Zaminer, *Der vatikanische Organumtraktat (Ottob. lat. 3025)* (= Münchner Veröffentlichungen zur Musikgeschichte 2), Tutzing 1959, pp. 99–100; Sarah Ann Fuller, "Aquitanian Polyphony of the Eleventh and Twelfth Centuries," diss., University of California 1969, pp. 310 and 327.

[39] Crocker, "Rhythm in Early Polyphony," pp. 153 (with a Treitler citation), 155, 162, 163, and 164.

[40] "Long or short are indicated in the organum in the following ways: by the degree of consonance, by a symbol, or by occupying the penultimate position. Therefore, the rule is: everything that satisfies the characteristic of the consonances is considered to be long." Johannes de Garlandia, *De mensurabili musica,* vol. 1, ed. by Erich Reimer (= Beihefte zum *Archiv für Musikwissenschaft* 10), Wiesbaden 1972, ch. XIII, p. 89 (translation by the author).

[41] At the height of the discussion appeared: Edward Roesner, "The Performance of Parisian Organum," in *Early Music* 7, no. 2 (1979), pp. 174-189; Edward Roesner, "Johannes de Garlandia on *Organum in speciali,*" in *Early Music History* 2 (1982), pp. 129-160; and Ernest H. Sanders, "Consonance and Rhythm in the Organum of the 12th and 13th Centuries," in *Journal of the American Musicological Society* 33, no. 2 (1980), pp. 264-286. See also the commentary by Fritz Reckow as well as Sanders's replica in *Journal of the American Musicological Society* 34, no. 3 (1981), pp. 588-591.

[42] Jeremy Yudkin, "The Rhythm of Organum Purum," in *The Journal of Musicology* 2, no. 4 (1983), pp. 355-376, esp. pp. 360 and 374.

> It should be noted that whenever in organum purum several *figgurae* come together over a single pitch [in the tenor], only the first should be beaten in fixed rhythm; all the rest should be taken in *floratura* [that is, performed in a rhythmically free fashion].[43]

Behind this formulation, there is a hidden reference to the pulse of quantifying meter. The beating (*percuti*) of the rhythm, known to be a part of this tradition, is now explicitly excluded in *organum purum.*

For these reasons, it seems plausible to assume that *organum purum* was not yet based on modal rhythms. However, the hypothesis examined in this article does not stand or fall based on how we evaluate this assumption. For, as will be discussed later, it cannot be a matter of defining precise historical boundaries. Thus, whether modal rhythmicity begins ten, twenty years earlier, or later has no effect on the hypothesis that there was a connection between the change in the general perception of time and musical time.

And this sort of rhythmic system not based on fixed quantities forms the basis of Janet Knapp's transcription of the florid organum *Alleluja Pascha nostrum* from the second half of the 12th century (musical example 1).[44] However, this immediately reveals the limitations of modern notation, in which a completely different approach to time has taken root. Knapp uses small horizontal strokes (tenuto markings) to indicate durations that are supposed to be longer than an eighth, but shorter than a quarter. These are not, of course, deviations from an imagined regularity, as suggested by modern notation, where thinking in terms of fixed sound durations based on units has become ingrained. It is not a kind of rubato, but long and short exist in this music neither as absolute nor as relatively fixed values. To all appearances, they are freely determined depending on context. But of course, we have reached a point here that opens the door to speculation and where the modern construction of the Middle Ages begins. [p. 15]

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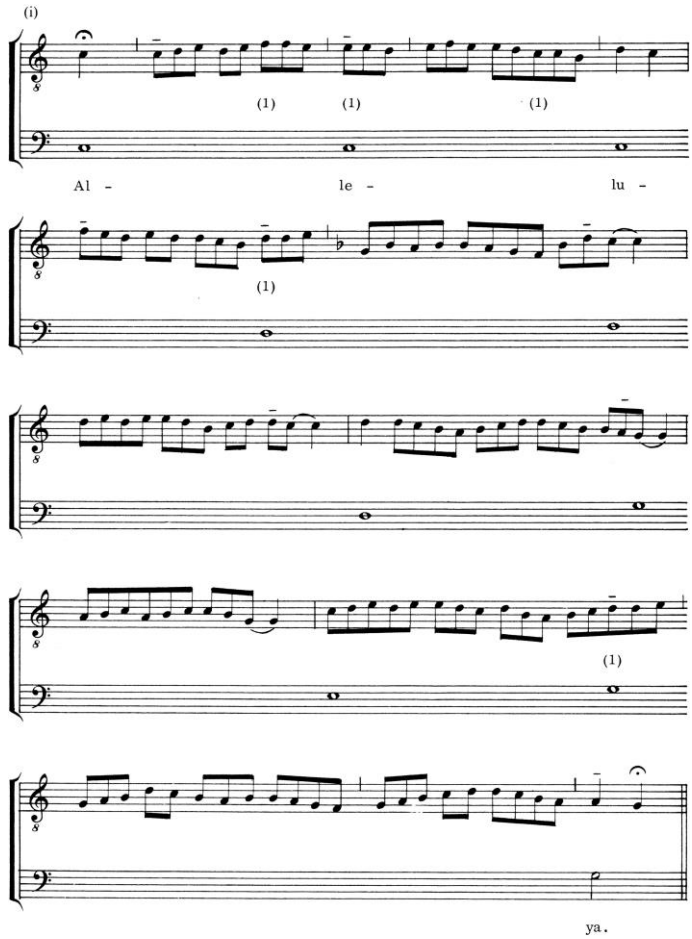
[43] Franco de Colonia, *Ars cantus mensurabilis*, ed. by Gilbert Reaney and André Gilles (= Corpus scriptorum de musica 18), Rome 1974, ch. XIV, p. 81. English translation from: Charles M. Atkinson, "Franco of Cologne on the Rhythm of Organum Purum," in *Early Music History* 9 (1990), p. 23.

