# Mälzel and Mechanical Music in Beethoven's Vienna

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AS WITH MUSIC WRITTEN AS explicit political propaganda, early nineteenth-century music for mechanical instruments—clocks, orchestrions, mechanical organs, and automata[1]—has traditionally been dismissed by scholars as the mere fulfillment of a commission, having no major artistic significance.[2] In the introduction to *Political Beethoven*, Nicholas Mathew describes the hierarchy according to which works are considered "truly" Beethovenian, citing Lewis Lockwood's comment that Beethoven's political music from the Napoleonic period "should be set aside as negligible by-products, not as works in the main line."[3] Although critical of the longstanding concept of a "fallow period," Lockwood views these works as the product of a period during which Beethoven underwent a process of artistic transformation and reemergence, and that such "practical" works as *Wellingtons Sieg*, op. 91 (1813) and *Der Glorreiche Augenblick*, op. 136 (1814) "were products of financial necessity, desire for fame, and a weakened defense of his inner conscience."[4] In modern parlance, according

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1 As Arthur W. J. G. Ord-Hume notes in his extensive work on the development, construction, and repair of organs, some histories of mechanical music use the terms "orchestrion," "musical organ," "panharmonicon," "mechanical organ," and "automaton" nearly interchangeably. I will use the term "panharmonicon" to designate the specific instruments designed and promoted as such by Gurk and Mälzel, and "orchestrion" when discussing this type of instrument more generally. See Ord-Hume, *Joseph Haydn and the Mechanical Organ* (Cardiff: University College Cardiff Press, 1982), 15–17, as well as Emily Dolan, "The Origins of the Orchestra Machine," *Current Musicology* 76 (2003): 8–16.

2 Even the Beethoven-Haus website describes *Wellingtons Sieg* as "not one of Beethoven's masterpieces" and "far too trivial." "'Wellingtons Sieg oder die Schlacht bei Vittoria' op. 91," *Beethoven-Haus Bonn Digital Archives* (accessed November 13, 2014), http://www.beethoven-haus-bonn.de.

3 Lewis Lockwood, as cited in Nicholas Mathew, *Political Beethoven* (Cambridge and New York: Cambridge University Press, 2013), 3.

4 Lockwood, "The Years 1813–1817: A 'Fallow' Period in Beethoven's Career," in *Beiträge zu Biographie und Schaffensprozess bei Beethoven: Rainer Cadenbach zum Gedenken*, ed. Jürgen May (Bonn: Verlag Beethoven-Haus Bonn, 2011), 99.

to this viewpoint, Beethoven "sold out," producing second- and third-rate works to support himself materially during a period of great personal turbulence. This interpretation of Beethoven's career during the 1810s helps those seeking to maintain the image of a troubled Romantic genius and helps to justify works that do not fit with their image of Beethoven as a social and political outsider, beyond the realm of daily goings-on.

However, whatever the practical necessities and the relative artistic merits of the political and mechanical music compared to "greater" works, I do not believe that the musical interests that Beethoven and his contemporaries held in either politics or technology can be so easily dismissed. *Wellingtons Sieg*, a work originally composed for Johann Nepomuk Mälzel's *Panharmonicon*, certainly "echoed [the] complex and mutable political culture" of the aftermath of the Napoleonic Wars in Vienna, but it also (and perhaps equally) echoed the complex position of musical technologies emerging during this period.[5]

If, as Emily Dolan and John Tresch claim, "there is a reason to think of these fields [scientific and musical organology] as complementary," in what sort of technological-musical cultures did Beethoven and Mälzel work?[6] How did audiences respond to the mechanical sound produced by orchestrions, and how did musicians and composers view the mechanical "conductor" produced by the metronome? What does it say about the capabilities of the panharmonicon that Beethoven could successfully (at least in financial terms) sell an arrangement of *Wellingtons Sieg* for both solo piano and full orchestra?[7] Moreover, what does it imply about the capabilities of Beethoven's pianos if the single keyboard instrument could stand in for both the orchestra and the orchestral machine?

This paper explores the possible musical repercussions of Beethoven's collaborations with Mälzel, paying special attention to the issues of interaction between art, technology, politics, and publicity. It consists of three segments: the technological and social context of Beethoven's involvement with Mälzel's mechanical instruments, the adoption of the metronome throughout Europe (and by Beethoven and his Viennese colleagues in particular), and the potential

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[5] Mathew, *Political Beethoven*, 7.

[6] John Tresch and Emily Dolan, "Toward a New Organology: Instruments of Music and Science," *Osiris* 28, no. 1 (2013): 281.

[7] The premiere and subsequent performances of the work (with full orchestra) in Vienna were given as part of a series of benefit concerts for wounded soldiers from October to December 1813. The piano score was published by S. A. Steiner in 1816. Hans-Werner Küthen, "Kritischer Bericht," *Beethoven Werke,* Abteilung II, Band I: *Ouvertüren und Wellingtons Sieg* (Munich: G. Henle, 1991), 48–49.

influences of these aspects of musical technology on the *Hammerklavier* Piano Sonata, op. 106, demonstrating that even a "great" work has technological elements lurking behind the scenes.

My analysis will focus primarily on the context for *Wellingtons Sieg* to consider what possible interpretations the technological questions raised by the piece pose for the *Hammerklavier*. Often acclaimed as the work marking the end of the alleged "fallow period," the sonata intersects with Beethoven's contentious relationship with Mälzel through its oft-remarked-upon metronome markings, the only ones among Beethoven's solo piano sonatas. In addition, its "unplayable" qualities and near-mythical connection to a specific instrument that so prominently entered Beethoven's life during the time of composition might well suggest an interaction between the human and the mechanistic in the same way that the rearrangements of *Wellingtons Sieg* "recast" human performers in the role of the machine.

