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EPISTEMOLOGIES OF TIME AND METRE IN THE LONG EIGHTEENTH CENTURY

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ABSTRACT

Wilhelm Seidel was the first to regard Johann Philipp Kirnberger's reformulation of metre in Die Kunst des reinen Satzes in der Musik *as a watershed moment in the history of music theory. As we consider Kirnberger's innovation and importance in regard to his break with the past, we might examine more closely the conditions that made his re-imagining of metre possible. Kirnberger's vital treatise participated in a broad epistemological shift in the conception of time. Changing metaphysical notions of time, along with technological developments such as the mechanical clock and the marine chronometer, helped to reshape a wider public's notion of temporal passage. Alongside these developments, the nature of metre and tempo in music underwent continual revision. This article will explore the impact of shifting temporal conceptualizations on metre in the eighteenth century.*

I

The history of metre has few great moments. If there is one in the eighteenth century, it is Johann Philipp Kirnberger's reformulation of metre in *Die Kunst des reinen Satzes in der Musik* (1771–1779), first pointed out by Wilhelm Seidel.[1] Kirnberger, along with his associates Johann Georg Sulzer and Johann Abraham Peter Schulz, fundamentally re-imagined the nature of temporal regularity in music through his conception of metre. He described bar division as created by accentuation, thus departing from the traditions that preceded him, which regarded accentuation as fixed in location within the bar. In remarks on Kirnberger's conception of metre, Carl Dahlhaus noted connections to theories of time, observed a correlation with Isaac Newton's refiguring of time in the *Principia*, and ultimately connected Kirnberger's innovation to the temporality of Hegel's dialectics.[2]

Many thanks are due to Gary Tomlinson, Emily Dolan, Gavin Steingo, Cliff Eisen, W. Dean Sutcliffe, Keith Chapin and the two anonymous readers for the journal, all of whom read drafts of this text and helped me to shape my ideas.

1 Wilhelm Seidel, *Über Rhythmustheorien der Neuzeit* (Bern: Francke, 1975), 85–134. Seidel's ideas on this issue were later taken up in Carl Dahlhaus, *Die Musiktheorie im 18. und 19. Jahrhundert. Zweiter Teil: Deutschland*, ed. Ruth E. Müller (Darmstadt: Wissenschaftliche Buchgesellschaft, 1989), 157–173, and William Caplin, 'Theories of Musical Rhythm in the Eighteenth and Nineteenth Centuries', in *The Cambridge History of Western Music Theory*, ed. Thomas Christensen (Cambridge: Cambridge University Press, 2002), 666–668. It is important to note here the collaboration between Kirnberger, Sulzer and Schulz on the music articles in Johann Georg Sulzer's *Allgemeine Theorie der schönen Künste* (1771–1774), where the formulation of metre is nearly identical to that in Kirnberger's *Die Kunst des reinen Satzes*. For the sake of convenience, the present article follows Caplin in identifying Kirnberger as the principal theorist. For more on the collaboration between Kirnberger, Sulzer and Schulz see David Beach, Introduction to Johann Philipp Kirnberger, *The Art of Strict Musical Composition*, trans. David Beach and Jürgen Thym (New Haven: Yale University Press, 1982), and Nancy K. Baker's partial translation of Heinrich Christoph Koch's *Versuch einer Anleitung zur Composition* as *Introductory Essay on Composition: The Mechanical Rules of Melody, Sections 3 and 4* (New Haven: Yale University Press, 1983), xvii, note 19.

2 Dahlhaus, *Die Musiktheorie im 18. und 19. Jahrhundert: Deutschland*, 160. See also Seidel, *Über Rhythmustheorien der Neuzeit*, 85–108. The present study builds upon the work of Dahlhaus and Seidel by considering music theory in the context of the history of science and technology and with an eye towards broader epistemological transformations.

By judging Kirnberger's innovation against his predecessors' ideas, we might see more clearly the conditions that made his re-imagining of metre possible. Kirnberger's vital treatise participated in a broad epistemological shift in the conception of time. The publication of Newton's *Principia* marked the beginning of an era in which the concept of time itself was in flux. Technological developments such as the mechanical clock and the marine chronometer helped to reshape a wider public's notion of temporal passage. Alongside these developments, metre and tempo in music underwent continual revision. Examining these seemingly disparate aspects of history together can allow us to understand how time – something easily taken for granted as an unchanging blank tablet on which history sits – underwent a turbulent reconceptualization during the long eighteenth century. The purpose of the present article, then, is to explore the impact of shifting temporal conceptualizations on metre in those years.

In *The Archaeology of Knowledge* Michel Foucault reflected on the work of Gaston Bachelard, using it to frame his own point of departure: 'the epistemological acts and thresholds described by Bachelard . . . suspend the continuous accumulation of knowledge, interrupt its slow development, and force it to enter a *new time*'.[3] *New time* – more specifically, the *negotiation* of time through theories of metre – will frame our explorations in the following section. In order to contextualize Kirnberger's contribution to the history of metre, we must consider the different traditions of metre out of which his work emerged. A review of thought about temporality in the seventeenth and eighteenth centuries will illustrate the relationship between Kirnberger's treatise and Newton's reframing of time. Placing Kirnberger and Newton in dialogue with technological developments will help to situate further their music-theoretical and philosophical discourses. Finally, we can trace the affordances of Kirnberger's re-imagination of metre in relation to changing notions of tempo.

II

Writings on metre in the seventeenth and eighteenth centuries appear in a limited number of contexts. Treatises on performance addressed the issue with varying frequency, some focusing on the practice of beating time for an ensemble. Composition treatises and general musical instruction manuals regularly included a discussion of metre alongside other musical fundamentals. Later, encyclopedias attempted to explain the foundation of broader concepts and thereby carved out a place for metre within the nature of music. Echoing through these different types of sources, three primary strands of thought on metre form the background for Kirnberger's treatise: traditions of (1) *thesis* and *arsis*, (2) *rhythmopoeia* and (3) the *quantitas intrinseca*. Of primary importance in considering these traditions is their common conception of accentuation as located within a predetermined bar division.

Theorists in the seventeenth century defined the principal unit of time measurement, or beat, as the *tactus*, or *battuta* in Italian. The *tactus* was subject to accentuation or non-accentuation according to its place in the bar. Seventeenth-century practice readily equated the bar with a single motion consisting of the fall and rise of a hand, a motion theorists codified in the terms *thesis* and *arsis* respectively.[4] In their seminal accounts of the musical beat, the seventeenth-century Italian theorists Agostino Pisa and Pier Francesco Valentini specified precise locations for the hand during the time-beating motion.[5]

3 Michel Foucault, *The Archaeology of Knowledge*, trans. A. M. Sheridan Smith (New York: Pantheon, 1972), 4 (my italics).

4 See the discussion on the origins of the bar in the seventeenth century in George Houle's *Meter in Music: 1600–1800* (Bloomington: Indiana University Press, 1987), still the most important secondary source in English on the history of metre in the seventeenth and eighteenth centuries.

5 Agostino Pisa, *Breve dichiaratione della battuta musicale (1611); con alcuni estratti da Battuta delle musica (1611)* [*sic*], ed. and introduced by Piero Gargiulo, Introduction trans. Hugh Ward-Perkins (Lucca: Libreria Musicale Italiana, 1996), *Breve dichiaratione*, particularly 9–11; Pier Franceso Valentini, 'Trattato della battuta musicale', Rome, Biblioteca Apostolica Vaticana, Ms. Barb. Lat. 4417, particularly 56–80. I am very grateful to Boston University Library and the Vatican Library for a photocopy of Valentini's treatise.