[44] Janet Knapp, "Polyphony at Notre Dame of Paris," in *The New Oxford History of Music*, vol. 2: *The Early Middle Ages to 1300,* ed. by Richard Crocker and David Hiley, New York 1990, pp. 581-585. Cf. also the editions of organa in the book edited by Edward H. Roesner edited *Le Magnus liber organi de Notre-Dame de Paris*, Monaco 1993-2009, and the transmission method of an *organum purum* modified on the basis of Robert Lug's considerations in Rudolf Flotzinger, *Von Leonin zu Perotin. Der musikalische Paradigmenwechsel in Paris um 1210,* Bern 2007, pp. 120-136, esp. pp. 128-131.



Nb. 1: Janet Knapp, Transcription of the sustained tone organ *Alleluja Pascha nostrum*.

[p. 16] Despite all their differences, such forms of rhythm—perhaps now more oriented to textual, content-related (Gregorian chant), now more to musical factors such as melody or harmony (polyphony), i.e., context-dependent, not bound to a fixed pulse—seem to have determined musical practice for centuries. One possible explanation for why Johannes de Garlandia formulated a rule on how to realize the rhythm of such polyphony was because the practice only came to need explanation at a time when a different interpretation of rhythm was spreading.

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Until the High Middle Ages, people's daily routines were not so much subdivided according to fixed units as they were in direct contact with the natural, seasonally varying day length and weather conditions. In monastic and ecclesiastical contexts,

the day had twelve hours, but their duration changed with the season.[45] These temporal hours [*hora temporalis*] were derived from the practice of life; time was not seen as a rigid framework that regulated the practice of life. The simplest sundials sufficed for approximate temporal orientation during the day.[46] Other measuring aids, not intended for astronomical research but for everyday life, such as the burning of a candle or the water clock, served primarily to estimate the time at night. The alarm function was in the foreground. The rooster's crow and stars were also used as indicators of time.[47] The Divine Office [*Officium Divinum*], i.e., the monastic hours of prayer, and the temporal hours were closely related to each other; however, the Office had a certain independence from the temporal hours but were lived just as flexibly.[48] Gerhard Dohrn-van Rossum summarizes the essential nature of these divisions concisely: "The time values are empirical values, which are not defined."[49]

This leads to the question whether a similar sense of time—more felt than calculated and intimately linked to context—has a counterpart in the temporal and rhythmic conception of monophonic chant and so-called early (pre-modal) polyphony.[50] [p. 17]

Admittedly, humanities and cultural studies are highly susceptible to rhetorical suggestion. If we uncritically avail ourselves of the manipulative power of language, a connection between musical time and everyday experience could be made plausible immediately. But we wish to avoid falling into this trap and choose rather to embrace this question as an open question. With this in mind, it is helpful to visualize the structure of the argumentation: It hinges on forming an analogy. Just as we can describe the way we deal with time in an everyday context as felt and context-dependent, we can also describe the form of musical rhythm as felt and context-dependent. It must be put up for discussion whether this analogy is sufficient to establish an actual nexus. After all—and therein lies a substantial difference to the analogy between the cathedral and the motet mentioned in the introduction—there is a direct connection between the structures brought into analogy: shaping musical objects, as is the case in rhythm, always necessitates the

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[45] Catherine Eagleton, "Clocks and Timekeeping," in *Medieval Science, Technology and Medicine. An Encyclopedia*, ed. by Thomas Glick et al, London 2005, p. 128; Gerhard Dohrn-van Rossum, *Die Geschichte der Stunde. Uhren und moderne Zeitordnung*, Munich 1992, p. 43.

[46] Dohrn-van Rossum, *The Story of the Hour,* p. 61.

[47] Ibid, p. 59. On the observation of the stars, see also Stephen C. McCluskey, "Gregory of Tours, Monastic Timekeeping, and Early Christian Attitudes to Astronomy," in *Isis* 81, no. 1 (1990), pp. 8–22.

[48] Dohrn-van Rossum, *The Story of the Hour,* pp. 41–43.

[49] Ibid, p. 42.

[50] Cf. Walter, *Grundlagen der Musik des Mittelalters*, pp. 135–136.

shaping of time. That the culturally specific experience of time is reflected in this is thus at least by no means improbable.

It is therefore worthwhile to trace the history of the understanding and organization of time: between 1271 and 1330, the mechanical clock—also known as the verge and foliot clock—was invented.[51] The most important part of the mechanism was the verge escapement, because without this technical detail, it would not have been possible to measure time accurately over a longer period of time. However, it has rightly been pointed out time and again that an invention that is often described by historians to this day as one of the most momentous in European cultural history left virtually no traces at the time of its construction. Thus, the question arises, on the one hand, whether such great importance should be attached to an object that appeared to go so unnoticed. On the other hand, the introduction of the hour striking clock a little later (1336) was perceived as a real sensation.[52] Alfred Crosby sees a significant turning point in these events, because the mechanical clock does not simply imitate the continuous flow of time, but divides time into specific, fixed units.[53] In contrast, Arno Borst qualifies:

> The fact that it [the clock's discovery], nevertheless, did not abruptly turn the consciousness of time and number upside down is demonstrated by the fact that the discovery can only be dated vaguely [...] and no contemporary names the inventor. [...] The fact that the new machine was equipped with a striking mechanism, i.e., that it additionally took over the function of a bell, did not fundamentally change the sense of time.[54]

To do justice to the problem, we must acknowledge that we are beginning from processes that themselves already possess an inherent complexity, which allowed different parallel perceptions of time. The fact that a means of measuring time [p. 18] independent of the seasons was now available and that this time measurement could also be communicated to the urban population in the form of the chiming of a bell does not rule out a flexible way of dealing with these innovations, nor does it rule out the possibility that different segments of the population dealt with them differently, neither does it rule out that more traditional forms of time measurement continued to be used in parallel.[55]

One may wonder whether the lack of documents concerning the construction of the mechanical clock is not simply due to the fact that it was a very gradual process, or a process that was not public before the tower clock with striking mechanisms were introduced. Moreover, the *terminus post quem* (1271) says nothing about how long the construction of a mechanical clock had been attempted. In any case,

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[51] Dohrn-van Rossum, *The Story of the Hour,* pp. 90-95.