## Orchestrions and Androids in a Time of War

By the time Beethoven began composing for musical machines, such devices were no longer a complete novelty for their aristocratic and bourgeois owners and audiences.[8] Nor was their function particularly esoteric or mysterious; by this time in history, clockwork devices had served both practical and entertainment purposes for centuries. For example, the seventeenth-century Doolhof, an inn and tavern in Amsterdam that expanded to include a labyrinth and galleries open (for a fee) to the public, contained a famous gallery of automata and wax figures.[9] Art historian Angela Vanhaelen describes it as an early "tourist attraction," noting how listeners and travel guides described the mechanicals, a combination of early musical clocks, "moving picture shows" displaying scenes from well-known theatrical and biblical stories, and androids.[10] According to her research, one of the most remarked-upon androids in the gallery was a bagpiper, which impressed onlookers with both its simulated breath and ability to

[8] Terrance Riley discusses at some length the differences in Romantic and twentieth-century approaches to musical machines in his "Composing for the Machine," *European Romantic Review* 20, no. 3 (2009): 367–79.

[9] *Doolhof* is Dutch for "labyrinth."

[10] Angela Vanhaelen, "Automata in the Labyrinth: Beast Machines in Early Modern Amsterdam," paper presented as part of the *Early Modern World: Works in Progress* series at the Institute for the Public Life of Arts and Ideas, McGill University, February 3, 2014.

seemingly play any number of tunes. This gave the figure a greater semblance of life than the non-"breathing" wax sculptures and moving pieces of the tableaux.

Although these devices were no longer new and shocking by the time Mozart, Haydn, and Beethoven began taking commissions to write for them, they still had considerable popular appeal. However, the sort of fascination associated with them had shifted over time. During the seventeenth century, audiences wondered at the unknown workings of the androids in the Doolhof—according to Vanhaelen, a number of travelogues and advertisements describe onlookers (usually foreign visitors to Amsterdam) fainting in shock.[11] By the late eighteenth and early nineteenth centuries, the wonder was caused less by what the machines appeared to accomplish independently, than by what their human inventors could design them to do. The French composer and music director Henri-Montan Berton claimed to have asked Mälzel whether he could build a device capable of composing original music independent of human input. His response was positive, but qualified with the statement that "I could build one capable of composing music such as that by the average composer, but none which would produce anything similar to the works of Mozart, Cimarosa, Sacchini, etc, etc; this power has not been given to me."[12]

This statement demonstrates multiple aspects of how Mälzel and his musical collaborators and customers viewed musical machines. First, they saw that true musical genius required a quality unattainable by mechanical means. Second, they acknowledged that even though Mälzel was willing to concede the upper limits of mechanical music, he considered it within the realm of possibility that mechanical music could be equal to or surpass ordinary human ability. The ideal automaton thus embodied both human and non-human qualities, in contradiction to later critiques of mechanization, which tend to view human and machine as usually distinct and often oppositional. In the E. T. A. Hoffmann 1812 novella *Die Automate*, for example, a pair of friends observe a collection of musical androids owned by an emotionally manipulative professor whose own musical

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[11] Ibid.

[12] Henri-Montan Berton, *De la musique mécanique et de la musique philosophique: suivi d'une épitre a un célèbre compositeur français* (Paris: Alexis Eymery, 1826), 41; trans. in Jon Frederickson, "Technology and Music Performance in the Age of Mechanical Reproduction," *International Review of the Aesthetics and Sociology of Music* 20, no. 2 (1989): 196–197. Dietrich Nikolaus Winkel, one of Mälzel's colleagues (and rival claimant to the invention of the modern metronome), actually invented a machine capable of creating variations on a theme. The "componium," as Winkel dubbed his device, did not attract as much attention as either the panharmonicon or the metronome, although it is mentioned alongside his conflicts with Mälzel in notices of his death. For an example, see [Anonymous], "Amsterdam," *The Harmonicon* 4, no. 48 (December 1826): 250.

abilities (exhibited alongside his inventions) are considered nearly as much a form of "mechanical music" as the sounds produced by his creations.[13] Katherine Maree Hirt argues that the figure of the automaton as simultaneously human and mechanical could be mapped onto late eighteenth- and early nineteenth-century anxieties about the duality between instrumental and vocal music, a far more important distinction for composers and critics of the time than that between human and machine. Hirt contends that, far from being against all mechanical music, Hoffmann's stories present a world in which human musicians are (for better or worse) not all that different from their instruments or mechanical performers.[14]

Outside the realm of fiction, Mälzel drew on the dual nature of his devices' "humanity" not only through his androids, which included dancers, dolls that could "speak," and musicians, but in his orchestrions, which took the form of instrumental ensembles without performers. Mälzel's panharmonicon bore a similar mechanism to an orchestrion of the same name created by Joseph Gurk in 1810. Gurk's and Mälzel's devices did not merely imitate a human ensemble's sound, they also utilized and displayed actual wind and percussion instruments in their construction and function. An 1811 advertisement in the London *Times* announcing the recent arrival of Gurk and his machine listed the instruments included in the device as "no fewer than 140 German and other flutes, 31 clarionets [*sic*], 18 bassoons, 14 trumpets, 4 French horns, 2 cymbals, 2 kettle-drums, 1 double kettle-drum, and a smaller military drum, a triangle, and a tambourine."[15] The accounts of Mälzel's two panharmonicons in the Leipzig *AmZ* are similar, describing the use of trumpets, flutes, and an impressive percussion component.[16] While some later scholars have criticized the publicity surrounding these devices for exaggerating their "realistic" sound and appearance far beyond their actual musical capabilities, the experience of seeing and hearing a machine play instruments no doubt contributed to the enthusiastic accounts and testimonials.[17]

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[13] E. T. A. Hoffman, "Die Automate," in *Die Serapions-Brüder*, ed. Wulf Segebrecht (Frankfurt am Main: Deutscher Klassiker Verlag, 2008), 396–417.

[14] Katherine Maree Hirt, *When Machines Play Chopin: Musical Spirit and Automation in Nineteenth-Century German Literature* (New York: De Gruyter, 2010), 41.

[15] [Anonymous], "The Panharmonicon," *The Times* (November 13, 1811): 3.

[16] "Nachrichten," [Leipzig] *AmZ* (March 5, 1800): 414–16 and "Nachrichten," [Leipzig] *AmZ* (July 30, 1806): 701–2.