Agostino Pisa, a self-proclaimed 'doctor of canon and civil law, and theoretical and practising musician' living in Rome, published two polemical treatises on the musical beat in 1611: the *Breve dichiaratione della battuta musicale* and the *Battuta della musica*.[6] His main contention concerned the onset of the downbeat. In opposition to his contemporaries, he maintained that the beginning of the first beat was marked by the onset of the hand's initial fall in time-beating motion, rather than the moment at which the fall terminated. Through all of his vitriolic language – which provoked Banchieri to call his treatise 'a printed folio in *macerata*' – it is clear that Pisa's notion of the beat is bound fundamentally to motion.[7] Despite the differences with his contemporaries, Pisa's review of contemporaneous terminology related to the beat elucidates this same general connection. His treatise cites four basic definitions of the musical beat:

'*segno fatto dal musico*' (signal made by the musician) [Zarlino]
'*percussione di mano*' (beat of the hand) [Banchieri]
'*un'abbassare et uno levare di mano*' (a lowering and raising of the hand) [Scaletta, Tigrini, Diruta]
'*misura*' [Gaffurius, Fogliano, Vanneo, Picitone and Cerreto][8]

The definitions Pisa collected, which must have informed the discourse surrounding metre, reveal a visceral conception of beat. The concept of *battuta*, which was always described as in motion, united the measurement of a temporal unit with the physical motion of beating – the two-part movement of a hand. The *battuta* thus explicitly and simultaneously referred to two things: a unit of musical time and a physical stroke. This duality is only latent and normally goes unrealized in the modern English word 'beat'.

Valentini's treatise of 1643, the 'Trattato della battuta musicale', responds to Pisa's treatise by employing elaborate instructional diagrams to show the proper place of the hand in relation to place in the bar, indicating the appropriate accentuation for each beat.[9] Although Valentini agrees with Pisa that the falling motion of the hand initiates the first beat, he argues that the times during which the hand remains stationary in the raised and lowered position also constitute musical time.

Figures 1a and 1b reproduce Valentini's diagrams of duple and triple metre respectively. His illustrations make clear the delineation between what he calls the *battuta eguale* and the *battuta ineguale* (equal beat and unequal beat), corresponding respectively to duple and triple metre. With the accompanying hand gesture in mind, he accounts for the time during which the hand falls and rises, indicated in both figures as the *primo moto* and *secondo moto* (first movement and second movement) respectively. Likewise, he labels the times during which the hand remains stationary the *prima quiete* and *seconda quiete* (first repose and second repose). Particularly significant are the relative durations of Valentini's distinct 'times' created by the motions of the hand, or the *thesis* and *arsis* portions of the bar. While these portions are of equal length for duple metre, they are non-equivalent durations in triple metre. Read anticlockwise, the segment of the circle from A to B describes the first descending motion of the hand, and the segment from B to D, the time the hand will remain in the low position. The segment of the circle from D to E then describes the raising of the hand on what will be the third beat, and the segment from E to A describes the time the hand will remain in the high position. Importantly, the distance around the circle from A to D is twice as long as the distance from D back to A. The numbers Valentini has placed around the perimeter of this diagram can also help us

6 The second treatise, the *Battuta della musica*, is an expansion and elaboration of the ideas Pisa set forth in the first, the *Breve dichiaratione della battuta musicale*. The fact that these are two distinct works has been obscured by their shared publication date and location and by the erroneous reproduction of the title page of the *Breve dichiaratione* as the title page in another facsimile edition of the *Battuta della musica*: Pisa, *Breve dichiaratione della battuta musicale* (Bologna: Forni, 1969). Thankfully, Piero Gargiulo addresses this issue in his Introduction to Pisa, *Breve dichiaratione* (1996), vii, note 1. Pisa's self-description graces the title page of his *Battuta della musica*.

7 Adriano Banchieri, *Lettere armoniche* (Bologna: Girolamo Mascheroni, 1628), 146, as cited and translated in Clifford A. Cranna, 'Adriano Banchieri's *Cartella musicale* (1614): Translations and Commentary' (PhD dissertation, Stanford University, 1981), 471.

8 As cited and identified by Piero Gargiulo, Introduction to Pisa, *Breve dichiaratione*, trans. Hugh Ward-Perkins, xx.

9 Valentini, 'Trattato della battuta musicale', 76–79.

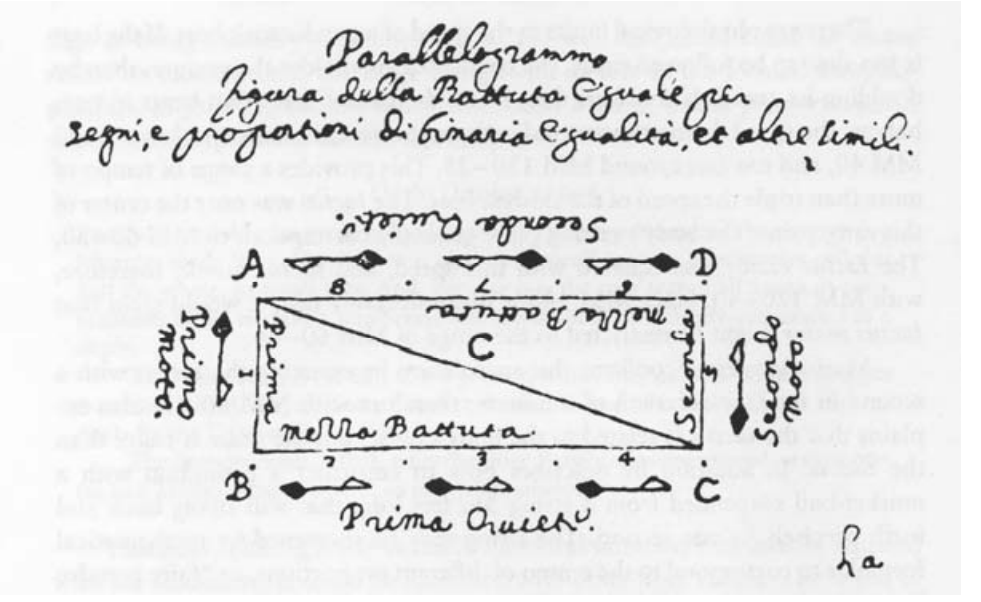

Figure 1a Parallelogrammo figura della battuta eguale, from Pier Francesco Valentini, 'Trattato della battuta musicale' (1643). Rome, Biblioteca Apostolica Vaticana, Ms. Barb. Lat. 4417, 76. Used by permission

to understand the non-isochronous nature of the triple metre he has constructed. The *circolo figura* contains twelve numbers around its perimeter; we can imagine that these represent twelve semiquavers in a bar of modern 3/4. The line dividing the circle in half – between the *primo moto/prima quiete* and the *secondo moto/seconda quiete* – is the segment from A to D, separating the initial eight semiquavers from the final four.

The duration of Valentini's individual 'times' rests on the unchanging two-part motion of the hand, as derived from the *prima* and *seconda* parts of the bar. Therefore triple metre emerges as an unbalanced version of duple. The motion of *thesis* and *arsis* takes precedence over the beat cardinality (the number of beats per bar), even to the extent of yielding an asymmetrical triple metre. In this regard, Valentini's description of metre is firmly rooted in the notion of time as a measurement of motion, deferring beat number to the motion of *thesis* and *arsis*.

The traditions of metre that Valentini and Pisa reflected are also shown in the writings of the Italian theorists Lorenzo Penna and Giovanni Bononcini. Both Penna's *Li primi albori musicali* (1684) and Bononcini's *Musico prattico* (1673) list all the possible types of metre, separating outmoded ('ancient') from modern notational practices and defining the movements for beating time. Again, the evidence for the *thesis/arsis* motion's precedence over beat cardinality is present in their accounts of triple metre. Both Penna's and Bononcini's descriptions of triple metre are followed by instructions for time-beating, 'two on the downstroke and one on the upstroke'.[10]

10 Giovanni Maria Bononcini, *Musico prattico* (Bologna: Giacomo Monti, 1673; facsimile edition, Hildesheim: Olms, 1969), 20–23; Lorenzo Penna, *Li primi albori musicali* (Bologna: Giacomo Monti, 1684; facsimile edition, Bologna: Forni, 1969), 36–44. By the late seventeenth century, the mensural signs that preceded proportion signs were beginning to fade into obscurity, and proportions were starting to take on the function of time signatures as we know them today. While Bononcini recommends the use of both mensural and proportion signs in combination, Penna discusses proportions as time signatures without reference to mensural signs. Printz, in the *Compendium musicae* (1714), remarked that most modern musicians left off the mensural sign, and he recommended the discontinuation of the practice. The separation of mensural signs from time signatures is significant in that it marks the beginning of a slow separation of tempo from metre. See Wolfgang Caspar Printz, *Compendium musicae signatoriae et modulatoriae vocalis*, second edition (Dresden and Leipzig: Johann Christoph Mieth, 1714), 16, and Houle, *Meter in Music*, 24–25.