[52] 52 Ibid, pp. 106-108.

[53] Crosby, *The Measure of Reality,* p. 80.

[54] Arno Borst, *Computus. Zeit und Zahl in der Geschichte Europas*, Berlin[3] 2004, p. 103.

[55] See also Dohrn-van Rossum, *The Story of the Hour,* pp. 111-112, and Nancy Mason Bradbury and Carolyn P. Collette, "Changing Times. The Mechanical Clock in Late Medieval Literature," in *The Chaucer Review* 43, no. 4 (2009), p. 352.

the discovery of the mechanical clock seems to indicate that there was a need for such a timepiece. The popularity of the invention in the urban environment and the extremely rapid dissemination of the clock[56] also testify to the fact that it was not just an instrument needed for astronomical research.

In all these considerations, one must not lose sight of the fact that it is not clear which historical factors acted as causes, which as effects. The image of the newly invented mechanical clock leads to the one-sided question of what changes it brought about. But nothing compels the assumption that the mechanical clock changed the sense of time; it is just as plausible (or more plausible?)—if we disregard the possibility of complex interrelations—that a new sense of time produced the measuring instrument required for its needs.[57] The exact time of its invention is then a secondary indicator marking a change in the history of mentalities. Three elements of this process are relevant to the question at hand:

1. Subdivision of time: The time is divided into small, defined units. "Now the tower clock also struck the half and quarter hours, and one already began to think in minutes and seconds, which until then had only been used by astronomers," as Arno Borst pointedly put it, even if—in the context of his differentiated taxonomy of time that rightly avoids a blind belief in progress—this only applies to one of four versions of time that he distinguishes from one another.[58] [p. 19]
2. Regulation of working time: Working time was regulated in a novel way, admittedly again in a multi-layered and partly contradictory process.[59] Since the end of the 14th century, it can also be documented that there was a clear effort to regulate committee times, market times, working hours, etc. by clearly specifying the hours.[60] This was an urban phenomenon.
3. Abstraction of time: Time is abstracted from the natural processes of life. The hour, like the other units, possesses an identity independent of the seasons.[61] Aaron Gurevich formulated it thus: "It was in the European city that time began, for the first time in history, to be 'isolated' as a pure form, exterior to life."[62] Admittedly, this quotation comes from one of those pictures of history painted with broad brushstrokes that have often been viewed critically in recent historiography.[63] However, the fact that there was now the possibility of

[56] On the example of England, see Linne R. Mooney, "The Cock and the Clock. Telling Time in Chaucer's Day," in *Studies in the Age of Chaucer* 15 (1993), p. 105.
[57] See also the discussion of the York case study in Chris Humphrey, "Time and Urban Culture in Late Medieval England," in *Time in the Medieval World,* ed. by Chris Humphrey and W. Mark Ormrod, Woodbridge 2001, pp. 105–118.
[58] Borst, *Computus*, p. 106.
[59] Dohrn-van Rossum, *The Story of the Hour,* p. 217; Crosby, *The Measure of Reality*, p. 82.
[60] Dohrn-van Rossum, *The Story of the Hour,* pp. 220 and 267.
[61] Crosby, *The Measure of Reality,* pp. 81–82.
[62] Gurevich, "Time as a Problem of Cultural History," p. 241.
[63] Cf. Dohrn-van Rossum, *The Story of the Hour,* pp. 110–114.

abstractly conceiving time in everyday life as an option alongside other frameworks is already evident due to the previously mentioned factors—regulation of working hours, introduction of committee times, etc.

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Building on these three characteristics—subdivision, regulation, abstraction—it is now possible to specify the hypothesis that the changes in the handling of musical rhythm are related to changes in the perception of time:

1. The subdivision of musical time became an explicit topic in music theory starting in the 13th century. As durations of tones were traced back to time units, the entire system of note values presented itself as a system either of adding time units or, conversely, of subdividing longer durations. The importance of the idea of divisibility is shown both by the statement of Johannes de Garlandia, according to whom the musical unit of time (*tempus*) is indivisible,[64] and demonstrated in the claim of Johannes de Muris that musical time could in principle be subdivided into infinitely small parts by analogy with time as commonly understood—both authors use the term *tempus.*[65] Decisive for the present argumentation is not whether [p. 20] a new concept of time is reflected in such statements, but that music theory was working on a problem that had in fact become central for musical practice: subdividing durations of tones. The discussions associated with the *ars nova* about binary or ternary time[66] and about the smallest note values[67] also revolved around the problem of the subdivision of time values.
2. A fundamental, new way to regulate musical rhythm was introduced. In the 13th century, fixed note values were introduced that stand in very specific relations to one another. A discourse arose which extended at least from the middle of the 13th century to the end of the first third of the 14th century and in which such central authors as Johannes de Garlandia, Franco of Cologne, Jacobus de Ispania (Jacques de Liège) and Johannes de Muris were involved. The desire to impose

[64] Johannes de Garlandia, *De mensurabili musica,* ch. I, pp. 37–38: "dicendum, quod unum solum tempus, prout hic sumitur, est illud, in quo recta brevis habet eri in tali tempore, quod t indivisibile." See also Erich Reimer in the commentary volume, p. 46.

[65] Johannes de Muris, *Notitia artis musicae,* ed. by Ulrich Michels (= Corpus scriptorum de musica 17), Rome 1972, ch. XIII, p. 104: "Tempus est de genere continuorum, ergo potest dividi in quotlibet partes aequales."