[17] In her description of Gurk's panharmonicon, Dolan notes that "The Spring Gardens advertisement boasts that the machine consists of no fewer than 210 instruments and is 'equally grand as a full orchestral band'—a misleading statement, since Gurk required a separate instrument for each

Gurk seems to have shared some of Mälzel's business acumen for linking his mechanical device to a celebrated composer. In an anonymous article (possibly written or supplied by Gurk himself) that appeared in the *Times* shortly after the first concert announcement, Gurk claimed that Haydn suggested the name "panharmonicon," supposedly telling the inventor "if any body ask [*sic*] you any question about it, tell him the name proceeds from old Haydn."[18] Mälzel's first attempt to profit from connecting his instrument to an acknowledged musical genius was more complex than Gurk's interactions with Haydn. The business partnership between Beethoven and Mälzel began in 1813, when Mälzel approached the composer about touring Europe (particularly England) with a piece for Mälzel's panharmonicon celebrating Napoleon's defeat. The benefits of this concept were twofold: first, relative ease of planning (no need to organize and pay musicians) and second, the promise of huge audiences attracted by pro-Wellington and anti-Napoleon sentiment and previously exposed to the virtues of the instrument via recent successful tours of orchestrions by Gurk and others. The military band nature of the panharmonicon was especially ideal for a battle symphony, and surviving images of Gurk's and Mälzel's instruments play up the relationship between the mechanical and the military, complete with "drapes, decorative helmets, and weaponry."[19] The construction of the panharmonicon—especially the blending of individual band instruments and the organ mechanisms—explains some of the ease with which Beethoven was able to quickly rearrange it for orchestra and solo keyboard. In some ways, like a computer program that mimics a "real" keyboard or metronome for the purposes of aesthetics and user-friendliness, the appeal of *Wellingtons Sieg* for non-mechanical performers lurked just beneath the surface.

Furthermore, the military aspects of mechanical musical instruments in Napoleonic Europe served more than just a purely patriotic or aesthetic purpose, and it is important to consider the specter of war as one of the many "social technologies" supporting the popularity of both the instruments and their repertoire. Although, as Mathew observes, militarization and increased conscription from the 1790s onward influenced "the very concept of a Viennese public" and were "the most tangible manifestations of an Austrian public

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pitch, with the result that it was an organ of five or six stops; in other words, the instrument was a modest-sized, though quite noisy, chamber organ." Dolan, *The Orchestral Revolution: Haydn and the Technologies of Timbre* (Cambridge and New York: Cambridge University Press, 2013), 191.

[18] [Anonymous], "The Panharmonicon," *The Times* (November 28, 1811): 4.

[19] Dolan, *The Orchestral Revolution*, 192.

whose self-image was shaped by wartime experience," connections amongst the mechanical, the military, and the musical were often more complex.[20] Inventors like Gurk and Mälzel did not work solely in the realm of music, nor were their mechanical devices always solely for entertainment. Mälzel's famous panorama of the Conflagration of Moscow, completed in 1813, was both a performance of current events that had occurred when Mälzel was in Moscow and a sort of "live" war reporting in the decades before developments in chemistry made wartime photojournalism a grim reality.[21] On a more practical level, Mälzel's experiments with various medical devices, including prostheses and hearing aids, had a more direct application to those injured in battle or invasion.[22] Music written or arranged for the panharmonicon (used in Mälzel's later years to accompany the simulated artillery of the Conflagration panorama) was intimately bound up in this network of real and simulated military encounters.

On a completely different note, the personal appeal for Beethoven of Mälzel's proposed venture likely included—in addition to the aforementioned financial benefits and possible lingering bitterness over his former idealization of Napoleon—the composer's ongoing (but never realized) desire to visit England. In a manner similar to his negotiations with London publishers, having a symphony performed by a mechanical instrument would reinforce his international stature as one of the "eminent German Masters" (as the advertisements for Gurk's instrument referred to Mozart and Haydn).[23] The orchestrions helped to create and proliferate a repertoire that blended contemporary and historical music through commissions of new compositions and rearrangements of particularly popular or suitable works. The announcement of Mälzel's first panharmonicon in the Leipzig *Allgemeine musikalische Zeitung* includes "Haydn compositions, an overture by Mozart, and an aria by Crescentini played with the greatest precision."[24]

Despite the appeal and ready public for both orchestrions and military music

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[20] Mathew, *Political Beethoven*, 52.

[21] Once the threat of Napoleon's troops was no longer so immediate, the Conflagration of Moscow exhibit took on a more circus or haunted house quality, and Mälzel often used it as the conclusion to his touring exhibitions. See James W. Cook, "From the Age of Reason to the Age of Barnum: The Great Automaton Chess Player and the Emergence of Victorian Cultural Illusionism," *Winterthur Portfolio* 30, no. 4 (1995): 245–46.

[22] For Mälzel's attempts to build hearing aids for Beethoven, see George Thomas Ealy, "Of Ear Trumpets and a Resonance Plate: Early Hearing Aids and Beethoven's Hearing Perception," *19th-Century Music* 17, no. 3 (1994): 266–67.

[23] [Anonymous], "The Panharmonicon," *The Times* (November 13, 1811): 3.

[24] "Nachrichten," [Leipzig] *AmZ* (March 5, 1800): 415.