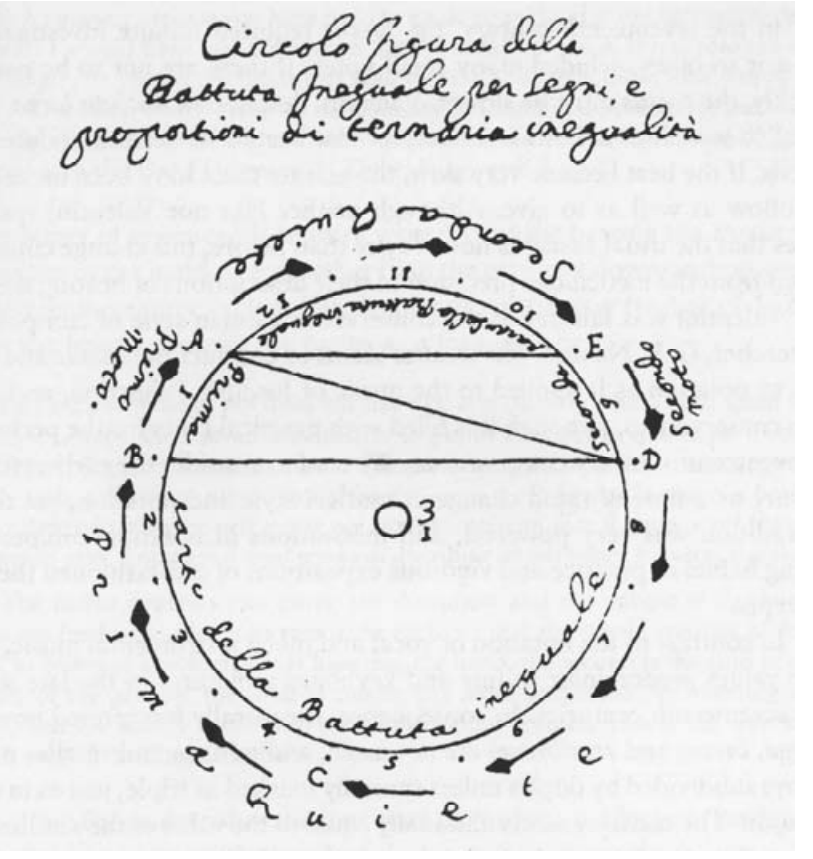

Figure 1b Circolo figura della battuta ineguale, from Pier Francesco Valentini, 'Trattato della battuta musicale' (1643). Rome, Biblioteca Apostolica Vaticana, Ms. Barb. Lat. 4417, 78. Used by permission

Non-isochronous time-beating patterns of this sort can also be found in French theory treatises, although it is apparent that the rules surrounding barring and time-beating were in flux by the time that Étienne Loulié, in his 1696 *Éléments*, gave three tempo-dependent options for time-beating in triple metre:

> La Mesure à trois Temps se bat de trois manieres.
> 1° Deux Frappers et un Lever pour les mouvements lents.
> 2° Un Frapper qui vaut deux Temps, et un Lever pour les mouvements plus vistes.
> 3° Un Frapper qui vaut trios Temps pour les mouvements tres-vistes.
>
> The bar in three can be beaten in three ways:
> 1. Two downstrokes and one upstroke for slow movements.
> 2. One downstroke that has two times and one upstroke for faster movements.
> 3. One downstroke that has three times for very fast movements.[11]

If the beat is not 'tres-vistes' (*très vite*), as in the third option, the time-beater will either remain on the downstroke twice as long or simply re-articulate the downstroke before giving an upstroke. Like all the Italian treatises listed above, that of Loulié reinforces the priority of the two-part motion over beat

11 Étienne Loulié, *Éléments ou principes de musique* (Paris: Christophe Ballard and author, 1696; facsimile edition, Geneva: Minkoff, 1971), 33. Translations throughout are my own unless otherwise indicated.

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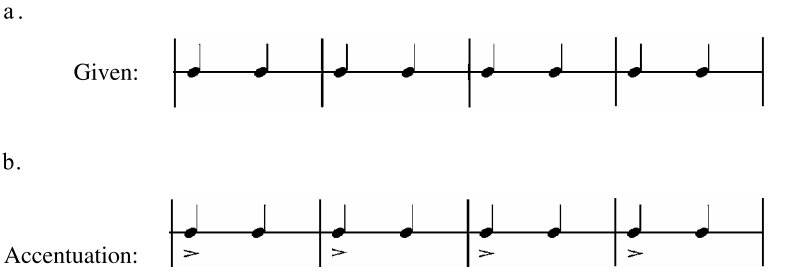

Figure 2 (a) Predetermined bar division; (b) Location of accentuation within predetermined bar division

cardinality in the *thesis/arsis* metric tradition. Musical time in this tradition is a measurement of the same fundamental two-part motion.

Another factor that unites the time-beating treatises discussed above is a lack of theorization of the bar as such. Because the treatises are practical in nature, the bar is treated as a given, pre-existing entity within which *thesis* and *arsis* are located. Although the concept of *thesis–arsis* movement begins to lose prominence in eighteenth-century writings on metre, both the *rhythmopoeia* and the *quantitas intrinseca* traditions begin with the assumption that the bar exists outside of accentuation. What links these traditions is crucial: the manner in which all three explain accentuation relies on the existence of the bar as an autonomous unit within which the appropriate beats for accentuation are located. In this way we can see some continuity between the largely practical account given in the *thesis/arsis* tradition and the somewhat speculative accounts of *rhythmopoeia* and the *quantitas intrinseca.* Figure 2 illustrates the view of metre and accent common to all three traditions, showing the division by bar as a given in Figure 2a, and the location of accentuation vis-à-vis the bar in Figure 2b. In this view, metre proceeds by units (or bars), and musical events, beats or accents are locatable within these discrete units.

The *rhythmopoeia* tradition, practised well into the eighteenth century, attempted to translate quantitative poetic metres into their musical equivalents. An early practitioner of the tradition, Marin Mersenne, advocated the use of *rhythmopoeia* in identifying the 'musical feet' already present in commonly performed music, especially dance music of the period, with its regularly recurring rhythmic structure.[12]

As a practice, *rhythmopoeia* relied on patterns of accentuation located in a predetermined bar. In his seminal *Der vollkommene Capellmeister* (1739), Johann Mattheson regarded the *rhythmopoetic* foot as a basic unit of all metric constructions and clearly adhered to the concept of fixed accentuation through two-part division: 'The main nature of metre is built on the fact that each bar, each section of time measurement, has only two parts and no more.'[13]

Also an early advocate of *rhythmopoeia*, Wolfgang Caspar Printz was one of the first theorists in the *quantitas intrinseca* tradition. He was able to reconcile the different lengths of poetic feet in *rhythmopoeia* with metric stress by invoking the notion of 'inner length' for notes otherwise equal in duration. If notes in metrically strong positions were not longer than others in the bar, they acquired instead a certain 'inner' length by virtue of their position. He explained the bar's supremacy over accent in his *Satyrischer Componist* (1696):

12 Houle, *Meter in Music*, 62.

13 'Das Haupt-Wesen des Tacts kömmt einmahl für allenmahl darauf an, daß eine iede Mensur, ein ieder Abschnitt der Zeit-Maasse nur zween Theile und nicht mehr habe' (Johann Mattheson, *Der vollkommene Capellmeister: Studienausgabe im Neusatz des Textes und der Noten*, ed. Friederike Ramm (Hamburg: Christian Herold, 1739; Kassel: Bärenreiter, 1999), 171–172 (page numbers refer to the original edition)). Houle points out that Mattheson fails to explicate thoroughly the relationship between *thesis/arsis* accent and *rhythmopoetic* accent; see Houle, *Meter in Music*, 69.