[66] Ibid: "Laudabilis autem esset musicus et peritus, qui super idem tempus aequale ipsum dividendo nunc per duas, nunc per tres et ceteras partes integre discantaret."

[67] Jacobus Leodiensis, *Speculum musicae,* vol. 7, ed. by Roger Bragard (= Corpus scriptorum de musica 3), Rome 1973, chap. XV, p. 32: "Cum Antiqui, inquiunt, semibreves dicant esse indivisibiles, non est hoc verum, secundum Modernos, cum quaelibet trium semibrevium, in quas brevis perfecta ponitur esse divisibilis, iterato divisibilis sit in tres quae minimae vocantur."

an organizational system on this new regulation is expressed particularly clearly in the tables that Johannes de Muris used to illustrate the durations of tones (see, for example, Figure 1). Indeed, at the latest in the motets of the 13th century, works were composed that would be inconceivable without a fully codified system to organize musical time that precedes the act of performance. The fact that there are partly distinct traditions associated with the pieces, that the notation allows different readings in details, and that overall the motet in the 13th century has collage-like features or must be read as a "work in progress" (anachronistic, but nevertheless illuminating descriptions), does not invalidate these observations. For, all such works show polyphonic structures that are based on a system of measured durational values.

3. The compositional practice presupposes an abstraction of musical rhythm. In particular, compositions for more than two voices no longer function when rhythm is structured based on feeling and context. Already a short time after rhythm came to be based on an abstract, a priori system, composers made use of the possibilities created by this, by setting the *tenores* in each *cursus* of a motet rhythmically identically, or by composing *tenores* according to a quasi-isorhythmic structure (cf., for example, Mo 25, Mo 30, or Ba 49), but also by composing a kind of ritardando at the end of a motet (as in Ba 72), or by changing the rhythm while keeping the sequence of notes unaltered (as in Ba 73), and so on.[68] [p. 21] The elaborate procedures of diminution and isorhythm, as common in the 14th century, can be seen as a continuation of such compositional methods. Even if such terms are, first, anachronistic and, second, it is now clear that these phenomena must not be overemphasized as constructive formal elements, nor be torn out of their appropriate context,[69] they were in any case employed as elements of compositional practice. Finally, a composition such as Guillaume de Machaut's *Ma fin est mon commencement*, which is reflected symmetrically around a central axis, is inconceivable without an abstract understanding of musical time.[70] His text directly thematizes this peculiarity.

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[68] Editions: Hans Tischler (ed.), *The Montpellier Codex,* 4 vols, Madison 1978-1985; Gordon A. Anderson (ed.), *Compositions of the Bamberg Manuscript* (= Corpus mensurabilis musicae 75), Rome 1977.

[69] See Annette Kreutziger-Herr, *A Dream of the Middle Ages*, p. 266, and again Bent, "What Is Isorhythm?".

[70] See also Crosby, *The Measure of Reality,* pp. 162-163.

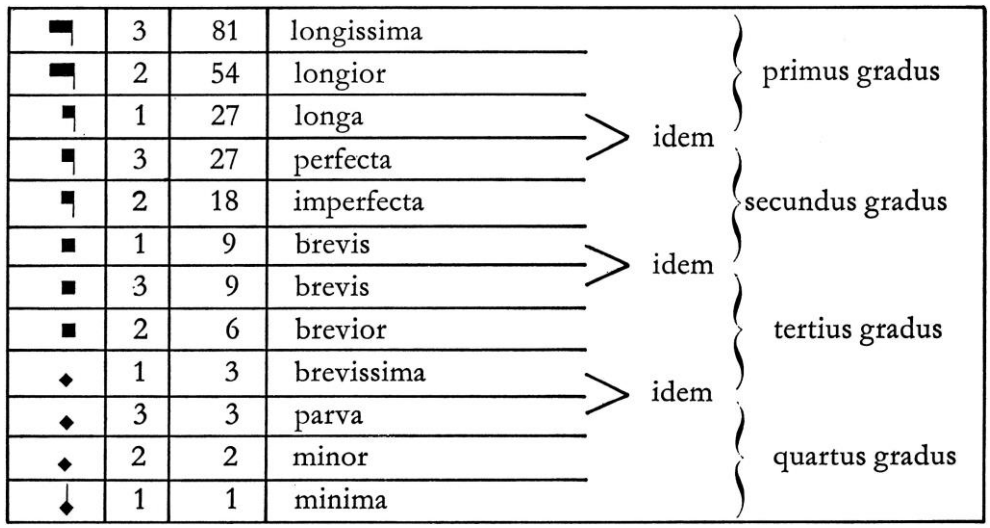

Fig. 1: Johannes de Muris, *Notitia artis musicae,* ch. V, p. 79.

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The fact that these musical transformations took place in the urban space is consistent with the fact that the general changes in perceptions of time also happened in the urban context. Gerhard Dohrn-van Rossum writes about this:

> The change in the urban organization of time, which began synchronously with the spread of public clocks in the late 14th century, was not the result of political decisions. Neither promoting nor accelerating nor inhibiting authorities or interests can be identified. Rather, the change in organization of time was a largely anonymous process [p. 22] that began with many small steps in different and independent urban spheres of life. The organization of time can thus be understood as a process of modernization and consolidation of time-organizing regulations.[71]

Like the spread of the hour-striking clock, polyphony, as established since the 13th century, would then be an expression of social consolidation and modernization.

However, if one accentuates the geographic fact that public clocks and the modern hourly calculation originated in Italy,[72] and the chronological fact that the spread of hour-striking city clocks and the new regulation of working time according to identical hours can only be documented for the end of the 14th century,[73] it is

[71] Dohrn-van Rossum, *DieGeschichtederStunde*, pp. 250-251; see also Crosby, *TheMeasureofReality,* p. 148.