***Figure 1*** *London advertisement for Mälzel's Exhibition, ca. 1825; reproduced with permission of Look and Learn / Peter Jackson Collection.*

throughout Europe, the initial collaboration of *Wellingtons Sieg* as a piece of mechanical music fell through. However, the piece soon found success in Vienna (and elsewhere) with an entirely human orchestra.[25] The percussion section for

[25] See the stemma of sources for *Wellingtons Victory* constructed by Hans-Werner Küthen in the critical edition to the complete Beethoven edition. Küthen, "Stemma (op. 91)," *Beethoven Werke*

the premiere was made up of a number of prominent composers, including Salieri and Hummel (who played timpani) and Moscheles (who played cymbals), thus placing the human composer in the role of what were originally conceived of as mechanized percussive sound effects. These early performances, however, were not entirely free of truly mechanical music. They featured, among other things, Mälzel's Trumpeter, an android in full military dress that played marches and cavalry calls and performed selections of Dussek accompanied by orchestra.[26] For more than a decade following its performances in Vienna, the Trumpeter appeared as part of Mälzel's collection of various automata, musical instruments, and panoramas in touring exhibitions of the United Kingdom and the United States. (See Figure 1 for a flyer advertising such an event.) An article in the Philadelphia-based *Franklin Journal and American Mechanics' Magazine* on the chess-playing machine mentions the Trumpeter briefly as being one of Mälzel's best-designed machines, noting that it "performs a variety of airs, with the most perfect truth, and brilliant execution."[27]

The Trumpeter's appearance as a European military figure set it apart from other automata exhibited by Mälzel. As with the eighteenth-century English piano virtuosi, many android automata—musical or otherwise—were children, women, or foreigners.[28] This was often a part of their mixture of charm and oddity; the aforementioned account in the *Franklin Journal* includes the chess player (famously dressed in Turkish attire and renowned for what onlookers described as the exaggerated manners of an educated foreigner), children who could say "Mother" and "Father," and a beautiful female dancer. Perhaps tellingly, this is the same demographic Vanhaelen's primary source readings on earlier mechanicals

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Abteilung II, Band I: *Ouvertüren und Wellingtons Sieg* (Munich: G. Henle, 1991), 49.

[26] "Nachrichten," [Leipzig] *AmZ* (January 26, 1814): 70–71.

[27] [Anonymous], "Observations upon the Automaton Chess Player, now exhibiting in this city, by Mr. Mälzel, and upon various Automata and Androides," *Franklin Journal and American Mechanics' Magazine* 3, no. 2 (1827): 131–32.

[28] Gretchen Wheelock and James Parakilas, "The Piano Revolution in the Age of Revolutions," in *Piano Roles: A New History of the Piano*, ed. Parakilas (New Haven and London: Yale University Press, 1999), 78–80. Further discussed in Erin Helyard, "Muzio Clementi, Difficult Music, and Cultural Ideology in Late Eighteenth-Century England" (PhD diss., McGill University, 2011), 66–68. Said musical "prodigies" (in the eighteenth-century scientific sense of the word to include all "freakish" abilities) could also themselves be described in mechanical terms. Mälzel even exhibited a child prodigy—the singer Lisette (also known as Elise) Barensfeld, briefly his student—alongside his Trumpeter in 1809. See Rita Steblin, *Beethoven in the Diaries of Johann Nepomuk Chotek* (Bonn: Verlag Beethoven-Haus Bonn, 2013), 138.

describe as most emotionally sensitive to the illusion of the android.[29] Devices that by their very nature were the ultimate in technical, emotionless behavior were disguised in the visages and clothing of those same groups often seen as victims of their emotionality. The Trumpeter—and, by extension, the "invisible" military band implied by the playerless instruments of the panharmonicon—were notable for blending a native, masculine sensibility with a mechanical lack of emotion. The Trumpeter's performance with a "real" orchestra of human men (which for the Vienna's premiere furthermore consisted of the local who's who), rather than setting it up as the "ideal" musician, makes the differences between human and android all the more clear.

## The Utility of the Metronome

This interaction between the human and the mechanical—the latter of which was known for its "perfect time"—would be reenacted in Mälzel's successful marketing of the improved mechanical chronometer, or metronome, throughout Europe. The standardization of tempos that had previously been realized only in subjective terms by performers and music directors, much like the contemporaneous attempts to standardize and measure time for military purposes, involved a host of interactions between people, technology, and industry.[30] If the military band nature of the panharmonicon tapped into nationalistic patriotism and a public shaped by ongoing wars, the preoccupation with "perfect time" necessary for military strategizing and scientific experimentation found new applications in the realm of music.

As with the panharmonicon, Mälzel's involvement in the development and success of the metronome is also shrouded in advertising, politics, and showmanship. Documents describing orchestrion performances and the proliferation of the metronome in London, Paris, and Vienna demonstrate a growing sense of international cultural exchange and awareness of the "great masters" in the music press that was tied to musical technologies. Just a few years after the Mälzel-Beethoven tour failed to materialize, a testimonial signed by Beethoven and

[29] Vanhaelen, "Automata in the Labyrinth."

[30] In his overview and analysis of the development and reception of the metronome, Roger Matthew Grant explicitly connects the problems of time as both a military and a musical issue in Napoleonic Europe. Grant, *Beating Time and Measuring Music in the Early Modern Era* (Oxford and New York: Oxford University Press, 2014), 198.

others (including Salieri, Hummel, and Moscheles) appeared in the *AmZ*. Similar testimonials signed by prominent composers appeared in Paris and London.[31]

Salieri and Beethoven also cosigned a second, equally glowing endorsement of Mälzel's metronome in an 1818 letter that focused exclusively on the metronome as a pedagogical tool, beginning with the enthusiastic exclamation, "Mälzel's metronome is here!"[32] Despite their musical differences during the 1810s, the two masters shared an engagement with music education during this period. Salieri's numerous remarks on the utility of the metronome throughout the decade are concurrent with his directorship of the newly formed Vienna Conservatory (then a singing school). As Gurk credited Haydn with the naming of the panharmonicon, Mälzel attempted to link the metronome to Salieri from the very beginning, claiming that he had helped in the initial development of the machine.[33] While Beethoven did not have the same sort of lengthy pedagogical career as Salieri (with whom he had studied text-setting at the turn of the century), the years immediately preceding his endorsement of the metronome and the composition of opus 106 saw an increased interest in both his nephew's education and Archduke Rudolph's composition studies.[34]

The "social technology" that supported the appeal of musical androids and automata into the nineteenth century also supported the elevation of entirely human composers and performers to a level above that of mere machines, allowing the metronome to take the place not of a replacement for human conductors, but of a supplement. The composer was not only the creator of music, but the ultimate judge of the latest forms of musical technology. His endorsement of the metronome was not only a guarantee that the mass-produced metronome

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[31] The testimonial in the *Times* signed by Clementi and Bishop (among others) directly cited this endorsement. A third letter circulated in Paris also includes Méhul, Cherubini, Spontini, Pleyel, and Kreutzer. Thomas Attwood et al., "Advertisement: To the Editor," *The Times* (July 1816): 3. All three testimonials were reproduced in the Viennese *AmZ* as part of a series of articles on or advertisements for the new metronome industry. "Rückblicke auf die Chronometer und Herrn Mälzels neueste Chronometerfabrik in London," [Wiener] *AmZ* (February 6, 1817):, 41–43.