> §6 Ferner ist zu wissen, dass die Zahl eine sonderbare krafft und Tugend habe, welche verursacht, dass unter etlichen, der Zeit nach, gleich-langen Noten oder Klängen, etliche länger, etliche kürzer zu seyn scheinen.
> §7 Diese unterschiedliche Länge etlicher, der Zeit oder Währung nach, gleich-lange Noten, wird genennet *Quantitas Temporalis Intrinseca*, die innerliche Zeit-Länge.[14]

> §6 Furthermore, it should be known that the position in the bar has a strange agency and virtue, which causes notes or tones of the same length to seem longer or shorter according to the time signature.
> §7 This different length of notes with the same value is called *Quantitas Temporalis Intrinseca*, or the inner time-length.

In Printz's writings, the bar explicitly took precedence over accent. Here accent emerged as a result of metric division; the *quantitas intrinseca* itself described the quality of accent outside of literal duration.

The eighteenth-century violin virtuoso, composer and theorist Giuseppe Tartini also engaged with the idea of fixed accentuation within the bar, alongside the application of poetic feet. In the *Trattato di musica secondo la vera scienza dell'armonia* (1754) Tartini laboured over text-setting, continually emphasizing position in the bar as the final determinant of stress, the latter overriding the natural poetic feet of the text. Showing the different places in a bar where a word with a natural dactyl might be set, Tartini maintained that the word's pronunciation was ultimately subject to its position in the bar:

> Il resulto della pronunzia musicale . . . e contro la volontà del musico . . . Le note musicali essendo sempre le stesse, il dattilo sempre lo stesso, è chiaro, che la ragione del cambiomento della sillaba breve in lunga è il luogo, e non altro.[15]

> The result of this musical pronunciation . . . is against the musician's will . . . The musical notes and the dactyl being always the same, it is clear that the reason for changing the short syllable into a long one is the placement in the bar, and nothing else.

Tartini's musician suffers a mechanical performance wherein accentuation is determined by the bar alone. The melodic parameters and the natural prosody of text have no bearing on accentuation, but instead are subservient to bar division.

Later in the eighteenth century, Johann Scheibe continued the *quantitas intrinseca* tradition in his *Ueber die musikalische Composition* (1773). Usually remembered as a theorist of musical rhetoric, Scheibe attempted to connect accent theories with harmonic theories.[16] Like his predecessors, Scheibe subscribed to the idea that only location in the bar can create inner length, or accent. Illustrating his point, he offered a literal account of inner-length accent in a hypothetical bar, specifically prohibiting the existence of accent outside of a metrical framework:

> Wenn ich also in Zweyzweytheiltakte eine jede halbe Taktnote in zwo Viertheilnoten zertheile: so ist die erste Viertheilnote einer jeden halben Taktnote die anschlagende Note und also innerlich lang, und eine jede zwote Viertheilnote eben derselben halben Taktnote ist die durchgehende Note und also innerlich kurz; und zwar aus dieser Ursache, weil auf die erste Note der Accent oder der

14 Wolfgang Caspar Printz, *Satyrischer Componist* (Dresden and Leipzig: Johann Christoph Mieth and Johann Christoph Zimmermann, 1696), 18. In his discussion of sub-syntactic timing variation, Justin London presents Printz's 'inner length' as a literal extension of accented beats; see Justin London, *Hearing in Time: Psychological Aspects of Musical Meter* (Oxford: Oxford University Press, 2004), 144–145.

15 Giuseppe Tartini, *Trattato di musica secondo la vera scienza dell'armonia* (Padua: Stamperia del seminario/Giovanni Manfrè, 1754), 115–116.

16 On Scheibe as a musical rhetorician see Patrick McCreless, 'Music and Rhetoric', in *The Cambridge History of Western Music Theory*, 870. On Scheibe's accent theories see Houle, *Meter in Music*, 81 and 127.

> Ton fällt, welcher der folgenden zwoten Note mangelt; denn zwo Noten von einerley Geltung könnon nicht alle beyde den Ton oder den Accent haben.[17]
>
> If I thus, in a 2/2 bar, halve each minim into two crotchets, in this way the first crotchet of each minim will be the striking note and also inwardly long, and each second crotchet of the same minim will be the continuing note and thus inwardly short; this is because the accent falls on the first note, whereas the second note lacks it, for two notes of the same value cannot both have the accent.

In sum, common to the texts of Mattheson, Printz, Tartini and Scheibe is the primacy of the bar, with accents (*rythmopoetic*, inner-length or otherwise) located somewhere within it and determined by it. In this view, time proceeds as a succession of musical bars or discrete units. This understanding of metre is descended from the *thesis/arsis* tradition and is implicitly linked to a common temporal epistemology. In both views, time proceeds as a series of units constituted by events and/or motions. Examining Kirnberger's break with these traditions allows us to place his shift in metric conception in dialogue with an epistemological shift in temporal conception.

III

Johann Philipp Kirnberger's *Die Kunst des reinen Satzes* arose from the collaborative efforts of the author, his student Johann Abraham Peter Schulz and the philosopher and aesthetician Johann Georg Sulzer.[18] Remembered primarily for its treatment of harmony and dissonance, the work addresses a variety of topics, including scales, keys, modes and metre. When considered in the context of the traditions of metre out of which his work emerged, Kirnberger's formulation of metre in *Die Kunst des reinen Satzes* marks a clear break with the past. Here he asserts the primacy of accent over bar division. In order to construct metre in this way, he imagines an endless string of undifferentiated durations to which one could apply accent; bars are created through the placement of accents within this chain of undifferentiated durations. Setting out his theoretical premise, Kirnberger employs an important metaphor, referring to an unending 'flow':

> Wenn man sich einen Gesang vorstellt, in dem alle Töne mit gleicher Stärke, oder mit einerley Nachdruck angegeben würden und auch durchaus von einerley Länge oder Dauer wären, wie wenn z. B. der Gesang aus lauter ganzen Tacktnoten bestünde, so würde er einem gleichförmig fließenden Strom gleichen . . .
>
> Wenn man ein Folge von gleichen Schlägen, die in gleichem Zeitraum mach einander wiederholtet werden, vernimmt, z. B. [Figure 3a] so lehrt die Erfahrung, dass wir in unsern Gedanken alsobald eine tacktmäßige Eintheilung dieser Schläge machen, indem wir sie in Glieder ordenen, die eine gleiche Anzahl Schläge in sich fassen, und zwar so, dass wir auf den ersten Schlag eines jeden Gleides einen Accent legen, oder ihn stärker als die übrigen Schläge u vernehmen glauben. Diese Eintheilung kann auf drenerley Art geschehen, entweder also: [Figure 3b] nemlich, wir theilen die Schläge in Gleider von zwey, oder drey, oder vier Schlägen ein.
>
> If one imagines a melody in which all the notes are presented with the same intensity or stress, and in which they have the same length or duration (as if, for example, the melody were to consist only of whole notes), it would be comparable to a monotonously flowing stream . . .
>
> If one hears a succession of equal pulses that are repeated at the same time interval, as in [Figure 3a], experience teaches us that we immediately divide them metrically in our minds by arranging them in groups containing an equal number of pulses; and we do this in such a way that we put an accent on the first pulse of each group or imagine hearing it stronger than the others. This division

17 Johann Adolph Scheibe, *Ueber die musikalische Composition. Erster Theil: Die Theorie der Melodie und Harmonie* (Leipzig: Schwickert, 1773), 231.