[72] Dohrn-van Rossum, *The Story of the Hour,* p. 129.

[73] Mooney, however, emphasizes the speed with which the new era took hold in the 14th century (Mooney, "The Cock and the Clock," p. 92).

difficult to establish a relationship with the emergence of measured rhythm, which began around 1200 in Paris.

Both the spatial and the temporal incongruence must be dealt with in the methodically self-reflexive thesis formation, as it has been postulated here. Crucially, the question arises whether these two incongruencies are sufficient to falsify the thesis. This would only be the case, however, if one were to assume a direct causal relationship between the phenomena, i.e., if one were to argue that either the mechanical clock and the modern measurement of time had produced mensural music or, conversely, that mensural music had produced the mechanical clock and modern measurement of time. In this respect, examining this double inconsistency certainly helps to refine the hypothesis. Dealing with the geographic problem gives us the opportunity to state the main argument underlying this study more precisely: It is not assumed, as already indicated above, that there is a direct connection between time measurement or even the mechanical clock and mensural music, but only an indirect one, namely that these are two phenomena which react to the same development. And this development tends to be pan-European, i.e., a gradual change in the perception of time. This perception of time is expressed, on the one hand, in a certain musical rhythmic system, and, on the other hand, in the invention of the mechanical clock. The adoption of the early Italian tradition of installing public clocks was soon taken up in other regions because the cultural constellations were apparently comparable to such an extent that the new apparatus met with interest in various European centers. In Dohrn-van Rossum's list of public clocks, Italian cities are mentioned, starting with Orvieto in 1307/08, but Valenciennes follows in 1325/44, Windsor [p. 23] Castle in 1351/53, Avignon in 1353, Prague in 1354(?), Perpignon in 1356, Regensburg in 1358 and Vincennes in 1359.[74] And the clocks in England listed by Linne Mooney were not even considered by Dohrn-van Rossum.[75] Thus, it would be misleading to associate the mechanical clock specifically with "Italy."

That this phenomenon tends to be a pan-European one is confirmed once again by turning to the more serious problem of the asynchrony between the emergence of mensural music on the one hand and the emergence and spread of the mechanical clock on the other. At a minimum, the following indications should be taken into consideration:

1. The emergence of mensural notation, for its part, was a long process:[76] The first theoretical treatise dates from about 1250; however, discussions did not end

[74] Dohrn-van Rossum, *The Story of the Hour,* pp. 125–128.

[75] Mooney, "The Cock and the Clock," pp. 104–106.

[76] The extremely subtle expositions in Walter's *Grundlagen der Musik des Mittelalters*, which describe several transformations of the musical understanding of time in the history of music between 900 and 1400, would mostly fit well with this observation. In this study, however, many conclusions are drawn from very scant evidence, meaning the conclusions do not always seem to me to be sufficiently secure.

before 1330. And the musical development extends from modal notation to the Franconian notation and the notation of the *ars nova*. The fully codified abstract system for dealing with musical time is thus established only around 1350.[77]

2. Alongside rhythmically measured music, music in free rhythm continued to exist. Liturgical music often alternated in sections between rhythmically regulated and free passages (chant, organum, copula, discantus). It was not until the 14th century that the organum lost importance.[78] The monophonic chant continued to be practiced. The music of the troubadours, trouvères, etc. apparently did not undergo the same development.[79] Mensural music represented only one of many varieties of rhythm of the time.
3. Regarding the change in the perception of time, several symptoms can be identified that extended over a long period of time: [p. 24]
   a) the tendency observed in a monastic context documented at the end of the 12th century that make the possession of a clock mandatory[80]
   b) the disputes about the standardization of working hour in connection with efforts to determine fair wages at the latest in the 13th century[81]
   c) the indication of the time of day in notarial records since the beginning of the 13th century, although initially only in Italy[82]
   d) the invention of the mechanical clock after 1271[83]
   e) the inclusion of the times of day by chroniclers of the late 13th century[84]
   f) the introduction of the hour-striking clock no later than 1336[85]
   g) the new working time regulations from the end of the 14th century, etc.[86]

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[77] That the theoretical understanding of the new approach to rhythm took some time may be related to the conceptual difficulties that music theorists faced because of the traditions in which they found themselves and the pedagogical socialization they experienced. Cf. Max Haas, *Musical Thought in the Middle Ages: Eine Einführung*, Bern 2005, pp. 440–463.

[78] Rebecca A. Baltzer, "How Long Was Notre-Dame Organum Performed?", in *Beyond the Moon. Festschrift Luther Dittmer*, ed. by Bryan Gillingham and Paul Merkley, Ottawa 1990, pp. 129–130. Conversely, Ernest H. Sanders suggests that there were discantus passages that should be interpreted as modal rhythm as early as the 12th century ("The Earliest Phases of Measured Polyphony," in: *Music Theory and the Exploration of the Past*, ed. by Christopher Hatch and David W. Bernstein, Chicago 1993, pp. 41–58).

[79] Cf. Aubrey, *The Music of the Troubadours*, pp. 246–250.

[80] Dohrn-van Rossum, *The Story of the Hour,* p. 66.

[81] Ibid, p. 268.

[82] Ibid, p. 208.

[83] Ibid, pp. 89–90.

[84] Ibid, p. 205.

[85] Ibid, p. 126.

[86] Ibid, p. 277.

Against this background, the thesis that it could have been a matter of two parallel and related developments mediated by fundamental cultural axioms, becomes once again plausible. Both modal notation and Franconian notation as well as the mechanical clock are only symptoms of these processes, and the more exact times at which they appeared have rather little significance. Both processes, however, extend equally over a long period of time roughly between the 12th and 14th centuries.