[32] Beethoven and Salieri, "Erklärung: Mälzels Metronom," [Wiener] *AmZ* (February 14, 1818): 58–59.

[33] This was initially reported to Salieri in a letter from Gasparo Spontini, later translated into German and published in the Vienna *AmZ*. Spontini, "An Salieri. Paris. 9. April 1816," reprinted in Rudolph Angermüller, *Antonio Salieri: Dokumente seines Lebens unter Berücksichtigung von Musik, Literatur, Bildender Kunst, Architektur, Religion, Philosophie, Erziehung, Geschichte, Wissenschaft, Technik, Wirtschaft und täglichem Leben seiner Zeit* (Bad Honnef: Bock, 2000), 101–2. "Rückblicke auf die Chronometer und Herrn Mälzels neueste Chronometerfabrik in London," [Wiener] *AmZ* (January 30, 1817): 33–34.

[34] I am grateful to Katheryn Lawson for bringing this to my attention.

worked and that it, like the Trumpeter and the panharmonicon, could keep "perfectly accurate" time, but that it was as much an aid to the composer as to the performer, giving a heretofore vague term like "presto" or "adagio" a seemingly scientific, universal designation of time.

Metronomes also held much more widespread potential as a musical-technological interface than either the orchestrion or the android. The size of the orchestrion and the "curiosity" factor of the android—not to mention the cost and craftsmanship of both—meant that most musicians were unlikely to perform alongside (or be replaced by) machines that replicated musical sound. Just as early clockwork experiments had found their way out of the mechanist's or physicist's workshop and into public exhibitions and private collections for the purposes of entertainment, the metronome, whose antecedents lie with time-keeping pendulums and chronometers used in physiological, astronomical, and acoustical experiments, blurred the lines between scientific and musical technology, and possibly between science and music.[35]

Musicians and composers alike had to learn to conceive of time in something approaching an exact number of beats per second, and therefore became dependent on the device itself for accurately sharing tempos. Accounts of the metronome in the Leipzig *AmZ* throughout the late 1810s give numerous tables for "translating" regional tempo designations and the ideal performance tempos for specific works into standardized markings for Mälzel's metronome.[36] Although Beethoven's own sense of time in relation to the metronome and his own compositions has been much-debated, his letters to Ferdinand Ries reveal just how dependent he had become on the new technology. Following a list of corrections for copyist errors of pitch, accidentals and articulation in the score of the sonata, Beethoven writes to Ries, "my metronome is broken and I will have it back in a few days; therefore, I cannot yet send the tempos."[37]

Dolan and Tresch use the present-day computer and its programs for musical

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[35] For a brief summary of the scientific devices and experiments that led to the invention of musical metronomes, see Myles W. Jackson, "From Scientific Instruments to Musical Instruments: The Tuning Fork, the Metronome, and the Siren," in *The Oxford Handbook of Sound Studies*, ed. T. J. Pinch and Karin Bijsterveld (New York: Oxford University Press, 2012), 206–7.

[36] For example, in the year 1817, one finds "Bestimmung der Tempos von Cramers Etudes p. Pf, nach Mälzels Metronom," [Leipzig] *AmZ* (September 10, 1817): 633–34 and "Bestimmung der Tempos aller Symphonien von Beethoven nach Mälzels Metronom," [Leipzig] *AmZ* (December 17, 1817): 873–74.

[37] Letter to Ferdinand Ries, c. March 20, 1819. Beethoven, *Briefwechsel Gesamtausgabe*, ed. Sieghard Brandenburg (Munich: G. Henle, 1996), 4:262.

composition and sound engineering as a jumping-off point for examining similarities and interactions between musical and scientific instruments.[38] As an example of both, the metronome is similar to the computer in both its user-friendliness and its limits. Although the composer can quite easily (if frustratedly) correct at length errors committed by a copyist, tempo has now become something that needs to be measured by a scientific instrument. Part of the endorsement letters signed throughout Europe was a vow of "our intention henceforward to mark the time of all our compositions according to Mr. Mälzel's scale."[39] And yet, also much like the computer, when the metronome breaks, even "the greatest composers on the Continent" need to send it out for repair and are delayed in sending tempo markings to their publishers.

Perhaps because of this (and likely his contentious relationship with Mälzel), Beethoven's opinions of the metronome and its utility to both performer and composer are somewhat difficult to trace. Some of his letters seem to imply that he considers metronome markings crucial to realizing his musical ideas, as seen in the 1826 letter to the publisher Schott, wherein he proclaims that "in our century, it is certainly necessary; I have received letters from Berlin that the first performance of the [Ninth] Symphony went down with enthusiastic agreement, which I largely attribute to the metronome markings. We can no longer have any *tempi ordinarij* [*sic*], as one must judge oneself according to the ideas of unfettered genius."[40] Rather than imposing restrictions on a composer, metronome markings provide a level of freedom for the composer that vague expressive terms for tempo lack. Moreover, the uniformity of metronome markings allows for successful performances of great works even in the absence of the composer.

Elsewhere, however, Beethoven's feelings are less clear. If the metronome made it easier in some ways for the composer to require an exact tempo from performers, its incessant, unvarying rhythm also risked limiting individual musical expression and limiting virtuoso performances to even more mechanical displays of technical skill. The metronome, much like Mälzel's Trumpeter, does not need to stop and take a breath. It does not pause dramatically at key moments or gauge audience responses. In addition, providing metronome markings added to the process of preparing a piece for publication. Many of Beethoven's letters to various publishers throughout the 1810s and 1820s mention that "metronome markings will follow," suggesting that determining the precise time for a given

[38] Tresch and Dolan, "Toward a New Organology: Instruments of Music and Science," 279.