18 See David Beach, Introduction to Kirnberger, *Art of Strict Musical Composition*, xi–xii.

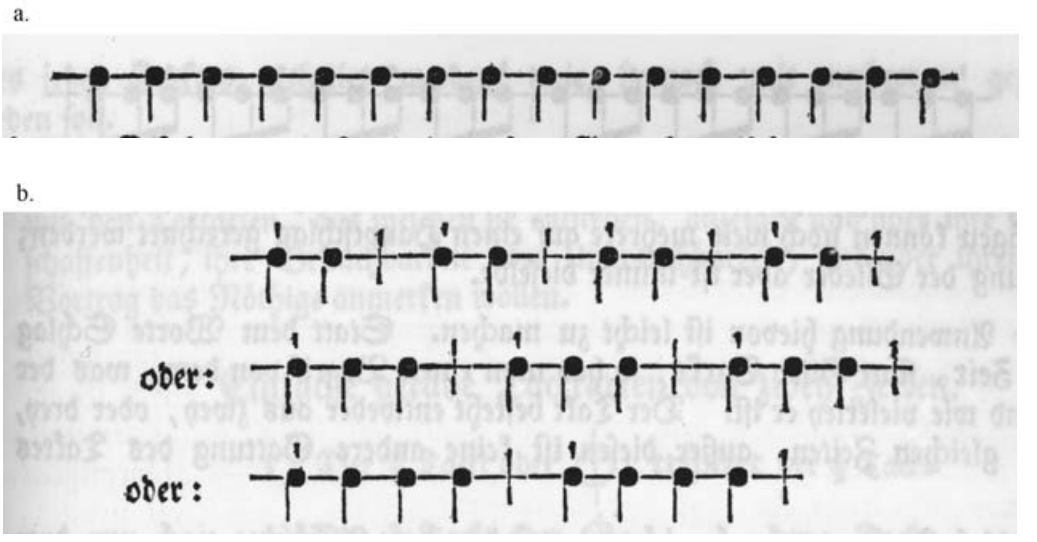

Figure 3 From Johann Philipp Kirnberger, *Die Kunst des reinen Satzes in der Musik* (Berlin, 1771–1779; facsimile edition, Hildesheim: Olms, 1968), 115. Used by permission

> can occur in three ways, as shown in [Figure 3b]. That is, we divide the pulses into groups of two, three or four.[19]

It will be instructive at this point to compare Figures 2 and 3. In Kirnberger's account, musical accents – or, more generally, events – are located in a theoretically unbroken expanse of duration. Bar division only arises subsequently, as a by-product of these accents. His description of metre leaves behind the 'full' conception of time as constituted by events, bars or motions, as in the theories of metre that preceded him. For Kirnberger metre is empty: rather than beginning with bars in which to organize accentuation, or a motion around which beats are described, he allows for a theoretical succession of 'monotonously flowing . . . equal pulses', a stretch of melody emptied of accentuation or bar division. Only then does our mind 'immediately divide' this empty stretch into bars through accentuation (real or imagined).

After this meditation on the genesis of metric hearing, Kirnberger's discourse on metre returns to familiar territory. The subsequent passages in *Die Kunst des reinen Satzes* treat the relationships between time signatures, tempo and character. The idea that a given time signature should indicate the tempo and character of a piece can be traced as far back as Tinctoris, and many of the seventeenth- and eighteenth-century theorists discussed above refer to or outline their own detailed characterizations of each time signature.[20] In this regard, Kirnberger's discussion of metre is somewhat unremarkable. Instead, it is his renegotiation of metre and accent, as Seidel, Dahlhaus and William Caplin have pointed out, that marks *Die Kunst des reinen Satzes* as the touchstone for a new manner of thinking about the temporal regularities of music.

As the forerunner of a new tradition, Kirnberger's work represents one piece of a larger shift in epistemologies. Conceptualizations of time underwent a slow but dramatic change in the late seventeenth and the eighteenth centuries. Isaac Newton's efforts to understand the physics of empirical causal relationships resulted in his metaphysical redefinitions of space, time and motion, although, of course, we cannot credit Newton alone for first reframing the period's thinking on temporality. Through his texts, Newton

19 Johann Philipp Kirnberger, *Die Kunst des reinen Satzes in der Musik* (Berlin: Christian Friedrich Voss, 1771–1779), 113–115; trans. in Kirnberger, *Art of Strict Musical Composition*, 382–383.

20 Houle, *Meter in Music*, 57–61.

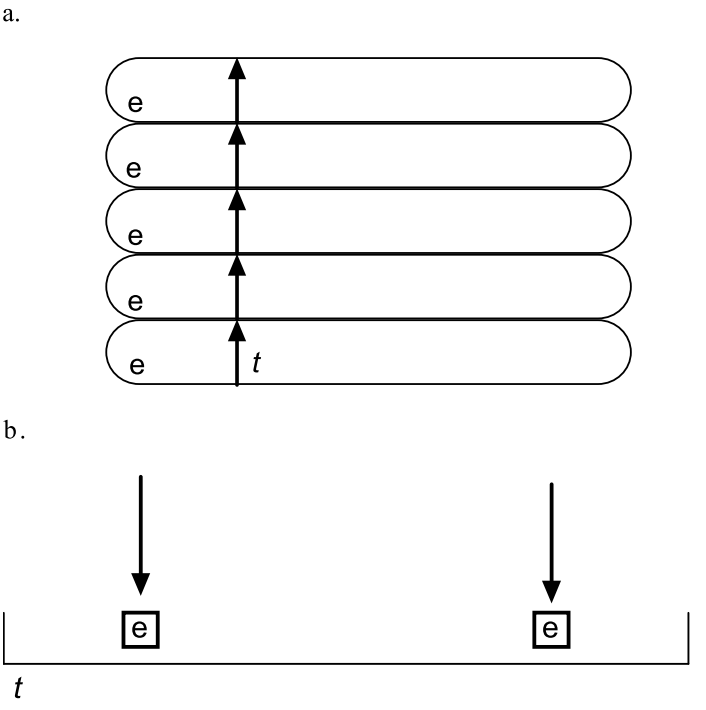

Figure 4 (a) Aristotelian conception of time; (b) Newtonian conception of time

places himself specifically in dialogue with older, Cartesian and Aristotelian traditions, and he is acutely aware of his departure from them. For Aristotle, as for Descartes, the existence of time and space was dependent upon motion and bodies; time advanced in units such as hours or days, measurements of celestial and terrestrial motions. For Newton, by contrast, time is an empty, open expanse in which events occur. Figure 4 graphically illustrates the difference between these two temporal conceptions, where 'e' represents an event and *t* represents time. In the Aristotelian conception (Figure 4a), time is constituted of events themselves, whereas in the Newtonian conception (Figure 4b), events fall within the empty substratum of time.

In the Aristotelian and Cartesian traditions, space and time function exclusively in relation to substance and motion; substance is the primary category of being in the world, made up of bodies and thinking entities.[21] Natural philosophy takes bodies, or entities, as its subject of study. Because bodies are, by nature, 'extended', they are everywhere – 'the world is a *plenum*'.[22] The only conceivable differentiation between these extended bodies is motion. Space, then, exists only in relation to the motion of the extended bodies that fill it, and time is a *measurement of* that motion. Time and space exist only as descriptions of extended-body motion.[23]

The conceptions of metre that preceded Kirnberger, then, are founded on the understanding of time articulated by Aristotle and Descartes. In the *thesis/arsis*, *rhythmopoeia* and *quantitas intrinseca* traditions, the temporal dimension of music consists of predetermined, fixed measures and/or movements. Time, as these theorists saw it, was a measurement of motion – the two-part movement of *thesis* and *arsis* – and music was 'a *plenum*', always already full of bars.

21 Howard Stein, 'Newton's Metaphysics', in *The Cambridge Companion to Newton*, ed. I. Bernard Cohen and George E. Smith (Cambridge: Cambridge University Press, 2002), 257.

22 Stein, 'Newton's Metaphysics', 257.

23 René Descartes, *Principles of Philosophy*, trans. Valentine Rodger Miller and Reese P. Miller (Dordrecht: Reidel, 1983), xxiv. See also Stein, 'Newton's Metaphysics' for an account of the relationship between Newton's and Descartes's metaphysics.