Examining the history of terminology employed lends additional weight to the thesis. To speak of time (*tempus*) in relation to rhythmic duration seems obvious. However, if one searches the music-theoretical sources of the Middle Ages for this use of the term, it is striking that the term *tempus* for rhythmic duration does not come into play to any significant extent until the discussion about the regulation of rhythm after 1250. The term *tempus* is only found in four treatises on music that I know of between 900 and 1200. The one text by Remigius of Auxerre, namely his commentary on *De nuptiis Philologiae et Mercurii* by Martianus Capella, is extremely difficult to interpret, and due to its commentary character oscillates between ancient and contemporary views, which is legitimized by its direct link to an ancient tradition of metrics as also present in Augustine's *De musica*. If one omits this work, then only three texts remain. Firstly, it is remarkable that none of these remaining texts is focused on a concrete performance practice context, but that abstract theoretical topics are the subject of the passages in question, [p. 25] namely the subdivision of the discipline *musica* or its subject matter. Moreover, all three texts characteristically shift the question of *tempus* to another discipline. For Heinricus Augustensis (11th century), the measuring of syllables and times (*tempora*) explicitly does not belong to the task of the *musicus*, but to that of the *metricus*.[87] In the pseudo-Guidonian treatise *De modorum formulis et tonarius*, it says: "Duration (*tenor*), however, is the lingering (*mora)* of each individual voice, which the grammarians also call *tempus* with respect to short and long syllables."[88] And Theinred of Dover writes in the 12th century: "Musical tones are related to one another according to their quantities, at once according to their duration (*tempus*), which is a matter for the poetic or lyrical mode of consideration, and at the same

[87] Heinricus Augustensis, *Musica,* ed. by Joseph Smits van Waesberghe (= Divitiae Musicae Artis, Ser. A, vol. 7), Buren 1977, p. 36: "D Qui sunt, qui abusive musici vocantur? M Metrici, qui certo syllabarum et temporum numero modulandis versibus inserviunt."

[88] Anonymus, *De modorum formulis et tonarius*, ed. by Clyde Brockett (= Corpus scriptorum de musica 37), Rome 1997, p. 48: "Tenor autem est mora uniuscuiusque vocis, quem et tempus grammatici in syllabis brevibus et longioribus superscribunt." On the term *mora*, see also Sanders, "Consonance and Rhythm in the Organum," p. 285 and Walter, *Grundlagen der Musik des Mittelalters*, p. 143, footnote 14.

time according to height and depth, which belongs to the musical mode of consideration."[89]

Tempus comes into focus as a term or as an object only at the margins of *musica* before the 13th century. This could be related to the fact that rhythm was handled much more freely in music, as Guido of Arezzo writes: "Let the musician determine from which of these subdivisions [meaning here *neumae of* different lengths] he forms the unfolding chant, just as the metrician determines from which verse feet he composes the verse, except that the musician does not constrain himself so much by the necessity to adhere to a law."[90] Thus, the terminology used specifically for mensural music coincides with terminology that was familiar from the context of measuring time by means of the clock. The famous testimony of Robertus Anglicus, from which the *terminus post quem* for the invention of the mechanical clock is derived, employs the word *tempus* several times;[91] and Petrarch mentioned in the 14th century [p. 26] a "*publicum horologium*," still considered new, by which almost all the citizens of southern Alpine Gaul measured time (*tempus*).[92]

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The seriousness of historical research, which of course is fundamentally dependent on current problems and discussions, necessitates that we reflect on our own interest in knowledge. In the present case, this interest also includes the proof that

[89] Theinred of Dover, *De legitimis ordinibus pentachordorum et tetrachordorum,* ed. and transl. by John L. Snyder (= Musical Theorists in Translation 18), Ottawa 2006, p. 146: "Referuntur autem musici soni ad se invicem secundum sui quantitates, aliquando secundum tempus quod poetice vel lyrice considerationis est, aliquando secundum acumen et gravitatem quod ad musicam contemplationem attinet."

[90] Guido Aretinus, *Micrologus,* ed. by Joseph Smits van Waesberghe (= Corpus scriptorum de musica 4), Rome 1955, ch. XIV, p. 167: "Proponatque sibi musicus quibus ex his divisionibus incedentem faciat cantum, sicut metricus quibus pedibus faciat versum, nisi quod musicus non se tanta legis necessitate constringat."

[91] Lynn Thorndike, "Invention of the Mechanical Clock about 1271 A. D.," in: *Speculum* 16, no. 2 (1941), pp. 242-243, e.g., p. 243: "Hora equalis vocatur vicesima quarta pars diei naturalis unde si totum tempus diei naturalis divideretur in 24 partes equales quelibet partium illarum diceretur una hora equalis et iste hore sumuntur penes ortum partium equinoctialium et est una hora nihil aliud nisi tempus dum oriuntur 15 gradus de equinoctiali."

[92] Franciscus Pertrarca, *Epistolae de Rebus Familiaribus et Variae,* vol. 3, ed. by Joseph Fracassetti, Florence 1863, var. XLIV, p. 419: "[...] publicum horologium, quo ultimo invento per omnes fere iam Cisalpinae Galliae civitates metimur tempora [...]." An investigation of the question whether and to what extent in this milieu the general language usage of times of day and durations also changed in the course of the changing time experience could provide additional information but cannot be done here in view of the extraordinary amount of material and the complexity of the sources to be interpreted.

there are examples of an inner connection between music and other cultural factors in the history of music. Thus, the accounts may be unintentionally biased. Armed with such skepticism, I will tackle two factors that call for a critical examination.

First, the existence of dance music before mensural music might at first sight seem to be evidence against the thesis presented here, because of course the regularity of danceable rhythms could have been measured. This difficulty can be resolved if one interprets the performance of rhythm in dance music not as the implementation of an abstract, predetermined scheme, but as the musical realization of regular bodily movements. Indeed, Elisabeth Aubrey and Hans-Herbert Räkel write, "The weighted syllables in instrumental melodies reflect the physical movement of steps; the rhythm thus obtained is heteronomous to the melody."[93] In this sense, then, it is accidental that dance rhythm is at the same time measurable. We are dealing, as in chant, early polyphony, etc., with a regulation of musical durations derived from context. However, this observation helps us to further refine the thesis: the claim is not that people before the time of mensural music would not have been able to perform regular rhythms,[94] but merely that musical durations before [p. 27] mensural music were essentially not understood as realizations of abstract values but as the execution of context-sensitive actions, and that this way of dealing with musical durations corresponded to the way of dealing with time in everyday life.