[39] Attwood et al., "Advertisement: To the Editor," *The Times* (July 1816): 3.

[40] Letter to B. Schotts Söhne, December 18, 1826. Beethoven, *Briefwechsel*, 6:330.

movement involved more from the composer than merely correcting a copyist's errors.[41] Furthermore, Beethoven's metronome seems to have required repair fairly frequently, further delaying tempo designations and demonstrating that, despite its unwavering pulse, the machine was just as fragile and fallible as its human owner. One recent study draws on Beethoven's accounts of his metronome's failure, proposing that the extreme tempo given in the first movement of the *Hammerklavier* is due to a combination of Beethoven attempting to determine metronome markings by sight (since, by this point he would have been unable to hear the device's audible pulse) and the constant damage and repairs to the metronome throwing off its pendulum.[42] In one such letter, Beethoven remarked to Schott that "the tempos according to the metronome before long, my own is sick, and must get back its equal, steady pulse at the watchmaker's."[43] Alexander Evan Bonus writes that "Beethoven often considered Mälzel's metronome to be a meager reflection of his own living pulse; the mechanical movement of the metronome was a lifeless representation of his own heartbeat."[44] However, isn't it equally likely that Beethoven saw the fragility of the metronome as mirroring his own unstable health? By framing the metronome in terms of health and illness, Beethoven suggests a sort of android or automaton quality, an intermediary between wholly mechanical and wholly human. It may not breathe or consider the emotional implications of the number of beats in any given minute, but it nonetheless has a pulse.

## Beyond Mechanics: *Hammerklavier* as Technological Experiment

What might the *Hammerklavier*, a piece for an entirely human performer considered by many to mark the end of Beethoven's so-called "fallow period," have to do with Mälzel's mechanical devices? The mythology that has grown up around the work—a mythology that began during Beethoven's lifetime—tends to frame

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[41] In one such letter (also to Schott), Beethoven seems to parody the constant pulse of the metronome's movement, cursing the malfunctioning mechanical device and writing that metronome markings "follow—follow—follow." Letter to B. Schotts Söhne, August 19, 1826. Ibid., 6:269.

[42] Sture Forsén, Harry B. Gray, L. K. Olof Lindgren, and Shirley B. Gray, "Was Something Wrong with Beethoven's Metronome?," *Notices of the AMS* 60, no. 9 (2013): 1146–53.

[43] Letter to B. Schotts Söhne, March 19, 1825. Beethoven, *Briefwechsel*, 6:45.

[44] Alexander Evan Bonus, "The Metronomic Performance Practice: A History of Rhythm, Metronomes, and the Mechanization of Musicality" (PhD diss., Case Western Reserve University, 2010), 118.

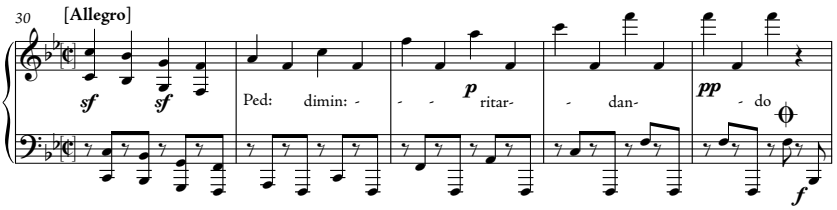
it in terms of artistic genius and the start of a new creative period in Beethoven's career. Numerous factors, including the treatment of Beethoven's Broadwood as a near-religious relic, a comment attributed to Beethoven (later much exaggerated) that the *Hammerklavier* would be performed decades later, and the development of the piano sonata as a genre for professional public performance all served to place the sonata and its creator on a pedestal, to be worshipped by performers and audiences alike.[45] This mythologizing, while important to understanding the creation of Romantic views of music history, obscures the social and mechanical technologies of the *Hammerklavier*'s genesis and realization.

To find mechanical technologies lurking behind the scenes, one need look no further than the first page of the first movement (reproduced on p. 94 of this volume). The metronome marking, which names the inventor in an ingenious bit of further advertising that quickly became standard practice, is half-note equals 138, a tempo that has since been widely discussed and debated by performers and scholars. Given Beethoven's own mixed feelings about the metronome, it is unsurprising that even commentators who knew Beethoven disagreed on whether or not performers should follow his sometimes nigh-impossible tempos. Opinions on how strictly Beethoven intended his metronome markings to be taken vary widely, from those who say that Beethoven's tempos are to be taken essentially as written (with some leeway for expressive decisions over the course of a movement) to those who lean towards disregarding them entirely.[46]

Whether or not human hands could play the entire first movement of opus 106 at the written tempo, the speed suggests a level of forward motion reminiscent of Mälzel's other musical machines and the winding of the clockwork required to keep them running. This drive, which has been frequently framed in terms of a heroic struggle (and just as frequently linked to various ongoing struggles in Beethoven's life during the "fallow" period), is not in itself "mechanical." Very little about the music itself in opus 106 suggests the emotionless quality of an orchestrion or android performer, but the relentless technical demands on the

[45] Martin Cooper, "Opus 106 in B-flat Major," in *Beethoven: The Last Decade, 1817–1827* (London: Oxford University Press, 1970), 158.

[46] For an example of the former approach, see Rudolf Kolisch, "Tempo and Character in Beethoven's Music," *The Musical Quarterly* 77, no. 1 (1993): 90–131. Kolisch, while not explicitly discussing opus 106 for most of his article, argues that Beethoven did not intend for his tempos to remain metronomically stable throughout. For the latter, see Bonus, "The Metronomic Performance Practice." Bonus focuses almost exclusively on the ambivalent or negative comments Beethoven made about the metronome towards the end of his life, arguing that Beethoven wholeheartedly objected to the artificiality of metronomic tempos, and that adding them to his music was primarily a mandate from publishers and editors.