Newton framed his first definitions of time and space as a critique of the metaphysical constructions that his important predecessor Descartes had advanced. This approach is apparent in Newton's first attempt to redefine and dissociate space, time and motion – in 'De Gravitatione et aequipondio floridorum', a document dating from about 1685 and never published during his lifetime:

> Since in these definitions I have supposed that space is given distinct from body, and have determined motion with respect to the parts of space, and not with respect to the positions of contiguous bodies, lest this be taken as gratuitous against the Cartesians, I shall endeavour to dispel his fictions.[24]

A fully developed definition of absolute time appears as the first in a series of definitions that begin the *Principia* (1687). Absolute time, for Newton, is an uninterrupted flow with no relationship to space or motion. Events, bodies and motions are locatable *within* this empty expanse of time. He warns against confusing his equably flowing absolute time with units of time measurement, or 'common time':

> Absolute, true and mathematical time, of itself, and from its own nature, flows equably without relation to anything external, and by another name is called duration: relative, apparent and common time, is some sensible and external (whether accurate or unequable) measure of duration by means of motion, which is commonly used instead of true [absolute] time: such as an hour, a day, a month, a year.[25]

Newton's metaphysical emptying of space and time in the *Principia* and elsewhere constituted a significant milestone in a slow but dramatic change in ideas about space and time across the seventeenth and eighteenth centuries, one articulation in an epistemological shift of huge scope and impact.

Newton's recourse to the metaphor of an endless 'flow', in his spatialization of absolute time, is significant. He was not entirely successful in divorcing the concepts of time and space in his metaphors – a 'flow' is still a 'flow' in space, after all. Yet we understand that absolute time 'flows equably without relation to anything external', or, in other words, that it represents an infinite, undetermined medium against which events are reckoned.

As Kirnberger attempted to divorce events from the temporal substrate against which they are situated, he, like Newton, resorted to the same metaphor of endless 'flow'. Just as Newton worked to distinguish absolute time as a concept from the things that measure it, so too Kirnberger worked to understand metre as a division of musical duration through accentuation. Unlike his contemporaries, Kirnberger did not 'mistake' the musical bar, a unit of measurement created only through accentuation, for time itself. This is precisely the 'mistake' Newton sought to dispel in debunking the 'fictions of the Cartesians'. Contextually, then, we can understand that Kirnberger and Newton articulated the same epistemological shift in temporal conception.

IV

These innovations may first appear modest in scope. The number of individuals in the eighteenth century engaging with Newton or Kirnberger was necessarily quite limited. But the shift from Cartesian to

24 A. Rupert Hall and Marie Boas Hall, eds and trans., *Unpublished Scientific Papers of Isaac Newton* (Cambridge: Cambridge University Press, 1962), 91–92. See also Robert Rynasiewicz, 'By Their Properties, Causes and Effects: Newton's Scholium on Time, Space, Place and Motion. II: The Context', *Studies in History and Philosophy of Science* 26/2 (1995), 295–322. Historians of science have long disputed the dating of this unpublished document; see Stein, 'Newton's Metaphysics', 302–303.

25 Isaac Newton, *Philosophiae naturalis principia mathematica*, third edition of 1726 with variant readings, ed. Alexandre Koyré and I. Bernard Cohen with the assistance of Anne Whitman (Cambridge: Harvard University Press, 1972), 46, as cited and translated by Richard T. W. Arthur, 'Newton's Fluxions and Equably Flowing Time', *Studies in the History and Philosophy of Science* 26/2 (1995), 324.

Newtonian concepts of time can be traced in areas beyond science, philosophy and music theory. Developments in technology played an important role for a wider body of individuals and afforded new ways of constructing time.

Social historians frequently note the connections between metaphysical reframings of time and the development of a 'modern' society.[26] The growing availability and eventual ubiquity of the mechanical clock in the eighteenth century played an important role in developing concepts and social practices related to time. After the clock became common, rather than relying on an Aristotelian or Cartesian conception of time to underpin its calendar units, western society was able to conceive ever more easily of time as empty and events as situated within mechanized clock time.

Suggested dates for the first mechanical clock range from the tenth century to the fourteenth. Samuel Macey offers several late fourteenth-century cathedral clocks as the earliest definitive examples of this technology.[27] From the time the earliest mechanical clocks appeared, both the clock's mechanism and its role in society developed considerably, continuing through the eighteenth century. As developments in mechanical action increased the accuracy of timekeeping devices, advances in production allowed for large-scale manufacture and wider distribution.

Along with the advances in clock technology, the public imagination of time underwent a shift. Other, less accurate methods of calculating time were available, of course, before the clock became common, but these methods left time closely related to what J. Peter Burgess has called 'socio-spatial markers': natural occurrences, daily routines or meetings of social organizations in proper, fixed places. Time in this system is full, 'measured by activity, material or natural events'. Once it spread, the clock provided a certain formalization of time itself. As Burgess sees it, 'the introduction of the notion of time as temporal uniformity, as pure form, is, for better or worse, the most important innovation of modernity. It is the key to the modern dissociation of space and place.'[28]

The pervasiveness of the mechanical clock leaves 'modern' life forever dissociated from space and place. Temporal organization is now dependent on an abstract principle – the mechanical ticking away of seconds – rather than a local principle.[29] As such, social temporal organization is no longer grounded in a filled routine of discrete events tied to spaces, but is rather opened up to the possibility of empty space through empty time.

Perhaps most significant for the public imagination of time in conjunction with space, however, was the development and use of the marine chronometer. Responding to a classic problem in marine navigation, the Spanish, Dutch, French and British governing bodies offered rewards for the 'discoverer of longitude' during the seventeenth and eighteenth centuries.[30] Although latitude could be calculated by reference to the sun's altitude while at sea, longitude required the use of a reliable timekeeper on board ship. Increasing frustration along these lines led to a widely publicized act of the British Parliament in 1713–1714, offering up to £20, 000 for anyone of any nationality who could solve the problem of longitude calculation. The fame and monetary stakes of this British act were enough to spark a tremendous effort on the part of many individuals to develop

26 See Jacques Attali, *Histoires du temps* (Paris: Fayard, 1982), 173, and J. Peter Burgess, 'European Borders: History Of Space/Space Of History', *CTheory*, article a013 (1994) <www.ctheory.net/articles.aspx?id=55> (13 October 2007).

27 Samuel L. Macey, *Clocks and the Cosmos: Time in Western Life and Thought* (Hamden: Archon, 1980), 18.

28 Burgess, 'European Borders'.

29 Anthony Giddens, *The Consequences of Modernity* (Stanford: Stanford University Press, 1990), 17. Necessarily, the true synchrony of temporal measurement across the globe would have to wait for the twentieth century. As David Landes points out, travellers in eighteenth-century Europe quickly became aware that each town and locale operated on slightly different time standards. This fact notwithstanding, it is possible to understand how the figure of the clock in eighteenth-century Europe was enough for the public imagination of time to change modes of conceptualization. Even if the time between towns remained uncoordinated, the advent and availability of the mechanical clock in the household would be enough to induce a change in temporal thinking. See David Landes, *Revolution in Time* (Cambridge: Belknap, 2000), 97–98.

30 Landes, *Revolution in Time*, 116.

a seaworthy chronometer. By 1752 an independent British watchmaker, John Harrison, had developed a device no larger than 13.2 centimetres in diameter that met Parliament's stipulations and won the prize. Harrison's advances, once refined by the French clockmaker Pierre Le Roy, led to the mass production of pocket-sized chronometers by the last decade of the eighteenth century.[31] The prestige that surrounded this invention was so sought after that watchmakers and chronometer artisans jockeyed for attention, flooding presses with pamphlet debates on the relative merits of their advancements and improvements on the instruments' design.[32]

Marine chronometers developed alongside shifting conceptions of time in the late eighteenth century. As ships departed for voyage, it was no longer their motion out on to the sea that constituted the time of their journey; instead, their position within an unmarked expanse of time and space was calculable. Time, then, was no longer a description of the visceral motions one made through space, but rather a matter of calculating one's position within infinitude, as the marine chronometer instrumentalized and marked off duration. Moreover, the practicality of navigation after the advent of the marine chronometer allowed for increasingly successful sea voyages and thereby furthered the development of colonialism and other contemporaneous trends. As Jacques Attali argues, the marine chronometer 'made possible, accompanied and accelerated the industrial revolution'.[33] As it divorced time from the sensuous experience of motion, the marine chronometer demystified the giant expanse of the world.