The second factor, on the other hand, seems to harbor more potential to falsify the thesis: Some music treatises of the Early and High Middle Ages mention the measurement of tone durations by means of beating or counting (*plaudere*, *percuti*), which served the purpose of coordinating the performance of shorter and longer tones in the choir.[95] In these texts, the focus is particularly on the final notes

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[93] Räkel and Aubrey, "Troubadours, Trouvères," column 965.

[94] Augustine already emphasized the anthropological tendency of humans to perform actions such as chewing, walking and scratching rhythmically evenly in analogy to the pulse: Augustine, De musica. Bücher I und VI. Vom ästhetischen Urteil zur metaphysischen Erkenntnis, ed. and trans. by Frank Hentschel (= Philosophische Bibliothek 539), Hamburg 2002, book VI, chap. VIII/20, p. 109. And in Latin poetry, unlike in the vulgar languages, quantizing metrics was common practice alongside accentuating (rhythmic) ones: Günter Bernt et al. "Vers- und Strophenbau," in Lexikon des Mittelalters, vol. 8, ed. by Norbert Angermann, Munich 2002, sp. 1570-1579; Jürgen Leonhardt, Dimensio syllabarum. Studien zur lateinischen Prosodie und Verslehre von der Spätantike bis zur frühen Renaissance (= Hypomnemata 92), Göttingen 1989. I would like to thank Peter Orth, Cologne, for helpful comments.

[95] Anonymus, Scholica enchiriadis de musica, ed. by Hans Schmid (= Bayerische Akademie der Wissenschaften. Veröffentlichungen der Musikhistorischen Kommission 5), Munich 1981, Part I, p. 86, line 384 to p. 89, line 428; Anonymus, Commemoratio brevis de tonis et psalmis modulandis, ed. by Hans Schmid, ibid, p. 176, line 295 to p. 177, line 359; Anonymus, Die Quaestiones in musica. Ein Choraltraktat des zentralen Mittelalters und ihr mutmaßlicher Verfasser Rudolf von St. Trond (1070–1138), ed. by Rudolf Steglich,

of sections that were supposed to be sung for longer.[96] In part, these texts seem to suggest that the tones of the chant had, in principle, a uniform duration.[97] As we have already seen, this contradicts the currently favored attempts to reconstruct monophonic rhythmic practice. In view of the difficulty of interpreting these sources and their rarity—they can be traced back to a *Scolica enchiriadis* or *Commemoratio brevis* tradition and a Guido of Arezzo tradition—it seems prudent to, on the one hand, not overestimate them, even though they are found in important sources. On the other hand, one must not ignore their existence. In addition, we should not rule out the possibility that theories of metrical chant interpretation will one day experience a revival. In this respect, there is an important potential for falsification in the discussions about the practice of interpreting monophonic music. A falsification of the thesis about the connection between mensural music and the new sense of time is not so much to be expected on the basis of the interpretation of sources from the 13th and 14th centuries, but on the basis of findings about earlier musical practice. In the end, one arrives at the comfortable position of having a clear perspective [p. 28] for falsification, which unfortunately is not always the case in the humanities.[98]

The last-mentioned sources clarify once again that it would be absurd to argue that people of earlier times would not have known the possibility to count rhythmic durations at all. The only sensible claim is that this possibility did not function as a fundamental and general element of musical rhythm. The change in musical rhythm between the 12th and 14th centuries must therefore be understood as a gradual quantitative, not qualitative process, within which, first, music was measured rhythmically from itself, i.e., not as a representation of pre-existing speech rhythm or danceable bodily movements, second, rhythmic quantification became a central,

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Leipzig 1911, pp. 60-62; Guido Aretinus, Micrologus, ch. XV, pp. 162–177; Anonymus, Expositiones in Micrologum Guidonis Aretini. Liber argumentorum, Liber specierum, Metrologus. Commentarius in Micrologum, ed. by Joseph Smits van Waesberghe (= Musicologica medii aevi 1), Amsterdam 1957, pp. 146, 83–154, 84; Aribo, De musica, ed. by Joseph Smits van Waesberghe (= Corpus scriptorum de musica 2), Rome 1951, ch. XXI, pp. 48–51.

[96] On these sources, see Walter, Grundlagen der Musik des Mittelalters, pp. 127–131 and 138–153, and on Guido and Aribo Karen Desmond, “Sicut in grammatica: Analogical Discourse in Chapter 15 of Guido's Micrologus,” in The Journal of Musicology 16, no. 4 (1998), pp. 467–493, especially pp. 479–485.

[97] Walter, Fundamentals of Medieval Music, p. 130; Desmond, "Analogical Discourse," p. 484.

[98] Karl Popper’s theory of science might still provide the most important criterion for scientificity (*Logik der Forschung*, Tübingen[10] 1994), and at least as a regulative idea it must also guide research in the humanities. However, apparently plausible theses are repeatedly formulated in the humanities without any possibility of their falsification being apparent. As far as I can see, the current discussions in philosophy of science do not offer any solutions to this problem.

theorizable aspect of music theory that was treated in detail in written discourses, and third, the foundations were laid for the mensuration of music to increasingly become a matter of course in musical practice and composition, encompassing more and more genres.