***Example 1*** *Ludwig van Beethoven, Piano Sonata in B-flat major, op. 106, first movement, mm. 30–34.*

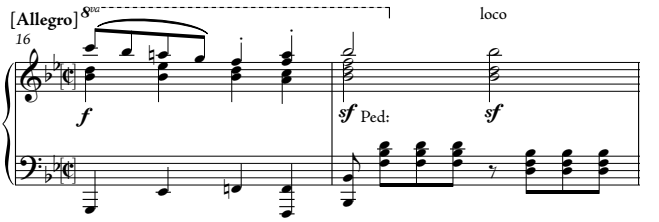
performer and the instrument imply an obsessive quality that might be linked to growing distinctions between human and mechanical performers. Perhaps the work demonstrates the ultimate in human-machine interface; while the solo performer is human, the instrument(s) and the metronome are equally important to the preparation and realization of the music.

A second element contributing to the difficulty, and more deeply tied to this interface between human and machine, is the sonata's range, which spans beyond that of both Beethoven's Viennese and English instruments**,** leading to further discussion of Beethoven's desire to publish a piece that was essentially unplayable by most performers in either London or Vienna. In a letter to Broadwood thanking him for the instrument, Beethoven famously remarked that he would send the piano builder "the first fruits of my inspiration," and the mythologizing around the Broadwood has tended to suggest that opus 106 was the result of Beethoven's encounters with the English piano.[47] Putting aside the historical and musical inaccuracies in this myth (in any case, Beethoven began work on the sonata before receiving the gift), the dual-instrument nature of the sonata observed by Tom Beghin is more accurately seen in terms of the composer working through the capabilities of the different instruments, both real and remembered.[48] This is especially apparent in the number of "written out" (that is, not explicitly designated) trills and fermatas in the first movement, the ranges of which might reveal an aspect of Beethoven's experimentation with changing instrument technologies.

One particularly tantalizing example is found in mm. 30–34 (Example 1), where pedal, diminuendo, and ritardando markings all seem to suggest a fermata. During this passage, both hands play a broken F major triad, spanning a total

[47] Letter to Thomas Broadwood, February 7, 1818. Beethoven, *Briefwechsel*, 4:173.

[48] Tom Beghin, "Beethoven's Broadwood: A Construction Project," *Keyboard Perspectives* 5 (2012): 81–94.



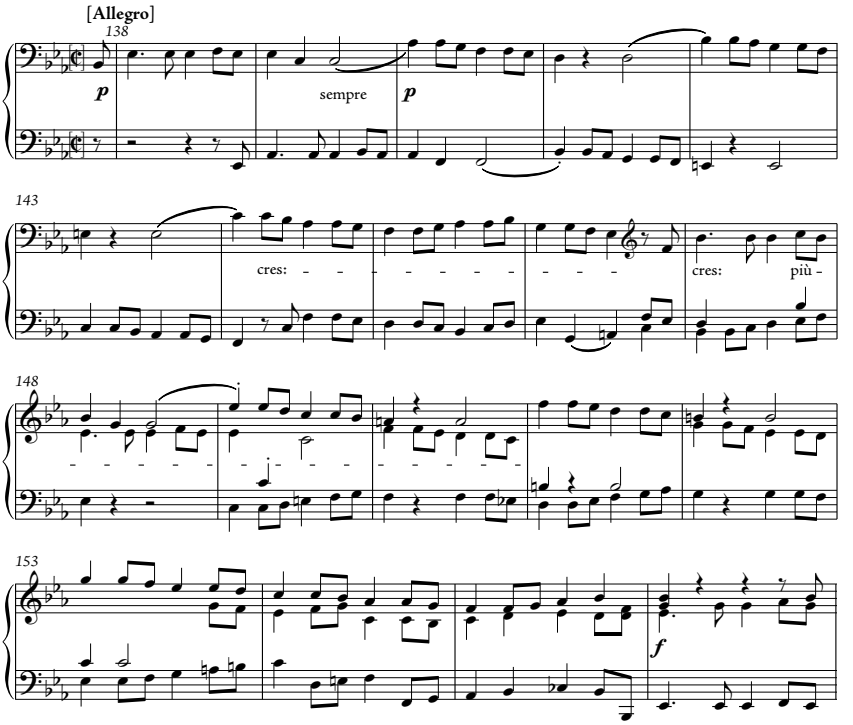

***Example 2*** *Ludwig van Beethoven, Piano Sonata in B-flat major, op. 106, first movement, mm. 16–17.*

range of five octaves from low F to high F. As Beghin observes in his contribution to this colloquy, this is the same range as that on the keyboards Beethoven would have encountered early on in his training and in his career as a performer during the 1790s. By this point in the movement, however, Beethoven has already well exceeded this range upward by a fifth in m. 16 (Example 2), marking the highest note on a five-and-a-half octave piano. In drawing out these extremes early on in the movement, is Beethoven (as Rosen argues) straining at the limits of earlier instruments that restricted "the ideas of unfettered genius"?[49] Or is he in fact (as Beghin proposes) testing what he can now do on the newest models of both Viennese and English pianos by emphasizing both old and new limits of range and register and drawing out what had previously been inaudible?

Perhaps it would be useful here to consider the "range" of the keyboard not just in terms of what notes can be played on it in what registers, but also in terms of what the instrument is capable of doing in performance. The often-remarked upon "monumental" size of the *Hammerklavier*, its contrasting of numerous styles and topics, and its complex contrapuntal passages all suggest an expansion not only of piano technology, but of the social technology surrounding the sonata as a genre and expectations of the solo keyboard performer. Much as *Wellingtons Sieg* is a piece conceived for mechanical performers that was reconceived for human performers (in both orchestral and solo piano configurations), this sonata could just as easily be conceived of as a work for a larger ensemble, such as piano four-hands or even an orchestra, transferred to a solo keyboard performer.

The scope of the work suggests something more complex than what Beethoven's contemporaries would understand as a "sonata," and Kenneth Hamilton notes that after Beethoven's death, when the piano sonata was beginning to gain ground as a public, professional genre, "for general audiences in those days [speaking of

[49] Charles Rosen, "The Limits of Beethoven's Keyboard," in *Beethoven's Piano Sonatas: A Short Companion* (New Haven and London: Yale University Press, 2002), 117.