V

We might imagine two levels at which clock technology interacts with temporal thought in music. The first concerns the development of technologies used to measure and beat tempo; these developments paralleled the development of the clock. The second concerns the changing nature of temporal consciousness in general, which manifested itself in thought on metre and the nature of tempo.

Technologies for measuring tempo date back to at least the early seventeenth century, when Mersenne meditated on the workings of the pendulum and its use in indicating tempo.[34] The first device designed entirely for the purpose of determining tempo was Loulié's *chronomètre*, also built on the pendulum design. This device never gained widespread popularity, since, in addition to its ungainly size and prohibitive cost, the *chronomètre*'s temporal gradients meant nothing to those who did not own one.[35] Variations on Loulié's design and system persisted through the early nineteenth century, but it was not until Mälzel's metronome appeared in 1815 that tempo indication became firmly tied to mechanical technology.[36]

The technological efforts that preceded Mälzel's metronome and Beethoven's tempo markings are symptomatic of the slow fracturing, through the eighteenth century, of the edifice that had once joined

31 Landes, *Revolution in Time*, 172–179.

32 See, for example, the debate between Pierre Le Roy and Ferdinand Berthoud, captured in Pierre Le Roy, *Précis des recherches faites en France depuis l'année 1730 pour la détermination des longitudes en mer par la mesure artificielle du temps* (Amsterdam and Paris: author, 1773); Ferdinand Berthoud, *Traité des horloges marines* (Paris: L. F. Delatour for J. B. G. Musier fils, 1773); and the debate between John Arnold and Thomas Earnshaw over their respective escapement mechanisms, in John Arnold, *Certificates and Circumstances Relative to the Going of . . . Arnold's Chronometers* (London: Bigg, 1791) and *An Answer From John Arnold to an Anonymous Letter on the Longitude* (London: Becket, 1782), Thomas Earnshaw, *Longitude: An Appeal* (London: author, 1808), and Joseph Banks, *Sir Joseph Banks's Protest* (London: W. Bulmer, 1804). See also Rupert T. Gould, *The Marine Chronometer* (London: Potter, 1923), 121–125, and Landes, *Revolution in Time*, 180–202.

33 'Ainsi, le chronomètre de marine rend possible, accompagne et accélère la révolution industrielle' (Attali, *Histoires du Temps*, 173).

34 David Fallows, 'Metronome', in *Grove Music Online* <www.grovemusic.com>, ed. Laura Macy (13 October 2007).

35 Fallows, 'Metronome'. I would like to thank an anonymous reviewer for bringing this point to my attention.

36 Fallows, 'Metronome'. Although Diederich Nikolaus Winkel may have invented a clockwork-driven, double-pendulum metronome around 1812, the patent for the device was awarded to Mälzel in 1815.

together metre, character and tempo. Although even Kirnberger's *Die Kunst des reinen Satzes in der Musik* treats the relationship between metre and character, it is clear that an anxiety about the communication of tempo in printed music arose in the early nineteenth century. Beethoven's letters to his publisher Schott in 1826 emphasize the point that natural tempos, or *tempi ordinari*, once indicated by the metre and character of a piece, were no longer adequate performance instructions:

> Die *Metronomisirung* folgt nächstens. Warten Sie ja darauf. In unserm Jahrhundert is dergleichen sicher nöthig; auch habe ich Briefe von *Berlin*, daß die erste Aufführung der *Symphonie* mit enthusiastischem Beyfalle vor sich gegangen ist, welches ich großentheils der *Metronomisirung* zuschreibe. Wir können beynahe keine *Tempi ordinarij* mehr haben . . .
>
> The metronome markings [for the *Missa solemnis*] will be sent to you very soon. Do wait for them. In our century such indications are certainly necessary. Moreover I have received letters from Berlin informing me that the first performance of the [ninth] symphony was received with enthusiastic applause, which I ascribe largely to the metronome markings. We can scarcely have *tempi ordinari* any longer . . .[37]

Another letter to his publisher earlier in the same year gives the Mälzel metronome marks for the Ninth Symphony in the midst of an inquiry about the publication of his complete works for posterity.[38] It is clear that Beethoven felt a need to inscribe specific tempo indications for as many of his works as possible, because he believed that tempos were simply no longer generally understood.

The correspondence between developing time-keeping technologies and developing conceptions of metre was, however, less than direct. On the one hand, the same technological advances drove both the splintering of tempo and character from metre and the development and dissemination of the mechanical clock. Mälzel's metronome might be seen as a product of this evolving technology. On the other hand, we can understand these advances in time-keeping technology as symptoms of the same epistemological shift that made possible a new view of metre and tempo. Just as the clock and the marine chronometer allowed society to calculate its place in time and space, so the separation of metre, tempo and character allowed for the calculation of the precise temporal regularities between beats in the form of Mälzel metronome markings. No longer was time a description of the motion of vessels in the ocean or the motion of the hand through a time-beating pattern; time was now an empty expanse within which one located one's place, one's ship or one's tempo.

VI

Where the metronome marks one piece of the puzzle, the impact of this conceptual shift in compositional practice and musical style is somewhat harder to pin down. Perhaps, as some have suggested, the shift away from continual motion in thorough-bass composition accompanied a new thinking with regard to time.[39] Unlike the monolithic fullness of the older practice, late eighteenth-century compositions often feature a phenomenon that Frank Samarotto and others have called 'shadow meter', a stratification in the

37 Ludwig van Beethoven, *Briefwechsel: Gesamtausgabe*, ed. Sieghard Brandenburg (Munich: Henle, 1996), volume 6, 330; ed. and trans. Emily Anderson, *Beethoven's Letters* (New York: St Martin's, 1961), volume 3, 1325. See also Rudolph Kolisch, 'Tempo and Character in Beethoven's Music, Part I', trans. Arthur Mendel, *The Musical Quarterly* 29/2 (1943), 169–187.

38 Beethoven, to Bernhard Schotts Söhne, Mainz, 13 October 1826, in Beethoven, *Briefwechsel*, volume 6, 302–303; Anderson, *Beethoven's Letters*, volume 3, 1315.

39 See, for example, Wilhelm Seidel, 'Rhythmus, Metrum, Takt', in *Die Musik in Geschichte und Gegenwart: Allgemeine Enzyklopädie der Musik*, second edition, ed. Ludwig Finscher (Kassel and Stuttgart: Bärenreiter and Metzler, 1994–2008), Personenteil 7, columns 257–317, especially 291–301.

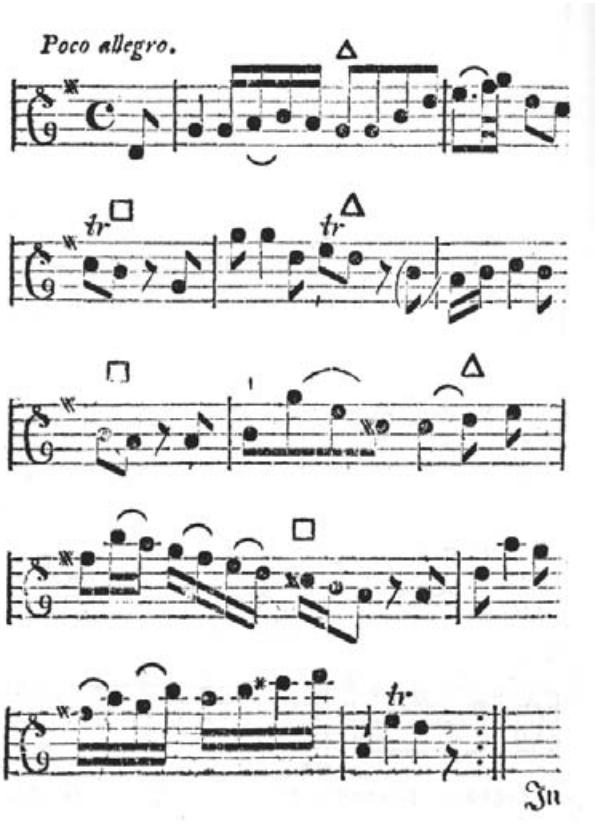

Figure 5a Sample small form. Heinrich Christoph Koch, *Versuch einer Anleitung zur Composition* (Leipzig: A. D. Böhme, 1782–1793; facsimile edition, Hildesheim: Olms, 1969), 226. Used by permission

hypermetric organization between melody and accompaniment patterns.[40] Alternatively, we might investigate what Karol Berger sees as a move towards directionality in form after 1750, contrasting Bach's 'cyclical' ritornellos with Mozart's 'linear' drives to cadences.[41]

The work of one of Kirnberger's contemporaries, Heinrich Christoph Koch, certainly marked an important transition in stylistic practice. In his writings on small forms and phrases, he departed in his own way from the theoretical traditions that preceded him. Although it is unlikely that he was well acquainted with Kirnberger's *Die Kunst des reinen Satzes* when he wrote his *Versuch einer Anleitung zur Composition* – particularly considering Koch's discussion of metre – nevertheless the *Versuch* did not manifest a 'plenist' or full conception of time.[42] The sample phrase expansion that concludes volume three, chapter three is an excellent illustration of this departure.