At the end, it should be emphasized once again that the thesis advanced here is in no way intended to imply that there was a direct dependence between the invention of the clock and the emergence of mensural music. Rather, we must assume an underlying connection, mediated by a common cultural process that concerned the experience of time and from which, not coincidentally, the mechanical clock and mensural music emerged at approximately the same time. Nevertheless, there are also some direct connections between time of day or time measurement and music, which should be listed briefly, although in terms of our argument they are at best secondary indications:

1. In the monastic context, there was no modern notion of punctuality: according to the Rule of Saint Benedict (6th century), the second psalm of the vigils is to be sung very slowly and with pauses as to allow latecomers to join the liturgy of the vigils.[99]
2. In the *Commemoratio brevis,* written around 900, it is explained that it is not arbitrary when to sing faster and when to sing slower, but that this depends on the occasion and time: "Furthermore, for example, the psalms or any other melody are to be sung faster or more humbly according to the occasion and the time [as well as] in accordance with the smaller or larger number of singers. For it is also not proper [p. 29] to perform (*modulari*) the chant at any time (of day) in a way (*modus*) that does not differ in pitch. Rather, the morning merriment is to be sung with a higher melody than the nightly assembly."[100]
3. Peter Damian (11th century) recommended to the alarm service in case of poor star visibility to memorize the duration needed to sing individual psalms, and then measure the time accordingly.[101]
4. At least music theory in the narrow sense belonged to the same circle of mathematical sciences that included astronomy and thus was a subject directly related to the construction of timepieces. Therefore, it is not surprising that in the context of the *Musica speculativa* (but not the *Notitia artis musicae,* which deals with *musica mensurabilis*) of Johannes de Muris, some *libri ad fabricam horologiorum* or similar are to be found, whatever may be hidden behind these

[99] Dohrn-van Rossum, *The Story of the Hour,* p. 42.

[100] Anonymus, *Commemoratio brevis*, pp. 176 and 320–324: "Praeterea quemadmodum psalmi vel alia quaelibet melodia ad rationem causae vel temporis, pro paucitate vero seu multitudine cantorum celsius vel humilius canendi sunt, nec enim indierenti altitudinis modo cantum cuiusque temporis modulari oportet, verbi gratia matutina laeticia elatiore canore celebrando quam nocturna synaxis."

[101] Dohrn-van Rossum, *The Story of the Hour,* p. 61.

references.[102] However, as with most sources of *musica speculativa,* these are manuscripts from the 15th century.

5. In the 13th century the construction of bells, organs, and clocks came under the purview of the same mechanics,[103] and in Jean de Meung's *Roman de la Rose* (c. 1230) a musical instrument is called an orologes.[104]

As a rule, the emergence of mensural music in musicology has either been derived from the musical material alone or has been attempted to be explained by transferring poetic procedures and characteristics to music.[105] The present approach to explain mensural music based on the history of time perception should by no means compete with other such approaches. For there is no reason to assume that only one single cause was responsible for the emergence of mensural music. Rather, several causes may be interrelated, provided they do not contradict each other. In particular, it is conceivable that the possible causes are [p. 30] interdependent to a certain extent. The different hypotheses about the origin of mensural music will not be discussed now, as they do not compete with the question of the role of the perception time in the manner suggested here. But by means of a short example, I will explain to what extent the explanatory approaches can be in a relationship of dependence to each other: Edward H. Roesner develops his thesis based on a polyphonic practice that he terms "proto-modal" music.[106] In this music, the temporal organization was largely a function of the melodic, tonal, and temporal content of the music. The characteristic aspect of this music was the alternation of stable and unstable sounds, which led not only to the emergence of the first mode, but also introduced the feeling for a pulse.[107] But this interpretation, for its part, of course again ignores the question why this transition occurred exactly at the time it did. Here we must then turn to the more general hypothesis on the experiences of time in the Middle Ages.

The aim of the present study was to make a plausible argument that, despite all due caution, a thesis about a possible connection between the emergence of

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[102] See the Hss. Mü 5, Ro2 and L1 in Christoph Falkenroth, *Die Musica speculativa des Johannes de Muris* (= Beihefte zum *Archiv für Musikwissenschaft* 34), Stuttgart 1992, pp. 44, 54 and 58.

[103] Dohrn-van Rossum, *The Story of the Hour,* p. 98.

[104] Ibid, p. 92.

[105] See esp. William G. Waite, *The Rhythm of Twelfth-Century Polyphony: Its Theory and Practice,* New Haven 1954; Leo Treitler, "Regarding Meter and Rhythm in the *Ars antiqua,*" in *The Musical Quarterly* 65, no. 4 (1979), pp. 524–558; Margot E. Fassler, "Accent, Meter, and Rhythm in Medieval Treatises 'De rithmis'," in *The Journal of Musicology* 5, no. 2 (1987), pp. 164–190; Margot E. Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," in *Speculum* 62, no. 2 (1987), pp. 345–374; Roesner, "The Emergence of *Musica mensurabilis,*" pp. 41–74.

[106] Roesner, "The Emergence of *Musica mensurabilis,*" p. 48.

[107] Ibid, pp. 47, 48 and 50, respectively.

musica mensurabilis and the spread of a new experience of time can be reasonably put forward, which may serve as the starting point for more detailed research. Assessing the plausibility of the thesis is ultimately a matter of subjective intuition, even though it may be based on facts that are objective in themselves (insofar as historiography can be objective). To blindly surrender to the thesis or to simply reject it seem to be equally unserious positions. There is a point, even if deciding when we have reached this point is again subjective, at which the denial of a cultural-historical connection with the help of—or under pretense of—positivist arguments, such as the—admittedly exaggeratedly naïve—argument that there is no explicit testimony proving the connection, is actually more dubious than the assumption that such a connection exists. Indeed, not proposing a hypothesis is also a judgment. Only this is easily overlooked, because rejecting an assumption if it is not proven beyond doubt has the appearance of more rigorous standards of research. In reality, however, the denial of a connection is also such an assertion, just an implicit one.