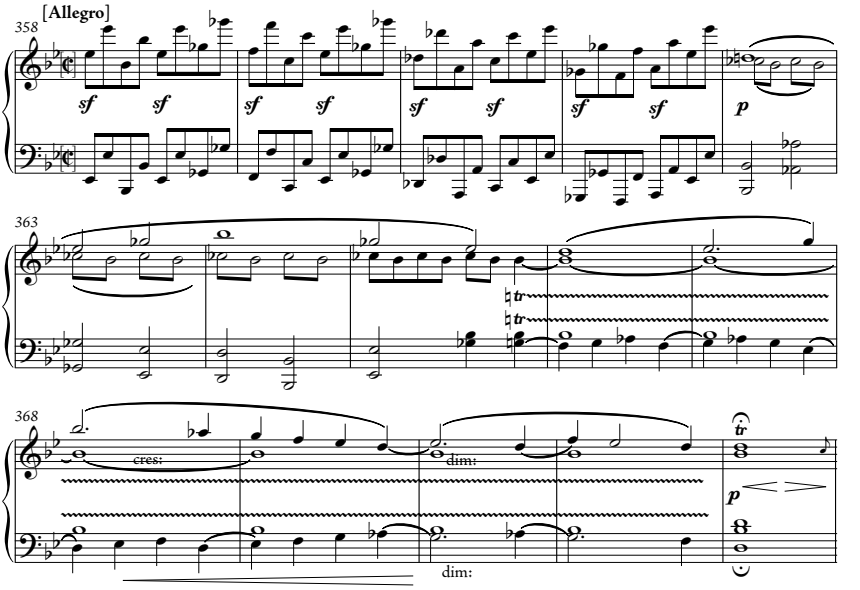



***Example 3*** *Ludwig van Beethoven, Piano Sonata in B-flat major, op. 106, first movement, mm. 138–56.*

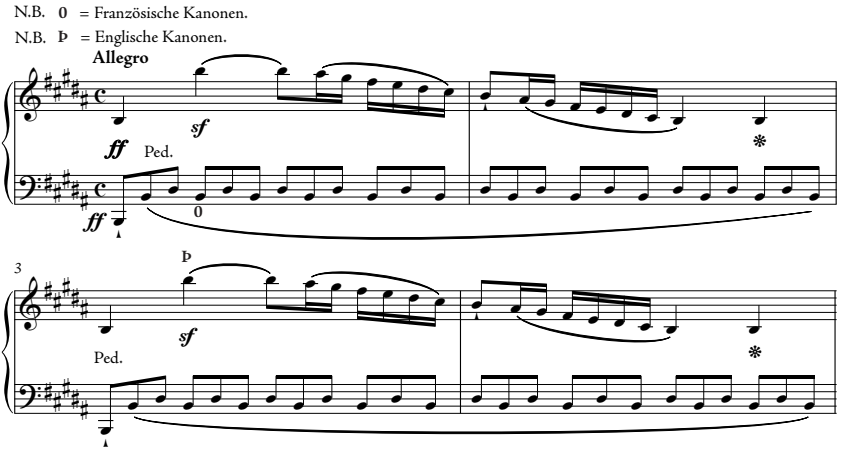
Liszt's performances in the 1840s], even one movement of a Beethoven sonata remained tough going."[50] One aspect of the unusual complexity found in opus 106 is the interplay between left and right hand, which increasingly resembles a struggle over the course of the first movement. The simple-sounding, but difficult-to-play fanfare that opens the piece is reminiscent of the martial anthems in the opening sections of *Wellingtons Sieg* and the repertoire of Mälzel's Trumpeter. Technically speaking, however, this theme is always more complicated than a mere trumpet call, from the opening leap in the left hand to its reappearances as the movement progresses. In the development, the fugato builds the ongoing "drive" of the first movement by building on and expanding the fanfare theme, suggesting a cerebral conflict among an increasing number of voices (Example 3).

Near the end of the coda, an incessant eighth-note pattern leads into a lengthy

[50] Kenneth Hamilton, "Beethoven's *Tempest* Sonata in Performance," in *Beethoven's Tempest Sonata: Perspectives of Analysis and Performance*, ed. Pieter Bergé (Leuven: Peeters, 2009), 137.




***Example 4*** *Ludwig van Beethoven, Piano Sonata in B-flat major, op. 106, first movement, mm. 358–72.*




***Example 5*** *Ludwig van Beethoven,* Wellingtons Sieg*, op. 91 (Vienna: S. A. Steiner, 1815), Schlacht (Allegro), mm. 1–4.*

trill (Example 4), before the ultimate return of the fanfare pushes both listener and performer to that movement's conclusion. This ongoing musical conflict is reminiscent of the physical warfare depicted in the battle movement of *Wellingtons*

*Sieg*, which consists of an ongoing drive of artillery represented in the piano arrangement by contrasted runs of small note values in both hands (Example 5). Here, the conflict intended to be depicted by an orchestrion or full orchestra is reduced to the capabilities of a single pianist (with the occasional hand cannon for more realistic effect), essentially pitting the performer against him- or herself.

If the *Hammerklavier* can similarly be viewed as a battle—albeit one without actual cannons—we are led to the question of the identities and role of the combatants. Is this Beethoven struggling with piano and mechanical technology? Or the intended performer struggling with the difficulty of the work? I would argue that the struggle taking place over the course of the piece is not between man and technology, but between the mechanical and virtuosic aspects of a single human performer. The emphasis on the work's simultaneous difficulty and musicality is at odds with eighteenth-century conceptions of mere technical skill as the sign of a musical charlatan, but the monumental scope aligns well with the increasingly public role of the solo piano virtuoso. At the same time, the ongoing drive suggests an impossible level of both energy and concentration and makes it apparent that the visible and audible difficulty of the sonata is a necessary part of the performance. In other words, only a machine could perform the *Hammerklavier* flawlessly, but only a human could possess the physicality necessary to play the piece convincingly.