40 Roger Kamien, 'Conflicting Metrical Patterns in Accompaniment and Melody in Works by Mozart and Beethoven: A Preliminary Study', *Journal of Music Theory* 37/2 (1994), 311–348; Frank Samarotto, 'Strange Dimensions: Regularity and Irregularity in Deep Levels of Rhythmic Reduction', in *Schenker Studies 2*, ed. Carl Schachter and Hedi Siegel (Cambridge: Cambridge University Press, 1999), 222–238. See also William Rothstein, 'Beethoven with and without *Kunstgepräng:* Metrical Ambiguity Reconsidered', *Beethoven Forum* 4 (1995), 167, and Eric McKee, 'Extended Anacruses in Mozart's Instrumental Music', *Theory and Practice* 29 (2004), 1–37.

41 Karol Berger, *Bach's Cycle, Mozart's Arrow: An Essay on the Origins of Musical Modernity* (Berkeley and Los Angeles: University of California Press, 2007).

42 Nancy K. Baker, '"Der Urstoff der Musik": Implications for Harmony and Melody in the Theory of Heinrich Koch', *Music Analysis* 7/1 (1988), 14. On Koch's theory see also Elaine Sisman, 'Small and Expanded Forms: Koch's Model and

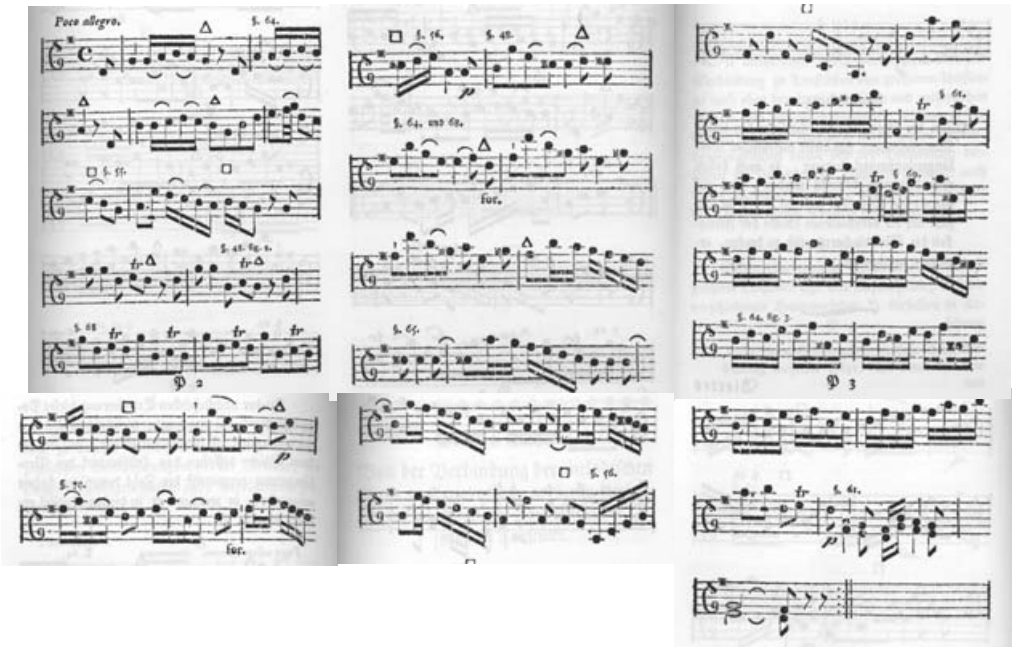

Figure 5b The same form expanded. Heinrich Christoph Koch, *Versuch einer Anleitung zur Composition* (Leipzig: A. D. Böhme, 1782–1793; facsimile edition, Hildesheim: Olms, 1969), 227–230. Used by permission

Figure 5a contains the small form that Koch, by means of his various and now celebrated techniques, expands into the larger form in Figure 5b. When even the first two-bar unit in the small form is compared with its equivalent in the expanded form, it becomes clear that balance and equivalence, once central criteria in writings on phrase rhythm, have shifted in meaning. Here Koch proposes a five-bar equivalent in the expanded form, adding additional material through two repetitions of the first phrase-segment and through the addition of an appendix. Two bars of small form again become five bars of expanded form in the following phrase, this time through an altered repetition and what Koch refers to as a *Paßagie* – an extension by means of a continued rhythmic pattern.[43] The penultimate phrase in the small form, of two bars' length, is expanded to three through the insertion of an incomplete idea. Finally, Koch employs varied repetitions, sequences, transpositions and a new closing appendix to bring the concluding phrase segment from two bars to nineteen.

The rigid balance of an older construction of phrase – one articulated perhaps most clearly by Riepel – had already begun to erode in Koch's writings.[44] The older constructions of the phrase took pre-existing, fixed structures of symmetry as their fundamental units, relying on the same fixed accentuation and bar division that marked the *rhythmopoeia* and *quantitas intrinseca* traditions. Koch's departure from the ideal of fixed symmetry formed part of a gradual transformation in the arts of phrase-building and participated in the shift in temporal epistemology. This new ideology of time underpinned many aspects of style, such that by the early nineteenth century Beethoven experimented with modulating metrical organizations, above the

Haydn's Music', *The Musical Quarterly* 68/4 (1982), 444–475. Sisman's eloquent and extensive treatment of Koch and Haydn has informed my investigation.

43 Heinrich Christoph Koch, *Versuch einer Anleitung zur Composition* (Leipzig: A. D. Böhme, 1782–1793; facsimile edition, Hildesheim: Olms, 1969), volume 3, 217.

44 Joseph Riepel, *Anfangsgründe zur musicalischen Setzkunst. Erster Teil: De Rhythmopoeia, oder von der Tactordnung* (Regensburg and Vienna: Bader, 1752).

level of the bar, in his scherzos.[45] Without changing metres, Beethoven was still able to create the effect of metric modulation through irregular phrase structures in these faster movements. Lacking the preordained accents presupposed in earlier eighteenth-century views of metre, Beethoven's style engendered irregular metric structures on a plane of undifferentiated musical time.

VII

Kirnberger's *Die Kunst des reinen Satzes in der Musik* perhaps marks only one great moment in the history of metre. Then again, perhaps the search for moments is precisely where the root of the problem lies. Rather than seeking discrete points of transformation – in the history of metre, temporality or horology – we ought to be in search of the very non-moment of slow shift. Instead of crediting Newton with a new conceptualization of time, or Kirnberger with a new conceptualization of metre, we can understand that the work of these figures is inextricably bound together through processes larger than both. The condition of possibility for both Newton's time and Kirnberger's metre was a larger refiguring of temporal epistemologies.

Opening a dialogue between epistemologies of time and metre, we might hope to explore the frameworks and foundations for temporality as it operates in musical, music-theoretical, scientific and philosophical thought. If time forms a part of our narratives about the history of science and the history of music theory, we must ground our histories within the larger scope of what may have allowed them to be possible, and what they subsequently afforded.

45 Joel Lester provocatively suggested this idea in *The Rhythms of Tonal Music* (Carbondale: Southern Illinois University Press, 1986), 107–117.